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EFFECTS OF ALGEBRAIC BOARD GAME ON SECONDARY SCHOOL STUDENT'S INTEREST AND ACHIEVEMENT IN ALGEBRAIC EXPRESSIONS

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Abstract: *This study, investigated the Effect of Algebraic Board Game on Students Interest and Achievement in Algebraic Expressions in Junior Secondary Schools in Enugu State. Six research questions and six null hypotheses guided the study. The population of the study comprised all JSS11 students in all public secondary school within the study area. The sample of the study comprised 455 students who participated in the study. Mathematics Interest Inventory and Mathematics Achievement Test of the multiple choice type which contained 28 items and 40 items respectively with a reliability coefficients of 0.74 and 0.71 respectively were used for data collection. Data collected were analyzed using mean and standard deviation to answer the research questions and ANCOVA statistics to test the hypotheses at 0.05 level of significance. The analysis of the data revealed that algebraic board game enhanced the students' academic interest and achievement in algebra better than the conventional (talk and chalk) method. Algebraic board game also enhanced the interest and achievement of male students more than their female counterparts. There was a statistically significant difference between the mean interest and achievement scores of students taught algebra with algebraic board game and those taught using the conventional (talk and chalk) method. There was also a significant difference between the mean interest and achievement scores of male and female students taught algebra using the algebraic board game and the interaction between methods and gender of the students was not significant. Based on the findings of the study, it was recommended, among others that in-service training and workshops/seminars should be organized for teachers to train them on the use of algebraic board game in classroom instruction because of its proven efficacy in enhancing students' academic interest and achievement in algebra. Such workshops and seminars should be made compulsory for every teaching staff so as to demystify the efficacy of algebraic board game on students' academic interest and achievement.*

Keywords: *Algebraic Board Game, Algebraic Expressions, Interest and Achievement*

Background to the Study

Mathematics occupies a peculiar position in the life of every individual and the society. It plays an indispensable role in the development of arts, humanities, science and technology. Mathematical thinking began in very ancient times. Certainly, it made considerable progress among the Sumerian, and Babylonians (Hussen, 2009). With the development of mathematical thinking and their application in stone monuments in Egypt, mathematical ideas began to spread to all parts of Africa (Sertima, 2009). Today, mathematics has been applied in all spheres of human endeavours – in day-to-day business, leisure activities, agriculture and formal academic disciplines. In fact, mathematical principles have also been intensively utilized in religious and cultic practices (Offiah 2008).

Although the indispensability of mathematics in the development of our society has been universally acknowledged,

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effective teaching and learning of mathematics is continuously confronted with numerous problems. This is manifested in the poor achievement of students in mathematics (Offiah 2008: Sofolohan 2009; WAEC 209). Research studies (Iji, Emiaku & Utubaku, 2015; Azuka, 2013; Ifamuyiwa and Kehinde, 2011) revealed that Nigerian candidates result in sciences and mathematics in West African School Certificate Examination since 1960 remain very discouraging. Furthermore, Iji, Ogbe and Uka, (2014) in a review of students achievement reported that the overall trend in students achievement indicate a very ugly situation which demands urgent attention. The West African Examination Council's Chief examiner's annual report of 2014, 2015 2016, 2017 and 2018 revealed a disheartening and alarming poor status in secondary school students' achievement in mathematics (WAEC, 2014; WAEC, 2015; WAEC, 2016, WAEC, 2017, WAEC, 2018). The summary of the annual report revealed that less than 68.7% of the total enrolments in mathematics obtain less than credit passes in school certificate examination while about 31.3% scored credit and above. Although the performance in school certificate mathematics examinations appear to show no clear pattern as it varies and fluctuates from year to year, a closer look at the WAEC annual performance report for the past five years reveal a very poor trend.

A survey of students' interest in mathematics also depicts a very sad situation. Obi, Agwagah, and Agah (2014) reported a very low interest in mathematics among secondary school students. Adeniyi and Salman (2015) stressed that interest controls the motivation to learn and as such should possess a direct positive relationship with achievement in a given field of study.

