

Effects of Ethnomathematics Instructional Approach on Students' Achievement and Interest in Mathematics

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Abstract

The study investigated the effects of Ethnomathematics Instructional Approach (EIA) on students' achievement and interest in Mathematics. Two research questions guided the study and two hypotheses were tested at 0.05 level of significance. The study employed a quasi-experimental research design specifically, the pretest posttest nonequivalent control group design. A sample of 100 senior secondary school one (SS1) students from two intact classes randomly selected from a population of 4,254 was involved in the study. The instruments used for data collection were Mathematics Achievement Test (MAT) and Mathematics Interest Inventory (MII). The internal consistencies of the instruments were established using Kuder Richardson Formula 20 for MAT and Cronbach Alpha statistics for MII which were found to be 0.82 and 0.72 respectively. Mean and standard deviation were used to answer the research questions while the Analysis of Covariance (ANCOVA) was used to test the hypotheses. The findings revealed that the students exposed to EIA showed superiority in their achievement and are better off in their interest in mathematics than those exposed to CLM. Also, there was a significant difference in the achievement and interest of students in mathematics when taught using EIA and CLM. Based on the findings, the study recommended that EIA should be used by mathematics teachers in teaching the students as it will help to enhance their achievement and interest in mathematics.

Introduction

Mathematics is one of the compulsory subjects that students must offer in senior secondary school not minding whether such students are in Science, Commercial, Arts or Social Science class. The inclusion of mathematics as a core and compulsory subject in the secondary school curriculum is due to the key roles it plays in achievement of the objectives of secondary school education. Tuge (2008) states that mathematics is a part of human cultural heritage which has to be developed because it provides foundational knowledge and skills to chemistry, art, physics, biology and economics. It is a science that studies numbers, shapes, objects and their properties which are needed as basic requirement for all sciences (Alamina, 2009). The high rate of failure of students in mathematics at secondary school level is no news in the global setting. The recurrent poor performance of secondary school students in Senior School Certificate Examination (SSCE) conducted by West African Examination Council (WAEC) in Nigeria is disturbing and embarrassing. For instance, the results released by WAEC in 2014 revealed that about 68.72% of the candidates who sat for the examination did not obtain credit level pass in mathematics. Similarly, in the year 2015 only 38.68% of the candidates who sat for SSCE passed at credit level while 61.32% of the candidates failed to obtain credit in mathematics. (Source: West African Examination Council annual report 2014-2015).

The failures recorded in mathematics can be attributed to the conventional instructional approach to mathematics which is based on European culture. The inability of students to comprehend the mathematical processes in the conventional teaching approach, results in their attempts to memorize the concepts and procedures taught rather than seek for their proper understanding and interpretations. This method of teaching mathematics in Nigeria is foreign as it does not have

Nigerian cultural bearing but rooted in the British culture (Ozioko as cited in Kurumeh, 2004). To provide solution to the problem of poor performance, Abiam, Abonyi, Ugama and Okafor (2016) and Kurumeh (2004) recommended that method of teaching mathematics should be practical, applicable and project oriented to reflect the immediate cultural environment of the learner. This will help the education system achieve the national objectives of inculcating the right type of values and attitudes for the survival of the individual, the training of the mind, abilities and competences and so on as required for the individual to live and contribute meaningfully to the growth and development of the society.

To achieve these objectives, Adam (2014), Adeneye and Adeleye (2011) and Kurumeh (2004) recommended ethnomathematics instructional approach for teaching and learning of mathematics in secondary schools. Abiodun and Nchelem (2015) interpreted this to imply that for ethnomathematics to be integrated into the mathematics instructions, the new instruction will have to be enriched with practical activities in the students' culture. Ethnomathematics instructional approach deals with the mathematics developed and used by different cultural groups across the world from ancient to modern times. Davison (2000) posited that Ethnomathematics is the art or technique of explaining, knowing and understanding diverse cultural contexts. Ethnomathematics is seen as the culturally influenced mathematical approach which makes the learning of mathematics practical, learner-oriented, active and applicable to the local environment.

