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Effect of Kinesthetic Learning on Students' Interest and Achievement in Mathematics

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Abstract

One of the pertinent reasons for poor academic achievement in Mathematics is fundamentally linked to the application of ineffective teaching methods by teachers to impact knowledge to learners. This study adopts a quasi-experimental pre-test post-test research design to examine the efficacy of kinesthetic learning on interest and achievement in Mathematics. Four research questions were raised to guide the study and four hypotheses were formulated and tested at 0.05 level of significance. The sample comprises 101 Junior Secondary School students drawn from two secondary schools in Bekwarra Local Government Area of Cross River State, Nigeria. Two intact classes were randomly selected from each school and assigned to experimental and control group. Data for the study were sourced using a modified Mathematics Interest Inventory (MII) and mathematics achievement test designed by the researchers tagged Students' Mathematics Achievement Test (SMAT). Data collected were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The findings revealed a high post-test interest cluster mean of 3.10 (above the decision benchmark of 2.50) and also a higher post-test mean achievement score with (Mean = 20.82; Standard Deviation = 3.63) for students in the experimental group compared to the control group. The result also indicated that both male and female students taught mathematics using kinesthetic learning in the experimental group had positive interest and achievement after exposure to the treatment. The test of the hypotheses indicated that there is significant difference in interest and achievement between students taught mathematics using kinesthetic learning and conventional method, whereas there is no significant difference on the interest and achievement of male and female students taught mathematics using kinesthetic learning. The study concluded that kinesthetic learning has a positive effect on interest and achievement in mathematics; and that gender is not a sole determinant of good academic performance or interest in mathematics but teaching method. The study recommended that mathematics teachers should adopt kinesthetic learning or play way method in teaching because of its relevance in improving learners' interest and achievement.

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INTRODUCTION

Mathematics has been regarded as a fundamental subject because arithmetic and logical reasoning are the basis of science and technology. It is a key subject necessary for the promotion of economic development, particularly in developing countries. For this reason, educational authorities emphasize students' proficiency in computational skills and problem-solving. Due to the importance that mathematics carries; the subject became key in school curriculum. According to Ngussa and Mbuti (2017), the mathematics curriculum is intended to provide students with knowledge and skills that are essential in the changing technological world. Nyaumwe and Metwa (2013) state that mathematics education is a bedrock and an indispensable tool for scientific and economic advancement of a person and a nation at large. It is also important in the scientific and technological development of countries (Enu, Agyman & Nkum, 2015). Mathematics knowledge plays a crucial role in understanding the content of other subjects such as science, social studies, and even music and art. Its importance can be seen in hidden ways, and in everyday usage, all around us: computers, body scanners, software, coding, and much more. Mathematics prepares one for the future world. Consequently, many nations take mathematics as a compulsory subject at secondary school education level since it is a fundamental subject for human life.

However, although Mathematics occupies a critical position in the school curriculum, researchers have observed that most students find it difficult to pass the subject (VaraidzaiMakondo, *et al* 2020). Many reasons have been attributed to the causes of poor academic performance in Mathematics. Among the causes of poor academic performance in Mathematics are attitudes of the learners towards the subject, lack of teaching experiences, economic conditions, lack of appropriate teaching and learning methods and low motivation of teachers' and students' attitudes (Biotenbeck, 2011). Thus, further research is necessary to establish the extent to which each of these causes can be controlled to improve interest and achievement in mathematics as a school subject.

Interest as a variable alludes to an individual's passion towards a particular object (Tembe, *et al* 2020). It is a quality of a person that is developed and sustained for a long period of time, gradually becoming personality characteristics (Silvia, 2005). Interest, however, may have certain uniqueness which makes it noteworthy. One of the most important distinctions in the conceptualizations of interest has to do with the time frame with which interest is being examined. For instance, a situation can raise interest in people that may only exist for minutes or even seconds (interest-as-state). On the other hand, it is possible for people to spend years passionately pursuing an interest (interest-as-trait) (Jansen, Lüdtke & Schroeders, 2016).