With the realization of the indispensability of mathematics in the survival of our society and the educational system, mathematics educators have been concerned with the ways in which students learn mathematics. This includes methods of teaching and instructional materials that aid the learning processes, means of identifying and overcoming difficulties encountered in the learning of mathematics, ways of providing for individual differences and the implementation of effective mathematics instruction (Ugama, 2011; Azuka, 2013; Iji, Ogbe & Uka, 2014). Particular emphasis, however, has been placed on theories of learning related to mathematics, motivation, concept formation, sensory learning, transfer of training, drill, individual differences and the implication of learning theories for the improvement of instruction and improvisation (Fischer, 2007; Ugama, 2011).

One aspect of learning, which has been neglected in mathematics instruction but has relevance in experimental learning theory, is the game instructional approach (Etukudo, 2012; Anugwo, 2011). Etukudo, (2012), described games as innovative instructional approach that could help stimulate student's interest to learn and achievement in mathematics. It is an interactive activity with set of rules in which the primary target is to achieve specific objectives and win play. Games motivate students, helps to develop positive interest, develop skills, abilities and strategies to learn (Imoko & Isa, 2015). Although game instructional approach is one of the most basic and recent development and advocated for use in mathematics instruction, it has not formed a part of normal instructional practice in secondary schools in Nigerian (Iji, Emiaku & Utubaku, 2015). While also it has become explicit that a lot of advanced mathematical principles are embedded in games of various forms, current emphasis on mathematics instruction has continually ignored game approach.

In mathematics, an algebraic expression is an expression built up from constants, variables, and a finite number of algebraic operations (addition, subtraction multiplications, division and exponentiations) by an exponent that is a rational number (Jason, 2013). Algebra, is simply finding the unknown or putting real life problems into equations and then solving them (Jason, 2013; Koirala, 2005). It could also be seen as a branch of mathematics that substitutes letters for numbers (Jason, 2013). Algebra can include real numbers, complex numbers, matrix vectors, etc. In the words of Jason (2013), algebra is closely related to arithmetic but with a bit difference. While arithmetic involves solving number patterns connected with any of the four basic arithmetic operations of addition, subtraction, multiplication and division, algebra is simply arithmetic with variables. Jason described variables as symbols without determined values. Mathematics educators consider algebra to be one of the most important areas of school mathematics (Jason, (2013). Algebra is chosen amongst other branches of mathematics like Arithmetic, Geometry and Calculus because of its importance in several disciplines such as Accounting, Engineering and Physics. Like Jason (2013) rightly stated, algebra serves as an opportunity getaway to higher studies

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involving mathematics. Jason also affirmed that algebra develops one's thinking in specific areas like logic, patterns, problem-solving, deductive and inductive reasoning.

Despite the importance placed on algebra in junior secondary school (the first three years at the secondary school level of education) mathematics curricula, many students find it to be abstract and difficult to comprehend (Odilli, 2007). Odilli stressed that students cannot understand simple algebraic concepts such as variables, expressions and equivalence because of poor mathematical background. The conventional teaching method (that is, chalk and talk or the traditional method) used in schools by teachers has not improved students achievement and not much attempts has been geared towards exploring mathematical games in complementing secondary mathematics (Iyekekpolor, 2007). He stressed that the gap is more amplified by the lack of attention paid to mathematical games by most secondary school mathematical test materials in Nigeria. There are also doubts as to whether many of the secondary teacher-education programmes in mathematics pay enough attention to enabling prospective teachers of the subject acquire necessary competence in designing and using mathematical games (Iyekekpolor, 2007).

Some researchers like Odo (2015) and Uka (2014) argued that many students at the elementary school level face difficulties in moving from an elementary level of mathematics that involves the manipulations of the arithmetic operations of addition, subtraction, multiplication and division in problem solving to a level that involves the use of letters in addition with the arithmetic operations in problem solving mainly because they cannot understand the structure and patterns of arithmetic. This is imbalance and can be balanced through mathematics games.

