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EFFECT OF LUDOMMATIC GAME AND GENDER DIFFERENCE ON SECONDARY

SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN ALGEBRA IN OBUDU LOCAL GOVERNMENT AREA OF CROSS RIVER SATE, NIGERIA.

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Abstract

The study explored the efficacy of ludomatic game and gender difference on senior secondary school 2 students' academic achievement and retention in Algebra. Six (6) research purposes, six(6) questions and six(6) null hypotheses guided the conduct of the study. The study employed a quasiexperimental design of non-equivalent control group. The study was conducted in Obudu local government area under Ogoja education zone of cross river state, Nigeria. Four co-educational secondary schools were drawn using multi-stage sampling procedures from eighty four (84) government approved secondary schools in the zone. Two intact classes from two different schools were then randomly assigned to the experimental and the control groups each. A total of 123 (67 males and 53 females) students out of 5643 students were involved in the study. The experimental group was taught algebra concepts using six (6) improvised ludomatic game boards while the control group was taught the same topics using the conventional lecture method. The researcherdeveloped instruments, Algebra Achievement Test (AAT), validated by three research experts which were used for data collection. The AAT had measures of estimate of reliability and item difficulty of 0.82 and o.24 respectively, while they all had internal consistency of 0.52. The questions were answered using mean and standard deviation, while the six null hypotheses were tested using ANCOVA at p

Keywords: mathematics, ludomatic, games, gender, algebra, achievement

Introduction

Mathematics is defined as a science, which deals with the meaning of numbers and their relationship to space. Mathematics is indispensable because it has application in all other human activities including school science and technology-based subjects. It has become the central intellectual discipline of the technological society. As such mathematics is one of the most important subjects Nigeria needs in this present era of technological advancement and in the realization of Nigerian vision of the year 2030 (Ukeje, 2017).

In spite of its importance and contributions in development and efforts made to improve the teaching and learning of mathematics in schools, there is still persistent poor achievement of students in mathematics. Studies

indicated low achievements and retention for Nigerian secondary schools (Obioma & Ohuche, 2017, Ale, 2019, Isinye, 2020). Again, the Chief Examiner's reports (WAEC, 2016, 2017 and 2018) stated that the mark for most centers in mathematics was either zero or near zero.

Recently, Chief Examiner's reports showed that poor student's performance in secondary school mathematics has been more prominent in some aspects of mathematics curriculum than in others. Such content areas like algebra have been reported to be very difficult to understand by students (WAEC, 2018). In a nationwide survey, carried out by Science Teachers' Association of Nigeria (STAN) on Mathematics and Physics panel, it was observed that majority of secondary school mathematics teachers indicated many concepts/topics that are difficult to teach or learn. The topics indicated include: Quadratic Expression, Series and Sequences (Ozofor, 2023).

Algebra (Quadratic Expression) has also been identified as one of the mathematics concepts which poses difficulties to secondary school students as established during the Federal Ministry of Education vacation course organized by State Ministry of Education Imo state (2020).

The teaching and learning of mathematics at all levels of the educational system may be described to be in a dismal state, the find it difficult to understand (2000), teachers find difficulties in teaching many topics (oyedeji,2022). The teaching of Mathematics has been described as been ineffective (oyedeji, 2022). The difficulties of students and the poor teaching usually come to light through the poor performances of students. Students are seen to perform poorly in both internal and external examination. For instance, in 2009, over 26% of the students failed mathematics in Senior Secondary School Examination (WAEC Chief Report). The situation is more pathetic in the senior secondary level (Ozofor, 2023). Thus, every concerned educationist is seeking a way out of these problems of poor performances in mathematics. One of such ways teaching helps is the mathematical games (ludomatic).

With the relationship of the indispensability of mathematics in the survival of our society and the educational system, mathematics educators have been concerned with the way in which students learn mathematics effectively and with utmost interest, better achievements and high retention. Hence effort now is to use mathematical games (ludomatic) to harness the intellectual power.

A mathematical game (ludomatic) is a type of play that follows a set of rules, aim at definite goal or outcome, and involves competition against other players or against barriers imposed by the nature of the game itself (worth, 2021). A game is regarded as mathematical when the players can perceive and/or influence the course of the game on the basis of mathematical consideration (Rudiger, 2014). Mathematical games may be use to introduce concepts as prelude to explicit teaching or practice skills or

Consolidate a concept after explicit teaching. Educational games do lead to improved learning (Dennis & Stewart, 2019). Some researchers have evaluated the effectiveness of mathematical games and gave reasons for the use games. Among them are the powerful motivation involvement and the development of positive attitudes in learning have long been recognized as being essential and necessary. Games are also valuable for encouraging social skill, for stimulating discussions, helping the development of understanding, for developing strategies for learning new concepts, reinforcing skills and concepts as an aid to symbolization and logic (Oldfield, 2021).