A learner with a high level of interest would display a consistently high cognitive commitment and emotional attachment to a specific (academic) domain (Krapp, 2002). In this sense, interest can be conceptualized as a domain-specific, cognitive, and an affective component, that is built and nourished over the school career, and is presumed to be relatively stable over a variety of situations and over time. Mathematics interest is a complex behavioral aspect of mathematics education. It has so many characteristics and it can be attributed to factors important to mathematics education. The key strategy of Mathematics teaching at the school

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level is to build learners' interest in Mathematics. If students are interested in learning mathematics, their academic achievement would be positively impacted, and the teachers' tasks would become a lot easier. Therefore, interest is a vital variable to consider in the teaching and learning of mathematics.

In a study on mathematics interest and academic achievement, Mohamed and Charles (2017) found that there is a significant difference in interest and academic achievement of secondary school students with respect to unique type of management and learning styles. Relatedly, Goolsby (2013) attributed factors influencing students' interest in mathematics to perception of teachers' attitude, mathematics anxiety, confidence in learning mathematics, locus of control, and learning style. Therefore, mathematics education researchers have continued to investigate various factors that could influence the interest of students in mathematics and affect mathematics achievement.

Achievement in mathematics is the competency shown by the student in mathematics tasks (Bhairab 2017). Abakpa (2011) defines achievement as a measure of accomplishment in a specific domain of study. Achievement can also be viewed as a demonstration of students' abilities to attain certain levels of instructional objectives and outcomes of their classroom instruction and experience (Abakpa, 2011). Students' achievement in Mathematics has always been a matter of concern to stakeholders of Mathematics Education because whatever students' achievement is, will have an impact on the students themselves, the school system and the nation at large. This explains the reason why there is so much campaign on the improvement of students' achievement in Mathematics by national and international examination bodies all over the globe.

In terms of quantification, a student's achievement could either be low or high. Achievement is low when the student does not measure up to the desired expectation or benchmark set by the examiner or instructor; and it is high when the performance of the learner is exactly or above the desired outcome. So many factors could be said to account for low or high achievement in Mathematics. Some of these factors include teacher factors, school factors, teaching and learning styles, parent factors, and government factors (Akinoso, 2011). This implies that for students' achievement in Mathematics to be improved, there must be a continuous investigation of the various factors to ascertain new and innovative ways of learning and teaching Mathematics.

Research has clearly shown that the type of learning style used in the class goes a long way in determining the interest and achievement of the students. Pantziara & Philipou (2007) reveals that learning styles such as kinesthetic and use of visual aid in the mathematics classroom could increase students' motivation and morale to their performance. This was also supported by Mtitu (2014) and Kafyulito, Rugambuka & Ikupa (2012) who emphasize that teachers have to be encouraged to apply student centered methods that require teachers to actively involve students in the teaching and learning process.

Kinesthetic learning is a process in which students learn by actively carrying out physical activities rather than by passively listening to lectures. It is also a type of learning whereby students tend to use parts or all of their bodies to communicate, receive information, and solve problems in learning activities. Sara, Luong &

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Young (2014) define kinesthetic learning as a teaching method that involves students' physical interaction among each other and the environment.

Kinesthetic learning styles are more dominant in learning through direct practice, or through movement or the power of sensation (Sari, 2019). Some of the characteristics possessed by students with kinesthetic learning styles include learning through manipulation and practice, memorizing by walking and seeing, using fingers as pointers when reading, using lots of body gestures, unable to sit still for long periods of time, likes games that keep him busy etc. This method is learner-centered which allows the learner to see, touch and manipulate objects while learning of subjects such as mathematics are more of seeing and doing than hearing; so also, with science that advocates "do it yourself.