Mathematical games are one of the strategies espoused by the National Mathematical Centre (NMC, 2010) for improving the teaching and learning of mathematics in schools. Mathematical game approach involves two or more students working together to find a solution to a given mathematics problem. In a mathematical game, the winner, the loser and the spectator(s) are all expected to learn the mathematics concept being practiced in the game. According to Anugwo (2011), mathematics games encourage students to discuss mathematical strategies with their peers, teachers and parents. As they are joking around, interest is captured and unusual solutions (solutions that were not easy to come by when the conventional teaching method is being used) to problems are achieved. Mathematical games can take the forms of puzzles, magic tricks, fallacies paradoxes, or any other form which provides amusement or curiosity (Okenyi, 2010). They tend to bring joy to the learner, breakdown resistance to learning by reducing tension, clearing boredom, and providing an environment where the student can develop skills and acquire more knowledge. They also have the features that may stimulate mathematical thinking and generate excitement and spirit of individualism, co-operation and competition (Anugwo, 2011).

This study will adopt Algebraic Board Game for Algebraic Expressions as instructional technique. The game combines mathematical skills with a competitive strategy. The objective of the game is similar to that of the ordinary "tic-tac-toe" or attack" (that is, each player ensuring that the opposition player do not make a four consecutive game play vertically, horizontally or diagonally as that guarantees a win),. The winner is the first of the two players, who places four tokens at the same time, either vertically, horizontally, or diagonally. Player 'A' begins the game by placing one of his factor markers and one of player 'Bs' factor markers on any factors on the factor board. The product of these factors determines the placement of player 'A' game token. Then on his own turn, player B can move only his/her factor marker (while A's marker remains in place) to another factor on the factor board. The product of these new factors (B's new position and A's position) determines the placement of player B's game token. For example, if player A placed his factor marker on X+1 and player B's marker on X-1, and player A then continued by placing a game token on x^2-1 because (x+1) (x-1) = X^2 -1. The game continues with each player moving only his or her factor marker and placing a game token on the corresponding product on the game board until either a winner is decided or a draw results is recorded. A winner is decided when either player succeeds in placing four games token in a row either vertically, horizontally, or diagonally. A player is penalized when a product that has already been covered is used or when an incorrect response to the factors is given. In the event of a penalty, the opposing player has the opportunity to move both factor markers, as in the beginning of the game. The game is considered by the researcher because it is easy to understand, can easily be developed by the classroom teacher, is portable (that is,

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the game can be moved from place to place with ease), can be played by the students anytime and anywhere.

From culture to culture and within any culture, mathematical instructions appear in various contexts which are either clear-cut or mutually exclusive. With the variations in instructional approaches and obvious differentials in drill patterns, it has been speculated that the impact of such mathematical instructional games on male and females may vary. According to Okenyi (2010), the extent to which game influences the learning process of males and females still remain a source of concern to the proponents' of game learning approach in mathematics. In fact, the extent to which the algebraic board game instructional approach influences the achievement and interest of secondary school students in mathematics may have some far-reaching implications which are worth exploring.

Statement of the Problem

The increasing poor achievement and interest of secondary school students in mathematics (Ugwuanyi, 2016; Ajai & Imoko, 2015; Azuka, 2013; Etukudo, 2012) raises some obvious questions, including:

1. What would be the fate of science and technology education that depends to a great extent on mathematics for its development?
2. What model would be most effective for mathematics instruction in Nigeria?

Although the phenomenon of poor achievement in mathematics coupled with mathemaphobia and mathematics anxiety have been blamed on the inability of mathematics educators to incorporate simulation activities into formal mathematics instruction, the extent to which such game oriented instructional activities influence the achievement and interest of students in mathematics remain very doubtful. The proponents of game instructional approach to mathematics instruction (Okenyi, 2010) argue that game instructional approach has the ability to generate interest among students and reduce stress associated with problems-solving in mathematics. As such, they proposed that the approach may likely enhance achievement of students in mathematics. Anugwo (2011) speculated that the game approach erodes the seriousness expected in students during mathematical reasoning and problem solving. She further stated that the game approach in often cases lack relative divergence with respect to different branches of mathematics like algebra, learners conflicting needs, may fail to address specific learners' problems, deficiencies and may also be gender stereotyped.