Ascher and Ascher (2014) asserted that mathematical games are culturally oriented and that each culture has its own sets of mathematical game. They stressed that mathematical ideas panhuman and are developed within cultures. Mathematics ideas taken be those that involve numbers, logic, spatial configuration in most importantly, the contributions or organization of these into systems or structures/ from culture to culture and within any culture, mathematical games and ideas appear in various contexts, which are either clear cut or mutually

exclusive.

With the inter-cultural variations in mathematics some approach and obvious differentials in play patterns, it has been speculated that the impact of such mathematics games on male and female could vary. According to rudiguer (2014), the extent to which mathematical games influence the learning process of males and females still remain a source of concern to the proponents of game approach to mathematical instruction.

Algebraic expressions in quadratic form are called quadratic because quadratus is a latin word for "square" in the leading term the variable is squared (free encyclopedia, 2018). Quadratic expression can be using three pieces of flat wood in teaching factorization and expansion. The application of board games in quadratic expression instruction has an interesting implication not only in boosting students' interest in algebra but also in enhancing achievement and retention in algebra and mathematics in general. In fact, the extent to which the game approach influences the achievement and retention of secondary school students in algebraic expressions both collectively and differentially demands very urgent attention .

Purpose of the Study

The purpose of this study was to examine the effect of ludomatic game and gender difference on Senior Secondary School Students' academic achievement and retention in algebra in Obudu Local Government Area of Cross River State. Nigeria.

Research Questions

To achieve the objectives of the study, the following research questions were raised:

What is the mean difference in the algebraic achievement scores of students taught using ludomatic game and those taught using the conventional method?

Is there any difference in the students' mean retention scores in mathematics between those taught using ludomatic game method and those taught using the conventional method?

What is the treatment main effect of using ludomatic game on students' achievement in secondary school algebraic concepts?

What is the treatment main effect of using ludomatic game on students' retention ability in secondary school algebraic concepts?

What is the interaction effect of ludomatic game and gender difference on the mean achievement of students taught algebra?

What is the interaction effect of ludomatic game and gender difference on the mean retention ability of students taught algebra?

Statement of hypotheses

In order to achieve the objective of the study, the following hypotheses were tested at .05 level; H01: There is no significant mean difference in the achievement of students taught using the ludomatic game and those taught using the conventional method.

H02: There is no significant difference in the students mean retention ability in algebra between those taught using ludomatic game method and those taught using the conventional method. H03: The treatment main effect of using ludomatic game on students' achievement in senior school algebra concepts is not statistically significant.

H04: There is no significant treatment main effect of using ludomatic game on students' retention ability in senior school algebra concepts.

H05: There is no significant interaction effect in the use of ludomatic game and gender difference on the mean achievement of students taught algebra.

H06: There is no significant interaction effect in the use of ludomatic game and gender difference on the mean retention ability of students taught algebra.

Methodology:

The design for this study was the quasi- experimental research design. It was made up of the pretest-treatment-post-test quasi experimental design with control. The sampled elements, both the experimental and control groups were subjected to a algebraic achievement test (pre-test) before the administration of the treatment; thereafter the students in the experimental group were taught using the ludomatic game (treatment) while the control was taught using the conventional method (without the treatment) and at the end of the five (5) weeks of teaching, both groups were administered the post-test algebraic achievement test. Furthermore, one month after the completion of the study, the algebraic retention test was administered on both groups.

The area of the study was Obudu local government area in Cross River State. Nigeria. Obudu is on latitude 48'and 67 40' N, and longitude 9 09%and 9]- 52.31 " E. Obudu has a population of about twenty thousand (19,668) based on the 2006 National census figure (Federal Republic of Nigeria, 2007).

The target population was made up of 1027 male and female students in senior secondary II. Out of this number, a total of 553 students were females and 474 males. The sample size for this study was 123 students, from four secondary schools. This was made up of 67 boys and 56 girls.

Two instruments were used to collect data. These are the Algebraic Achievement Test (AAT) and the Algebraic Retention Test (ARI). The AAT was a 30-objective test items covering the five topics, quadratic equation, simultaneous equation, linear inequalities, and algebraic fractions, that were treated based on the students' algebraic course content. The ART also contained 30 objective items that were parallel to the items in AAT. Each item was scored dichotomously.

Data collected from the study was analyzed using the Statistical Package for Social Sciences (SPSS) software. The analytical tools included descriptive statistics (means, standard deviation). T-test and Analysis of Covariance with F-test. The tests were carried out at .05 level of significance.

Results

Research Question One

What are the mean achievement scores of students taught algebra with ludomatic game and those taught with conventional lecture method?

To answer this research question, posttest achievement test from the two groups were used. The mean posttest achievement from those taught using ludomatic game method was 33.34 (SD = 3.62) and that from the conventional method was 18.54 (SD = 4.15). Therefore, the mean achievement scores of students taught algebra with ludomatic game was higher than that of students taught using conventional method as presented in Table 1.