Most students understand concepts easily when they learn by doing. Martinez (2017) describes in his book that the key to success in mathematics education is combining communication, social and emotional skills and playful and performative teaching methods. It is therefore of great importance to research into the effects and potential benefits of incorporating Kinesthetic learning into mathematics lessons. Kinesthetic learners are those who learn best by 'doing' and using a whole-body approach to learning. Additionally, learning by doing can narrow concentration at target task (Weinberg & Gould, 2011). The use of kinesthetic learning in the classroom can help engage students who are typically passive, sedentary, and disinterested learners to become more active and attentive (Honigsfeld & Dunn, 2009).

Kinesthetic learning style has a close connection with improvement in academic interest, achievement and positive impact on neurocognitive development of the brain (Duman, 2010). One core aim of Basic Education is to help students discover their interests and chart career pathways based on interests developed and nurtured in school. To this end, the present study seeks to investigate the effect of Kinesthetic Learning on interest and achievement in mathematics in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

The importance of Mathematics cuts across all aspects of human endeavour, starting from indirect use at home to actual applications to solve scientific and technological problems. However, mathematics involves steps and principles which sometimes present it as a difficult subject. Studies have shown the trend of poor academic performance in mathematics in many parts of the world. This problem has many causes, and it has educational, social, cultural and psychological dimensions. More recent studies have unveiled that one of the pertinent reasons for poor academic achievement is fundamentally linked to the application of ineffective teaching methods by teachers to impact knowledge to learners.

Conventional teaching method that dominates classrooms is teacher-centered and has not been yielding the desired result (Abah, 2020). Therefore, there is need to find instructional strategies that will improve students' memory and make teaching and learning of Mathematics student-centered especially in Bekwarra Local Government Area where the style is not the standard practice. This would possibly enhance students' interest and ability to recall basic mathematical facts necessary to excel in all forms of examinations. One of such strategies is kinesthetic learning.

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Kinesthetic learning deals with active and consistent engagement of students in the classroom. This type of student-centered learning may play a key role in providing meaningful and impactful learning experiences. It is therefore imperative to investigate on the effect of kinesthetic learning on interest and achievement in mathematics in Bekwarra Local Government Area of Cross River State, Nigeria.

The primary purpose of this study is to determine the effect of kinesthetic learning on the interest and achievement in mathematics in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria. Specifically, the study seeks to:

a. Ascertain the mean interest scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.
b. Determine the mean achievement scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.
c. Find out the mean interest scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Bekwarra Local Government Area of Cross River State, Nigeria.
d. Ascertain the mean achievement scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Bekwarra Local Government Area of Cross River State, Nigeria.

The following research questions guide this study:

a. What are the mean interest scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria?
b. What are the mean achievement scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria?
c. What are the mean interest scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria?
d. What are the mean achievement scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria?

RESEARCH METHOD

This study used a quasi-experimental pre/post-test design to determine how kinesthetic learning affects students' interest and achievement in mathematics. The kinesthetic learning was the independent variable whereas; student interest and achievement were the dependent variables. For this study, the researcher used two

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intact classes, one class for each of the two selected schools. One class represented the experimental group while the other class represented the control group. The experimental group was exposed to kinesthetic learning while the control group was exposed to Conventional Teaching Method. All the two strategies were crossed with gender at two levels (male, female).

The area of this study is Bekwarra Local Government Area of Cross River State, Nigeria. Bekwarra Local Government is preferred as area for this present study because the reviewed literature shows that in relation to this new topic under study, there is a greater gap to be filled.

The population of this study is made up of 2,115 junior secondary school one (JSS I) students in a total of fourteen (14) approved secondary schools in Bekwarra Local Government Area of Cross River State (Bekwarra Local Government Education Authority Office, 2023).