Although speculations on this issue are diverse and often contradictory, researchers have not really intensified efforts at resolving the contradictions so as to assess likely gains of introducing a stress free approach to mathematical instruction. As such the possibility of introducing the mathematical game instructional approach into mathematics instructions is still at crossroad. This proposed study is therefore, faced with problem of establishing the exact impact of the Algebraic Board Game approach to mathematics instruction on achievement and interest of junior secondary school students in algebraic expressions.

Research Questions

1. What is the effect of algebraic board game instructional package on students' mean interest scores in algebra?
2. What is the mean interest scores of male and female students taught algebra using the algebraic board game?
3. What is the interaction effect of method and gender on students' mean interest scores in algebra?
4. What is the effect of board game instructional package on students' mean achievement scores in algebra?
5. What is the mean achievement scores of male and female students taught algebra using the algebraic board game?
6. What is the interaction effect of method and gender on students mean achievement scores in algebra?

Hypotheses

HO_1: There is no significant difference in the mean interest scores of students taught algebra using the algebraic board game and those taught using the conventional approach.

HO_2: There is no significant difference in the mean achievement scores of students taught algebra using the algebraic board game and those taught using the conventional approach.

HO_3: There is no significant difference in the mean interest scores of male and female students taught algebra using the algebraic board game.

HO_4: There is no significant difference in the mean achievement scores of male and female students taught algebra using the algebraic board game.

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HO_5: The interaction effect of method and gender on the mean interest scores of students in algebra will not be significant

HO_6: The interaction effect of method and gender on the mean achievement scores of students in algebra will not be significant.

Interest in School Mathematics

Interest according to Collins English Dictionary (2009) is a sense of concern with, and curiosity about someone or something. It is a reason for wanting something done or wanting to learn something. It is a state of curiosity or concern about something. Interest is an important variable in learning. One can only achieve an objective for any activity when one is interested in it. Lack of interest on the other hand inhibits learning. Offiah (2008) defined interest as a persistent tendency to pay attention and enjoy some activity or event. He further explained that interest is a powerful motive and should be sustained for a meaningful learning to take place. Also, it is understandable that the influence of programmed instructional package in the society is more encompassing than those emerge from other fields of knowledge. And for this reason student tend to develop interest in science subjects.

Azuka (2013) affirmed that the level of students' achievement in science education depends on the level of the students' interest which is a factor of the instructional strategy of the teacher. It is the instructional strategy employed by the science education teacher at the course of teaching and learning that determines the students' interest and achievement. On the strategies to be applied to increase interest in science Olor (2010) said that innovative teaching like programmed instructional method in the class and outside classroom could improve interest in mathematics.

Azuka (2013) said that teachers should not limit themselves to the traditional method of teaching the students alone but they should accompany the teaching methods with innovative approaches such as programmed instructional method during which enhances interest of the learners. . It further explained that programmed instructional method is a powerful innovative teaching technique that a science teacher can utilize to blend the traditional teaching methods.

Okenyi (2010) view programmed instructional package as a teaching tool which has greater chances of integrating the unit of study into the cognitive structure of the students and thus being retained. It is absolutely essential that teachers should adopt this method of teaching and learning so as to enhance on the interest of the students. It adds that, the complex and counter initiative nature of scientific concepts and process require an opportunity for interactive learning, reasoning, interpretation and reflection. Introducing technical tools and resources which students can use interactively for expressing, evaluating and revising their developing ideas as they visualize the consequences of their own reasoning is very essential for science learning.

Gilbert (2008) in support of the role of programmed instructional package in increasing interest of students in mathematics education, added that upon investigation student teachers presented the following reasons for using programmed instructional package: It helps students to visualize a structure process; It helps less able student to remember a concept or an idea; it helps students' to link an idea with familiar event; and it provides a variety of ideas. Also Anugwo (2011) said that the utilization of programmed instructional package strategy in classroom teaching and learning, leads to enhancement of interest and permanent learning in the students.