Nchelem and Abiodun (2015) posited that the integration of ethnomathematics into the present mathematics curriculum focuses on the curricular that have the potential for facilitating self-employment or good skills in the new Nigerian society. In this present Nigerian setting where unemployment is a major prevalence; there is an urgent need to integrate ethnomathematical programme and approach into the existing mathematics curriculum to cater for the needs of students who will forge ahead with their education and those who will go into vocations and skill acquisitions. For mathematical achievement of students to be improved, there is need for a pragmatic approach which could help develop a learner in cognitive, affective and psychomotor domains which may not be achieved when the same learner is taught in a conventional way. For instance, when a teacher uses the part of an egg shell to teach the students about cone, she uses it show them the vertex, curved surface and the circular base. Also, the use of bamboo the demonstrate a cylinder, the teacher uses bamboo to show students the circular top, circular base, curved surface of a cylinder will enhance their understanding of the subject hence improve the students' achievement in mathematics.

Interest is an aspect of learning prerequisites which determine the extent to which concentration and attention is maintained towards teaching and learning encounter. In the words of Renninger (2000) 'individual interest is a relatively enduring predisposition to attend to certain objects and events and to engage in certain activities. This predisposition is triggered of by the positive feeling and perception of the activities as being appealing to the learner. There seems to be positive relationship between such comfortable feelings and learning. Renninger (2000) argued that the enduring predisposition is associated with a psychological state of positive effect and persistence and tends to result in increased learning. Therefore, ethnomathematics approach to mathematics instruction could be a possible alternative towards reigniting students' interest in mathematics. Nwaocha (2010) lamented that there exists alarming statistics in mathematics education in Nigeria indicated that very few or almost none of the students in high school fancy taking up a course in mathematics in the University. This, he attributed to cultural and racial

prejudice as well as poverty which are considered as serious issues confronting many of today's secondary school students in Nigeria. Therefore, ethnomathematics approach to mathematics instruction could be a possible alternative towards reigniting students' interest in mathematics. This is because it is culturally friendly to the local environment.

In this study, ethnomathematical instructional approach is the use of familiar daily activities in the immediate environment of a learner in teaching him mathematics. This study seeks to investigate on how best to teach mathematics as against the present way of teaching it for the improvement of academic achievement and interest in mathematics thereby integrating ethnomathematical instructional approach into the Nigerian classroom instruction.

Statement of the Problem

Mathematics is an important subject in advancing the knowledge of science and technology. This is because all the activities of learning revolve around it. Mathematics is regarded as the mother of science because it cuts across all aspect of science, human activities and learning. Mathematics as important subject as it is, should attract the interest of the students and should be one of the school subjects that should witness high positive achievement from. Over the years there is evidence from research that students interest in mathematics is very low, which has resulted into poor achievement in the subject. Most secondary school teachers have admitted that they find it difficult to capture the interest of majority of students in mathematics learning experience. These issues maybe as a result of inappropriate use of teaching methods that will not enable them elicit the needed interest from the students and sustain it all through the learning period.

Mathematics learning experience and teaching method that will enhance the interest of the students should be one that will enable them to transfer their classroom experience to solve real life problems. As difficult as concept in mathematics may seem to students, once the knowledge is relevant to their day to day activities, their interest in mathematics will be highly improved. As a result of this, it is anticipated that instructional methods that will involve indigenous practices will help boost the achievement and interest of students.

The problem of this study therefore is the lack of interest and poor achievement of students in mathematics. This call for a need to search for teaching methods which will integrate aspect of indigenous mathematics practices into classroom learning experience which will encourage transfer of knowledge from the classroom to life experiences, aimed at helping the students improve on their interest in mathematics and consequently better their performance in the subject. The study is therefore designed to find out the effects of ethnomathematics instructional approach on achievement and interest of secondary school students in mathematics.

The study examined the effects of ethnomathematics instructional approach on secondary school students' achievement and interest in mathematics in Onitsha North LGA of Anambra State.