The study randomly selected two (2) junior secondary schools for the study with a total number of one hundred and one (101) junior secondary school one (JSS I) students from the selected schools. The two government approved schools were selected using stratified random sampling, one public and one private secondary school in Bekwarra Local Government Area. A simple random sampling technique was then used to select the JSS I students within each school. The two selected schools were randomly assigned to the experimental group and control group. The experimental group had fifty (50) students while the control group had fifty-one (51) students.

Two instruments were used for data collection, namely Mathematics Interest Inventory (MII) and Students' Mathematics Achievement Test (SMAT). The first instrument was a modified 15-item Interest Inventory titled, "Math Interest Inventory" (MII). Items on interest in the instrument were adapted from interest inventory developed by Snow (2011) of which the students were asked to "rate how they think, feel, act, value and evaluate themselves in Mathematics" on a four-point scale, namely: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1. The researcher adapted MII to measure specific interest content in Mathematics with respect to the specific objectives of the study.

The second instrument was designed by the researcher to measure the achievement of Junior Secondary School students in Mathematics. The instrument was made up of two sections: Section A consisted of demographic data such as name of school, class, sex and age. Section B consisted of 30 multiple items test taken from the mathematics topics that were taught during the experiment. Each multiple-choice item has four options A to D. One mark was awarded for each question answered correctly and zero for every wrong answer. The maximum mark was 30.

The two instruments were subjected to content validation by an expert from the Department of Mathematics Education, Joseph Sarwuan Tarka University, Makurdi (JOSTUM), Nigeria, and two secondary school mathematics teachers. This is to ensure that the instrument measure what is intended to. The items in the SMAT and MII were checked for appropriateness, clarity and adequacy for the study. Comments were used to modify the instrument for data collection. The validators made a few suggestions on the instruments including that some of the items in the Interest Inventory were repeated and lacked proper structure for the

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research work, as such the complete revised version of Snow (2011) Mathematics Interest Inventory should be used. It was also suggested that suitable distractors should be added to the options in answering SMAT questions.

Reliability for both instruments was established after trial-testing them on a sample of 50 JSS I students from the study area who are not in the original sample for this study. The reliability of MII was determined using Cronbach Alpha, with the analysis yielding a Cronbach Alpha coefficient of 0.89, indicating a high level of internal consistency for the instrument. Similarly, the reliability coefficient of 0.85 was established for SMAT using Kuder-Richardson formula 20 (KR-20).

Data for the study will be collected through the administration of Mathematics Interest Inventory (MII) and Student's Mathematics Achievement Test (SMAT) to junior secondary school students in the selected schools based on the topic taught during the study. The schools under study were personally visited by the researchers and with full permission of the principal of each of the schools and duly completed informed consent by participating JSS I students, ensuring a high adherence to ethical standards.

Pre-test versions of the instruments were administered to the participants to establish their initial status before the commencement of treatment. The experimental group was taught by the researchers using kinesthetic learning style while the control group was taught by the school Mathematics teacher using conventional teaching method, with the researcher as observer based on the school management arrangement. After teaching the two groups for the period of two (2) weeks, the post-test version of Mathematics Interest Inventory (MII) was first administered to the students and after 10 minutes the inventory was retrieved. Thereafter, Student's Mathematics Achievement Test (SMAT) was then administered to the two groups. The SMAT lasted for 50 minutes, and the scripts were marked, scored and collated for analysis. The post-test version of the two instruments contained the same items as the pre-test version but reshuffled.

The data collected were analyzed using statistical tools, namely, mean, standard deviation and Analysis of Co-variance (ANCOVA). The choice of ANCOVA to test for the hypotheses at 0.05 level of significance was to take care of the covariates and control differences across groups and gender. ANCOVA also serves as a robust technique for handling extraneous variables arising from the use of non-randomized intact classes. Decision making for the research questions were based on the benchmark mean response of 2.50 for part B of Mathematics Interest Inventory (MII), such that mean equal to or above 2.50 was regarded as "Agree" while mean rating less than 2.50 was regarded as "Disagree". Version 23 of Statistical Package for Social Sciences (SPSS) software was used to compute the data collected.