Students Achievement in Mathematics

A critical review of literature has revealed that there is a fluctuating trend in student's performance in science subjects at secondary school level (Ajai and Imoko, 2015; Odo, 2015). These researchers stated that the history of students under achievement in science subjects on a prominent scale is not new in Nigerian. According to them, what is new is that this trend has continued to fluctuate unabated, and seems to loom larger since Nigeria's political independence. A review of the performance of students in chemistry in recent times shows the same fluctuating trend of students' poor achievement. WAEC Chief Examiner's Report (2016) noted "candidates contracted mainly in familiar questions that demanded recall of facts. They were unable to apply their knowledge of scientific principles to answer other questions." Other areas of weaknesses include inability to interpret questions correctly, and poor mathematical skills.

Methodology

This study adopted the quasi-experimental design. Specifically, this study employed pretest posttest non-equivalent control group design. The design is symbolically represented thus:

Y^b xY^a

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Y^b ~x Y^a

Where

Y^b	=	Pretest
Y^a	=	Posttest
X	=	Treatment
~x	=	Control

The population of the study comprised all junior secondary class II students in all the forty-six secondary schools in Awgu Education zone of Enugu State. The choice of JSS II students was because their scheme of work contains the topics for which the game instructional programmes were developed and it is not an examination class. Four co-educational secondary schools were drawn for this study. Out of the four secondary schools that were used for the study, two were assigned to the treatment group while the other two were assigned to the control group through a simple toss of coin. All the intact classes of JSS2 in the selected schools were used for the study. This study made use of Algebraic Achievement Test (AAT) and Mathematics Interest Inventory (MII) test as instruments for data collection. The Algebraic Achievement Test is a 40-item multiple choice objective test that was designed to assess students on the topics that were taught during the experiment. The topics were factorization, algebraic expansions, and simple linear algebraic expressions. The items of the instrument were drawn in such a way that a total of twelve items was drawn from algebraic factorization, twelve from algebraic expansions, and sixteen from simple linear algebraic expressions. The Mathematics Interest Inventory test contains 30items spread under four factors of; academic, vocational, leisure and general interests. The MII is structured on a four point rating scale of strongly agree, agree, disagree and strongly disagree. The AAT was subjected to both face and content validation. The face validation scrutinized the items in terms of relevance, general test format, suitability and clarity. The AAT was further subjected to content validation using the test blueprint. The 30item of the interest inventory was subjected to construct validity using factor analysis. Two items dropped out of the 30items making it 28items that was used for this study. The Algebraic Achievement Test was assessed for reliability using Kuder-Richardson 20 formula (K-R 20). The test of internal consistency of the instrument yielded a coefficient of 0.71. The 28items of the interest inventory were subjected to test of reliability using Cronbach alpha and it yielded a coefficient of 0.74. The experimental group was taught by the research assistant using lesson plan packaged on algebraic board game developed by the researcher. The teaching was carried out for a period of four (4) weeks using the official mathematics periods in the respective schools time tables. After the completion of the teaching, the post test was administered to both the experimental and control groups and the results obtained. Descriptive Statistics of Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Findings

Table 1: ***Mean and standard deviation of interest scores of students taught algebra using algebraic board game and those taught with the conventional method***

Group	Adjusted Mean	SD	N
Treatment	65.53	8.84	242
Control	41.64	11.84	213

The result on Table1 showed that students taught algebra using algebraic board game had a mean interest score of 65.53 and standard deviation score of 8.84 while those taught using the conventional method had a mean interest score of 41.64 and standard deviation score of 11.84. The implication is that algebraic board game enhanced interest of students in algebra better than the conventional teaching method.