Table 1: Means and standard deviation of students taught algebra using ludomatic game and conventional lecture method (Post test)

Hypothesis One

There is no significant difference in the mean achievement scores of students taught algebra with ludomatic game and those taught with the conventional lecture method.

In order to test this hypothesis, the t-test was used. Indeed, two independent groups (those taught using ludomatic method and those taught using the conventional method) were compared on the basis of their achievement in Algebra. The post-test achievement was the dependent variable while the method of teaching (categorized into the groups) was the independent variable. The result of the analysis is presented on table 2.

Table 2: Result of independent t-test of the difference in posttest achievement of students based on method of teaching.

* Significant, p<.05; critical t=1.980

From table 2, the critical t-value was 1.980 (? = .05 df = 121) which was less than the calculated tvalue of 21.139 (p<.05). Hence, the null hypothesis was rejected. To this end, the study concluded that there exists a significant difference in the mean posttest achievement scores of students taught Algebra with ludomatic game with those taught with conventional lecture method. Those taught with ludomatic game method scored significantly higher in their mean achievement than those with conventional method.

Research Question Two

What are the mean achievement scores of male and female students taught algebra.

The mean posttest scores for male and female student taught algebra irrespective of the method was computed. The result of the analysis is presented in Table 2.

Table 2: Means and standard deviations of male and female students' posttest achievement

From Table 2, on the average, the posttest achievement scores of male students taught algebra x ?=28.00;SD=7.67) was greater than that of their female counterpart x ?= 24.69; SD = 8.91)

Hypothesis Two

There is no significant difference in the mean achievement scores of male and female students taught algebra. In this hypothesis, the independent variable was sex (categorized into male and female) while the dependent variable was the posttest achievement of the students. The result of the test at .05 level is presented in Table 2.

Table 2: Result of independent t-test of the difference in male and female students' achievement in algebra.

*Significant p<.05; critical t= 1.98, x = .05, df = 121

From Table 2, the test was significant as the calculated t-value of 2.205 (p<.05) was greater than the critical t-value of 1.98 (?= .05, df=121). Hence the null hypothesis was rejected. Therefore, there was a significant mean difference in the achievement scores (posttest) between male and female students who were taught Algebra.

Hypothesis Three

There is no significant interaction effect of instructional methods and gender on the mean achievement scores of students in Algebra.

The analysis of covariance (ANCOVA) with F-test was used to test the hypothesis. The dependent variable was the students' post-test achievement scores. The pretest was the co-variate while the instructional method and gender were the independent variables. The result of the ANCOVA is presented in table 3 and 4.

Table 3: Mean and standard deviation of posttest achievement scores of male and female students based on method of instruction.

From Table 3, the difference in the mean posttest scores between the experimental group (x?= 34.63) and the control group (x ?= 20.36) among the male students was 14.27. Also, the difference between the experimental (x ?= 31.65) and the control groups (x ?= 15.91) among the female students was 15.74. From the analysis, it could be seen that the mean gain between the female and male students in between the experimental and the control group are almost the same so as not to justify significance of interaction.

Table 3: Analysis of covariance of the interaction effect of instructional methods and gender on students' achievement in algebra

*Significant, P<.05; R2 = .867 (Adj. R2 = .862),

From the model of Table 4, the main effects were all significant at .05 level; however, the interaction effect of sex and method (F =2.405, P>.05) was not significant. Therefore, the null hypothesis was rejected was not significant. Thus, interaction effect of instructional methods and gender on the mean achievement scores of students in algebra. The model accounted for 86.7% (R2 = .867) of students' posttest achievement in algebra.

Research Question Four

What were the mean retention score of students taught algebra with ludomatic game and those taught with the conventional lecture method.

In order to answer this research question, the retention test scores were used and comparison was carried out between those taught using the ludomatic game method and conventional lecture method. The means of the students in these groups were computed together with their standard deviation as presented in Table 4.

Table 4: Means and standard deviations of students' retention algebra

From Table 4, the mean retention score of students taught using ludomatic game method was 31.15 (SD = 4.62) while that of students taught using the conventional method was 22.98 (SD=4.66). Therefore, students taught Algebra using ludomatic game method have higher mean retention than their counter parts taught using the conventional lecture method.

Hypothesis Four

There is no significant difference in the mean retention scores of students taught algebra with ludomatic game and those taught with the conventional lecture method.

To test this hypothesis, the independent variable was the teaching method made up the ludomatic game method and the conventional lecture method therefore the independent variable has two levels. Also, the dependent variable was the retention scores. Thus, independent t-test was used and the test was at .05 level. The result of the test is presented in Table 4.