The following research hypotheses were formulated and tested at 0.05 level of significance:

a. There is no significant difference on the interest of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.
b. There is no significant difference on the achievement of junior secondary school students taught mathematics using kinesthetic learning and those taught

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using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

c. There is no significant difference on the interest of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.
d. There is no significant difference on the achievement of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

RESULTS AND DISCUSSION

The data collected using the instruments developed for the study are presented and analyzed according to the stated research questions and hypotheses.

Research Question One

What are the mean interest scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 1. Descriptive Analysis of Pre-test and Post-test Interest Scores of Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning and those Taught Using Conventional Method

Groups	N	Pre-test Mean	Standard Deviation	Post-test Mean	Standard Deviation
Control *(Conventional)*	51	2.43	0.34	2.62	0.27
Experimental *(Kinesthetic)*	50	2.58	0.29	3.10	0.38

Table 1 showed the pre-test and post-test analysis of mean interest scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in junior secondary schools in Bekwarra Local Government Area of Cross River State, Nigeria (confer appendix E for detailed inventory). Students exposed to kinesthetic learning had a post-test mean score of 3.10 while those exposed to conventional method had a mean score of 2.62. As exhibited in the table, it implies that junior secondary school students in Bekwarra Local Government Area of Cross River State, Nigeria have high interest in mathematics when exposed to kinesthetic learning.

Research Question Two

What are the mean achievement scores of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

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Table 2. Descriptive Analysis of Pre-test and Post-test Achievement Scores of Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning and those Taught Using Conventional Method

Groups	N	Pre-test Mean	Standard Deviation	Post-test Mean	Standard Deviation
Control *(Conventional)*	51	15.65	5.32	17.63	5.12
Experimental *(Kinesthetic)*	50	14.48	4.72	20.82	3.63

The result presented in Table 2 showed the pre-test and post-test mean achievement scores of junior secondary school students taught mathematics using conventional teaching method and those taught using kinesthetic learning. There was a higher mean score in Mathematics for students in the Control Group at pre-test with (mean = 15.65, SD = 5.32), compared to that of students in the Experimental Group with (mean = 14.48, SD = 4.72). But after treatment, there was a higher mean score in Mathematics for students in the Experimental Group with (mean = 20.82, SD = 3.63), compared to that of the Control Group with (Mean = 17.63, SD = 5.12). This result implies that kinesthetic learning has a positive effect on the achievement in mathematics of junior secondary school students in Bekwarra Local Government Area of Cross River State, Nigeria.

Research Question Three

What are the mean interest scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 3. Descriptive Analysis of Pre-test and Post-test Interest Scores of Male and Female Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning

Gender	N	Pre-test Mean	Standard Deviation	Post-test Mean	Standard Deviation
Female	28	2.54	0.35	3.08	0.28
Male	22	2.62	0.19	3.13	0.49

Table 3 above showed the pre-test and post-test analysis of mean interest scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Bekwarra Local Government Area of Cross River State, Nigeria (confer appendix E for detailed inventory). The male students have a slightly higher pre-test score of (mean 2.62, standard deviation 0.19) compared to the female students with (mean 2.54, standard deviation 0.35). Similarly, after treatment, the male students have a slightly higher post-test score of (mean 3.13, standard deviation 0.49) compared to the female students with (mean 3.08, standard deviation 0.28). This implies that both male and female students have high interest in mathematics when exposed to kinesthetic learning. However, that of the male students is slightly higher than the females.