Table 2: ***Mean and standard deviation of interest scores of male and female students taught algebra using algebraic board game***

Gender	Adjusted Mean	SD	N
Male	68.47	9.56	123
Female	62.49	6.82	119

Result as presented on Table2 showed that the male students had a mean interest score of 68.47 and standard deviation score of 9.56 while the female students had a mean achievement score of 62.49 and standard deviation score of 6.82. This implied that

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algebraic board game enhanced the interest of the male students more than their female counterparts in algebra.

Table 3: ***Summary of interaction effect of method and gender on students mean interest scores in algebra***

Gender Groups	Adjusted Mean for Treatment Group	Adjusted Mean for Conventional Method
Males	68.47	42.36
Females	62.49	40.93

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Summary of results presented in Table3 revealed that there was no interaction effects of teaching methods and gender on students' mean interest scores in algebra. Result presented in the table indicated that algebraic board game is superior to the conventional approach in enhancing students' interest at the two levels of gender (male and female).

Table 4: ***Mean and standard deviation of achievement scores of students taught algebra using algebraic board game and those taught with the conventional method***

Group	Adjusted Mean	SD	N
Treatment	49.26	7.12	242
Control	28.52	7.24	213

The result on Table4 showed that students taught algebra using algebraic board game had a mean achievement score of 49.26 and standard deviation score of 7.12 while those taught using the conventional method had a mean achievement score of 28.52 and standard deviation score of 7.24. The implication is that algebraic board game enhanced achievement of students in algebra better than the conventional teaching method.

Table 5: Mean and standard deviation of achievement scores of male and female students taught algebra using algebraic board game

Gender	Adjusted Mean	SD	N
Male	48.56	7.70	123
Female	49.99	6.42	119

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Result as presented on Table5 showed that the male students had a mean achievement score of 48.56 and standard deviation score of 7.70 while the female students had a mean achievement score of 49.99 and standard deviation score of 6.42. This implied that algebraic board game enhanced the achievement of the female students than their male counterparts in algebra.

Table 6: ***Summary of interaction effect of method and gender on students mean achievement in algebra***

Gender Groups	Adjusted Mean for Treatment Group	Adjusted Mean for Conventional Method
Males	48.56	30.12
Females	49.99	26.93

Summary of results presented in Table7 revealed that there was no interaction effects of teaching methods and gender on students' mean interest scores in algebra. Result presented in the table indicated that algebraic board game is superior to the conventional approach in enhancing students' interest at the two levels of gender (male and female).

Table 7*: Analysis of Covariance for Students overall algebra interest scores by teaching methods and interaction between methods and gender*

Source of Variation	Sum of Squares	Df	Mean Square	F	F.probability
Covariates	28226.87	1	28226.873	659.094	.000
Pretest	28226.87	1	28226.873	659.094	.000
Main Effects	65198.384	2	32599.192	761.187	.000
Methods	***63905.399***	***1***	***63905.399***	***1492.183***	***.000****
Gender	1112.362	1	1112.362	25.974	.000
2-Way Interactions	93.966	1	93.966	2.19	.129
Method Gender	***93.966***	***1***	***93.966***	***2.19***	***.129****
Explained	93895.086	4	23473.772	548.110	.000
Residual	19272.048	450	42.827		
Total	113167.134	454	249.267		

Summary of result in Table7 shows that for hypothesis 1, the alpha level (0.05) is greater than the f-probability value (0.00). Based on the decision rule the researcher rejects the null hypothesis and conclude that there is a significant difference between the mean interest scores of students taught algebra using the board game and those taught with the conventional method.

For hypothesis 3, the alpha level (0.05) is less than the f-probability value (0.129). At such the researcher upholds the null hypothesis and concludes that there is no significant

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interaction between methods and gender on students mean interest in algebra.