Table 4: Means and standard deviation of students' retention based on different teaching methods

* Significant, p<.05; critical t=1.98, x=.05, df=121

From Table 4, the test was significant. The calculated t-value was 9.724 (p<.05) as against the critical t-value of 1.98 (? = .05, df = 121. Therefore the null hypothesis was rejected. Thus, students taught algebra using ludomatic game method showed significant higher mean retention than those taught using the conventional lecture method.

Hypothesis five

There is no significant interaction effect of instructional methods and gender on the mean retention scores of students in Algebra.

To test this hypothesis, the pretest was the covariate, the instructional methods and gender were the independent variables while the students' retention test scores was the dependent variable. Hence, the analysis of covariance (with pretest as covariate) was used. The result of the descriptive together with the ANCOVA at .05 level are presented in tables 6 and 7.

Table 6: Means and standard deviations of retention scores of students taught algebra using different instructional methods based on their gender.

From Table 6, the mean gain between the experimental and control groups in the retention test by the male students was 7.96; while that of their female counterpart was 8.77. Thus the difference in the mean gain between the male and female students based on the instructional methods was not appreciable. However, to test the significance of the means due to the interactions the ANCOVA result is presented in Table 6.Table 6: Result of analysis of covariance (ANCOVA) of the interaction effect of instructional methods and gender on the retention scores of students taught algebra (with pretest as covariance).

*Significant, p<.05 NS - Not significant, R2 =. 688 (Adj R2 = .678)

From Table 6, the model was significant (F = 65.100) with R2 = .688; showing a 68.8% explained variance of the students' retention was based on sex and instructional methods. Whereas the main effects (sex main effect with F =91.363, p< .05) and methods main effects with F = 170.600, p<.05 were statistically significant, however the interaction effect of sex and methods for which the hypothesis sought after (with F = .341, p> .05) was not significant. Hence the hypothesis was rejected. To this end, sex and instructional methods interaction effect was not significant in the explanation of students' retention in algebra.

Discussion

The results from this study indicated that students taught algebra using ludomatic game performed better than students taught using the conventional method. In other words, the experimental group produced higher mean achievement score than the control group taught the same topic using the conventional method. The findings of this study were in agreement with the earlier research such as Singmaster (2017) who supported that mathematical games with its ability to general fun enhance cognition without stressing the learners. This is also in consonance with the findings of Smith (2013) that mathematical game provides a clear understanding of mathematical rules and principles.

The study is not surprising since mathematical games encourage systematic ideas or patterns. From this one could infer that students in the experimental group of this study advanced in level of understanding as they applied their own understanding of the rules of the game in solving mathematical problems such as the one of algebraic expression.

Summary of data analysis in table 2 reveal effects of the game approach on the mean achievement scores of male and female students. The findings indicated that male students achieved better than the female students.

Although the achievement of the male students in the algebraic expression test is higher than those of their female counterpart, the test of significance revealed that the difference in their achievement scores is very insignificant.

The findings of this study did not agree with the earlier arguments of Greenfield and Feldman

(2017). They argued that mathematical games are masculine and as such favored males more than females. This study has dispelled the argument with concrete data and most importantly the purported masculinity of game approach was not manifested in this experiment as females were observed progressing smoothly during the experimental sessions.

Summary of result presented in table 3 reveal that there is no interaction between gender and teaching approach on students' achievement in quadratic expression. Summary of result in table 3 also indicated that mathematical game approach is superior to the conventional approach the two levels of gender is fostering achievement. Treatment interaction generally implies that different learners with different characteristics may profit more from one type of instructional than from another and that therefore it may be possible to find the best match of learners' characteristics and instructional approach in other to maximize learning outcomes or whichever dependent variable that is involved.

Although the goal of research in treatment interaction is to find significant biordinal interaction between alternative treatments and personal variables, it must be emphasized that any approach which yields a superior no-interaction is cost effective and better in all ramification. With this in mind, one may begin to appreciate the worth of the mathematical game approach both in its superiority over the conventional approach and its ability to accommodate both males and females in fostering achievement in quadratic expression.

Conclusion

The study also revealed that although with mathematical game approach, males showed higher achievement than the females, the difference in the mean achievement of males and females taught using the method is not statistically significant. There was no significant interaction between gender and instructional method on student's achievement in quadratic expression.

Recommendations

Based on the finding of the study, the researchers made the following recommendations:

Primary and secondary school mathematics teachers should be encouraged to adopt mathematical game approach as part of their teaching methods.

State and federal government should establish, equip and fund mathematical resource centre in each education zone. This will ensure that teachers can go to these centres and learn how to use the games in teaching mathematical concepts.

State and federal government should encourage and sponsor in-service training for mathematics teachers to learn the tenets of mathematical games

The government in collaboration with curriculum developers and mathematics teachers should review the existing curriculum and integrate the basic tenets of the game approach in the curriculum.

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