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Research Question Four

What are the mean achievement scores of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 4. Descriptive Analysis of Pre-test and Post-test Achievement Scores of Male and Female Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning

Gender	N	Pre-test Mean	Standard Deviation	Post-test Mean	Standard Deviation
Female	28	12.54	4.44	19.57	3.12
Male	22	16.95	3.90	22.41	3.61

The result presented in Table 4 shows the pre-test and post-test mean achievement scores of male and female junior secondary school students taught mathematics using kinesthetic learning. There was a higher mean score on achievement in mathematics for male students at pre-test with (mean = 16.95, SD = 3.90), compared to that of female students with (mean = 12.54, SD = 4.44). After treatment, there was a slightly higher mean score on achievement in mathematics for male students with (mean = 22.41, SD = 3.61), compared to that of the female students with (Mean = 19.57, SD = 3.12). This implies that both male and female students have high academic performance in mathematics when exposed to kinesthetic learning. However, that of the male students is slightly higher than the females.

Research Hypothesis One

There is no significant difference on the interest of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 5. Analysis of Co-variance (ANCOVA) of Mean Interest Scores of Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning and Conventional Teaching Method

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7.061a	2	3.530	35.073	.000
Intercept	6.362	1	6.362	63.209	.000
Pretest (Covariate)	1.170	1	1.170	11.621	.001
Groups	4.500	1	4.500	44.703	.000
Error	9.864	98	.101		
Total	841.578	101			
Corrected Total	16.925	100			

R Squared = .417 (Adjusted R Squared = .405), α = 0.05

The analysis in Table 5 above revealed the result of ANCOVA computed on the post-test mean interest scores of junior secondary school students taught mathematics using kinesthetic learning and conventional method while controlling the covariant (pre-test). From the table, the result showed that F (1, 98) = 44.703 and the p-value of 0.000 was less than the α - value of 0.05. Therefore, the null hypothesis was rejected. This implies that, statistically there is enough evidence to

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infer that there is a significant difference on the interest of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Bekwarra Local Government Area of Cross River State, Nigeria.

Research Hypothesis Two

There is no significant difference on the achievement of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 6. Analysis of Co-variance (ANCOVA) of Achievement Scores of Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning and Conventional Teaching Method.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	680.000a	2	340.000	21.769	.000
Intercept	1694.111	1	1694.111	108.467	.000
Pretest (Covariate)	422.668	1	422.668	27.062	.000
Groups	335.757	1	335.757	21.497	.000
Error	1530.633	98	15.619		
Total	39474.000	101			
Corrected Total	2210.634	100			

R Squared = .308 (Adjusted R Squared = .293), α = 0.05

The analysis in Table 6 above revealed the result of ANCOVA computed on the post-test achievement scores of junior secondary school students taught mathematics using kinesthetic learning and conventional method while controlling the covariant (pre-test). From the table, the result showed that F (1, 98) = 21.497 and the p-value of 0.000 was less than the α - value of 0.05. Therefore, the null hypothesis was rejected. This implies that, statistically there is enough evidence to infer that there is a significant difference on the achievement of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional method in Bekwarra Local Government Area of Cross River State, Nigeria.

Research Hypothesis Three

There is no significant difference on the interest of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 7. Analysis of Co-variance (ANCOVA) of Mean Interest Scores of Male and Female Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.778a	2	.389	2.823	.070
Intercept	2.435	1	2.435	17.668	.000
Pretest (Covariate)	.738	1	.738	5.354	.025

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Gender	.007	1	.007	.050	.824
Error	6.477	47	.138		
Total	488.169	50			
Corrected Total	7.255	49			

R Squared = .107 (Adjusted R Squared = .069), α = 0.05

The analysis in Table 7 above revealed the result of ANCOVA computed on the post-test mean interest scores of male and female junior secondary school students taught mathematics using kinesthetic learning while controlling the covariant (pre-test). From the table, the result showed that F (1, 47) = 0.050 and the p-value of 0.824 was greater than the α - value of 0.05. Therefore, the null hypothesis was accepted. This implies that, statistically there is enough evidence to infer that there is no significant difference on the interest of male and female junior secondary school students taught mathematics using kinesthetic learning in Bekwarra Local Government Area of Cross River State, Nigeria.