Table 8: ***Analysis of Co Variance for male and female Students overall interest scores in algebra***

Source of Variation	Sum of Squares	Df	Mean Square	F	F.probability
Covariates	4907.812	1	4907.812	96.703	.000
Pretest	4907.812	1	4907.812	96.703	.000
Main Effects	1776.854	1	1776.854	35.011	.000
Gender	***1776.854***	***1***	***1776.854***	***35.011***	***.000****
Explained	6684.666	2	3342.333	65.875	.000
Residual	12129.631	239	50.752		
Total	18814.298	241	78.068		

Result on Table8 showed that the alpha level (0.05) is greater than the f-probability value (0.00). The researcher therefore rejects the null hypothesis and concludes that is a significant difference in the mean interest scores of males and females taught algebra using the board game.

Table 9: ***Analysis of Co Variance for Students overall algebra achievement scores by teaching methods and interaction between methods and gender***

Source of Variation	Sum of Squares	Df	Mean Square	F	F.probability
Covariates	9332.827	1	9332.827	256.236	.000
Pretest	9332.827	1	9332.827	256.236	.000
Main Effects	45997.388	2	22998.694	631.436	.000
Methods	***459946.734***	***1***	***45996.734***	***1261.482***	***.000****
Gender	28.342	1	28.342	0.778	.378
2-Way Interactions	81.939	1	81.939	2.250	.076
Method Gender	***81.939***	***1***	***81.939***	***2.250***	***.076****
Explained	55692.155	4	13923.039	382.261	.000
Residual	16390.276	450	36.423		
Total	72082.431	454	158.772		

Summary of result in Table9 showed that for hypothesis 4, the alpha level (0.05) is greater than the f-probability value (0.00). Based on the decision rule the researcher rejects the null hypothesis and conclude that there is a significant difference between the mean achievement scores of students taught algebra using the board game and those taught with the conventional method. For hypothesis 6, the alpha level (0.05) is less than the f-probability value (0.076). At such the researcher upholds the null hypothesis and concludes that there is no significant interaction between methods and gender on students mean achievement in algebra.

Table 10*: Analysis of Co Variance for male and female Students overall achievement scores in algebra*

Source of Variation	Sum of Squares	Df	Mean Square	F	F.probability
Covariates	356.153	1	356.153	7.234	.008
Pretest	356.153	1	356.153	7.234	.000
Main Effects	107.384	1	107.384	2.181	.141
Gender	***107.384***	***1***	***107.384***	***2.181***	***.141****
Explained	463.537	2	231.769	4.707	.010
Residual	11767.537	239	49.237		
Total	12231.074	241	50.751		

Result on Table10 showed that the alpha level (0.05) is less than the f-probability value (0.141). The researcher therefore upholds the null hypothesis and concludes that there is no significant difference in the mean achievement scores of males and females taught algebra using the board game.

Discussion of Findings

Result of analysis as presented in Table1 showed that students taught algebraic concepts using algebraic board game had higher mean interest score than those taught with the conventional chalk-talk approach. In addition, result in table8 showed that the difference in the mean interest scores of students taught algebra using algebraic game board and those taught using the conventional chalk-talk approach was significant in favor of the students taught using algebraic game board. The result is in consonance with that of Okigbo and Sam (2012) who recorded a significant difference in the mean interest scores of students taught mathematics using mathematical game and instructional analogy and those taught using the conventional chalk and talk method. Furthermore, the finding is in agreement with that of Ebele (2010) who recorded a significant difference between the mean interes scores of students taught mathematics using mathematical game and instructional analogy and those taught using the conventional chalk and talk method. The results have shown that using games as instructional strategy enhances students' interest in learning algebra and mathematics in generally.