Research Hypothesis Four

There is no significant difference on the achievement of male and female junior secondary school students taught mathematics using kinesthetic learning in Junior Secondary Schools in Bekwarra Local Government Area of Cross River State, Nigeria.

Table 8. Analysis of Co-variance (ANCOVA) on the Achievement Scores of Male and Female Junior Secondary School Students Taught Mathematics Using Kinesthetic Learning.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	201.937a	2	100.969	10.702	.000
Intercept	914.155	1	914.155	96.890	.000
Pretest (Covariate)	102.733	1	102.733	10.889	.002
Gender	16.316	1	16.316	1.729	.195
Error	443.443	47	9.435		
Total	22319.000	50			
Corrected Total	645.380	49			

R Squared = .313 (Adjusted R Squared = .284), α = 0.05

The analysis in Table 8 above revealed the result of ANCOVA computed on the post-test achievement scores of male and female junior secondary school students taught mathematics using kinesthetic learning while controlling the covariant (pre-test). From the table, the result showed that F (1, 47) = 1.729 and the p-value of 0.195 was greater than the α - value of 0.05. Therefore, the null hypothesis was accepted. This implies that, statistically there is enough evidence to infer that there is no significant difference on the achievement of male and female junior secondary school students taught mathematics using kinesthetic learning in Bekwarra Local Government Area of Cross River State, Nigeria.

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Discussion of Findings

The study investigates the Effect of Kinesthetic Learning on Interest and Achievement in Junior Secondary School Students in Bekwarra Local Government Area of Cross River State, Nigeria. The analysis on research question one reveals that kinesthetic learning increases the interest in mathematics in junior secondary school students in Bekwarra Local Government Area of Cross River State, Nigeria. The finding revealed that with kinesthetic learning, students can easily gain interest in learning endeavours, especially learning mathematics irrespective of the anxiety or attitude of the learner towards the subject as experienced while using conventional teaching method (as shown in Table 1). To further prove this claim, the result in table 6 of ANCOVA indicates that there is a significant difference on the interest of students taught mathematics using kinesthetic learning and those thought using conventional method [$F(1, 98) = 44.703$ and $p = 0.000$]. This finding is in connection with Awa and Onwioduoki (2019) who investigated on the effect of kinesthetic activities on mathematics interest of junior secondary school students in Akwa Ibom, Nigeria. One of the conclusions of the researchers was that kinesthetic learning is effective in enhancing the interest of secondary school students. To further affirm this statistical fact, the study of Agwagah *et al* (2020) explained that incorporating physical activity, movement and hands-on experience into teaching and learning help to increase the interest of learners who may struggle with traditional teaching method. Hamdan and Al-Jubouri (2017) in their study posits that kinesthetic learning improves students' interest level as well as their motivation to learn and participate actively in science classes. This implies that by incorporating physical movement, hands-on activities and play-way method into learning process, kinesthetic learning taps into different learning modalities and creates an interactive and engaging learning environment thereby increasing the interest of students in learning.

The result in Table 2 (research question two analysis) reveals that students in Bekwarra Local Government Area have high academic achievement in mathematics when exposed to kinesthetic learning style. The finding revealed that one of the reasons for poor academic performance in mathematics is attributed to lack of appropriate teaching and learning method, this is seen in students who were taught mathematics using kinesthetic learning (student-centered method) having higher scores in the post-test than the students taught using conventional lecture method (teacher centered method). This claim was statistically proven in Table 6 of ANCOVA result, where $F(1, 98) = 21.497$ and $p = 0.000$ that affirmed that there is a significant difference on achievement of junior secondary school students taught mathematics using kinesthetic learning and those taught using conventional learning. This finding links with Adetunji and Oladele (2020) who affirmed that incorporating kinesthetic learning, physical activities and movements into teaching can improve student engagement and comprehension. Olorunsola (2018) carried out a six-week study on academic achievement of students using kinesthetic and found out that the experimental group had a higher a higher mean score. Miltenoff and Spence (2017) added that both male and female students demonstrate high achievement in mathematics when exposed to kinesthetic learning and that it provides a more engaging and interactive environment, which can promote better understanding and application of mathematical concepts among the students. Thus,