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Finding of the study as presented in Table2 showed that the male students had a greater mean interest scores than their female counterpart. In addition, there was a significant difference in the mean interest of male and female students taught mathematics using algebraic board game in favor of the males as presented in table9. The result showed that using games as instructional method enhances male and female students interest in learning though it was higher in males than in females. However, the result is not in tandem with that of Okigbo and Sam (2012) who recorded a no significant difference in the mean interest scores of male and female students taught algebra using games and instructional analogy. In addition, the result also disagrees with that of Ebele (2010) who recorded no significant difference in the mean interest scores of male and female students taught algebra using mathematical games and instructional analogy. The implication is that different game approach to teaching enhances male and female students interest in algebra differently and as such, may be adjudged to be unfit in teaching both gender.
Result of the study as presented in Table3 revealed that there was no interaction effect between methods and gender on the students mean interest scores in algebra. The result showed that algebraic board game was superior to the conventional chalk-talk approach at the two levels of gender (male and female). The result is in consonance with that of Okigbo and Sam (2012) who recorded no significant interaction between method and gender on students mean interest scores in mathematics when taught using game and instructional analogy. In addition, the result is equally in agreement with that of Ebele (2010) who recorded no signification interaction between methods of teaching (mathematical game and conventional methods) and students' gender on their mean interest scores in mathematics. The implication is that the game method is suitable for use as an instructional approach in teaching both male and female students.
Result of analysis as presented in Table4 showed that students taught algebraic concepts using algebraic board game had higher mean achievement score than those taught with the conventional chalk-talk approach. In addition, result in table10 showed that the difference in the mean achievement scores of students taught algebra using algebraic game board and those taught using the conventional chalk-talk approach was statistically significant in favor of the students taught using algebraic board game. The result is in consonance with that of Iji, Abakpa and Takor (2013) who recorded a significant difference in the mean achievement scores of students taught mathematics using algebraic game and those taught using the conventional chalk and talk method. Furthermore, the finding is in agreement with that of Etukudo (2012) who recorded a significant difference between the mean achievement scores of students taught mathematics using Computer Assisted Instruction and those taught using the conventional chalk and talk method. The results have shown that using games as instructional strategies enhances students' achievement in learning algebra and mathematics in generally more than using the conventional approach.
Finding of the study as presented in Table5 showed that the male students had a lesser mean achievement score than their female counterpart. In addition, there was no significant difference in the mean achievement of male and female students taught mathematics using algebraic board game as presented in table11. The result showed that using games as instructional method enhances male and female students' achievement in learning though it favors the females than the males. The result is in tandem with that of Etukudo (2012) who recorded a no significant difference in the mean achievement scores of male and female students taught mathematics using computer assisted instruction (CAI). In addition, the result also agrees with that of Iji, Abakpa and Takor (2013) who recorded no significant difference in the mean achievement scores of male and female students taught linear graph using algebraic games. The implication is that using games as an instructional approach enhances achievement of students (male and female) in algebra.
Result of the study as presented in Table6 revealed that there was no interaction effect between methods and gender on the students mean achievement scores in algebra. The result showed that algebraic board game was superior to the conventional chalk-talk approach at the two levels of gender (male and female). The result is in consonance with that of Iji, Abakpa and Takor (2013) who recorded no significant interaction between method and gender on students mean interest scores in Linear graph. In addition, the result is equally in agreement with that of Ebele (2010) who recorded no signification interaction between methods of teaching and students gender on the students mean achievement scores in mathematics. More so, the result is in disagreement with that of Etukudo (2012) who recorded a no

interaction effect between methods and gender on students mean achievement scores in mathematics.

Conclusions of the Study

In line with the findings of the study, the following conclusions were drawn:

1. Algebraic Board Game as a teaching method is significantly better than the conventional chalk-talk teaching approach in enhancing students' interest and achievement in algebra.
2. With algebraic board game, male students showed higher interest than the female students while the female students had higher achievement than the males. The difference in the mean achievement of male and female students taught algebra using algebraic board game was however no statistically significant.
3. There was no significant interaction between methods and gender on students' mean interest and achievement in algebra. For both male and female students, algebraic board game was superior to the conventional package in facilitating interest and enhancing achievement in algebra.

Recommendations of the Study

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

1. Mathematics teachers both at the junior and senior secondary school levels should be encouraged to embrace the use of algebraic board game during teaching learning process to enhance students' interest and achievement in algebra;
2. Textbook authors should be encouraged to recommend in their texts algebraic board game as a strategy for effective teaching and learning of mathematical concepts;
3. Curriculum planners should endeavor to include algebraic board game as an instructional approach because of its efficacy in enhancing both male and female students' interest and achievement in algebra.

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