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kinesthetic learning affects students' abilities to retain and retrieve key information from their learning thereby leading to a better performance in mathematics. Therefore, with kinesthetic learning it is possible for a student to set a high achievement in mathematics as an objective and achieve it irrespective of the anxiety or fear that is seemingly stereotypical with the subject.

The result in Table 3 showed that both male and female students have high interest in mathematics when exposed to kinesthetic learning. However, the interest of male students is slightly higher than the females. The finding revealed that while male students have a higher preference in mathematics using kinesthetic learning, both genders can greatly benefit from this teaching and learning style. The ANCOVA result in Table 7 further affirmed this assertion with F (1, 47) = 0.050 and p-value of 0.824 greater than α - value of 0.05 that there is no significant difference on interest of male and female junior secondary school students taught mathematics using kinesthetic learning. This result is in line with Guan *et al* (2018), Evans and Williams (2016) who examined the effects of kinesthetic learning on students' interests and achievement in mathematics. The findings of the researchers indicated that both male and female students exhibited increased interest in mathematics and reported a more positive attitude toward the subject after engaging in kinesthetic learning. However, this finding varies with that of Valizedeth *et al* (2019) who found out that the effect of kinesthetic learning on interest was more significant for female students compared to male students. It can therefore be suggested that with the high preference of male students on kinesthetic learning, the learning style can also contribute to building confidence and positive beliefs on the abilities of female students.

The result in Table 4 showed that both male and female students have high achievement when taught mathematics using kinesthetic learning, although the male had a higher mean achievement score than the female students. To further prove this claim, the ANCOVA result in Table 8 indicates that there is no significant difference on the achievement of male and female students taught mathematics using kinesthetic learning in Bekwarra Local Government Area, Cross River State, Nigeria. This finding is in connection with Ofoegbu and Amadi (2019) who affirmed that kinesthetic learning activities have great improvements in academic achievement and motivation of both male and female students but there exists a greater achievement on the males compared to the females. The finding in this study also corroborates with that of Else-Quest, *et al* (2010) and Frenzel, *et al* (2010) who remarked that female interest in Mathematics is markedly lower than Male students' interest. The improved academic performance of both male and female in this present finding can be attributed to the multisensory nature of kinesthetic learning, which allows students to actively explore mathematical concepts and reinforce their understanding through physical experiences.

CONCLUSION

Based on the study, the following conclusions are drawn:

a. Kinesthetic learning has positive effect on interest and achievement in mathematics of junior secondary school students in Bekwarra Local Government Area of Cross River State, Nigeria.

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b. Kinesthetic learning is key in improving the interest and achievement in mathematics of male and female students especially the females.
c. Gender is not the sole determinant of good academic performance or interest in mathematics but teaching method.

Recommendations

Based on the findings of this research work the following recommendations are hereby made in other to enhance the teaching and learning of mathematics in junior secondary schools.

a. Mathematics teachers in Cross River State should adopt kinesthetic learning or play way method in teaching because of its relevance in improving learners' interest and achievement.
b. State Secondary School Education Board is encouraged to promote the campaign of the need to improve the interest and achievement of students by organizing workshops, conferences, seminars and symposia for serving teachers to educate them on the place of modern teaching approaches like kinesthetic learning in Mathematics in secondary schools.
c. There should be review of curriculum to make it compulsory for all mathematics teachers at junior secondary school level to employ the use of learner-centred teaching methods such as kinesthetic learning in teaching and learning of mathematics.
d. Teachers and school administrators should be encouraged by the government in providing the necessary equipment and materials to aid the use of kinesthetic learning in the classroom.

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