Research Questions

The study was guided by the following research questions:

1. What is the difference in mean achievement scores of students taught mathematics using Ethnomathematics Instructional Approach (EIA) and those taught using Conventional Lecture Method (CLM)?
2. What is the difference in mean interest scores of students taught mathematics using EIA and those taught using CLM?

Hypotheses

The following null hypotheses were formulated to guide the study which was tested at 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of students taught mathematics using Ethnomathematics Instructional Approach (EIA) and those taught using Conventional Lecture Method (CLM).
2. There is no significant difference between the mean interest scores of students taught mathematics using EIA and those taught using CLM.

Method

This study adopted a quasi-experimental pre-test post-test, non-randomized control group design. The reason for adopting this design was that the researchers found it difficult to randomize every subject (Ezeh, 2005). Intact classes were therefore used. The population of the study consist of 4,254 SS1 mathematics students from 16 government owned schools in Onitsha North L.G.A of Anambra State. Seven (7) co-educational schools were drawn from the 16 schools. Using simple random sampling, two (2) co-educational schools were selected from the seven (7) co-educational schools and by the flip of a coin one school was randomly assigned to experimental school and one school was assigned to control school. In each of the selected school, one intact class was randomly assigned to experimental group and control group respectively. The experimental group consists of 53 (29 males and 24 females) students while the control group consists of 47 (25 males and 22 females) students, hence constituting the sample size of 100 students.

The instruments used for data collection are Mathematics Achievement Test (MAT) and Mathematics Interest Inventory (MII). The MAT was compiled by the researchers using past WAEC questions. This was composed based on the topics that were taught during the period of the research. The topics are mensuration of solid shapes and set theory. Test blue print was constructed to reflect the questions from different contents in the selected topics. The items in MAT were structured to cover the lower order level (knowledge, comprehension, application and analysis levels). Mathematics Interest Inventory (MII) adapted from Okigbo (2010) consisting of twenty (20) items was used obtain data on students' interest before and after the treatment. MAT and MII were validated by three experts and has a reliability coefficient of 0.82 and 0.72 which were determined by the use of Kuder Richardson Formular20 (KR-20) and Cronbach Alpha respectively. Mean and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Experimental Procedure

Mathematics Achievement Test (MAT) and Mathematics Interest Inventory (MII) were used for data collection. MAT was administered to the students in both the experimental and control groups as pretest and posttest. MII was also administered during the pretest and posttest to identify the students' interest in the selected topics taught by the researchers. The experimental group was taught using Ethnomathematics Instructional Approach (EIA) by their teacher using the prepared lesson plan developed by the researchers while the control group was taught by Conventional Lecture Method (CLM). The experiment lasted for six weeks. The first week was used for pre-test and training of research assistants. The teaching lasted for four weeks and the sixth week was used for the posttest. The students in the experimental and control groups were taught the same concepts in Mathematics. The Mathematics concepts are measurement of solid shapes and sets.

Results**Table 1: Difference between the Mean Achievement Scores of Students Taught Mathematics using EIA and CLM**

Group	N	Pretest		Posttest		Gain in Mean
		\bar{x}	SD	\bar{x}	SD	
EIA	53	45.70	14.14	62.23	14.92	16.53
CLM	47	37.13	16.36	46.53	16.10	9.40
Mean Diff		8.57		15.7		7.13

Table 1 shows various means on achievement for students taught mathematics using Ethnomathematics Instructional Approach and those taught with conventional lecture method. From the table, the mean difference between the EIA and CLM groups revealed that the pretest mean difference scores of students in achievement is 8.57 while the posttest mean difference scores of students in achievement is 15.7

Table 2: Difference between the Mean Interest Scores of Students Taught Mathematics using EIA And CLM

Group	N	Pre-test		Posttest		Gain in Mean
		\bar{x}	SD	\bar{x}	SD	
EIA	53	53.17	17.17	68.85	17.22	15.68
CLM	47	45.34	17.47	52.55	16.12	7.21
Mean Diff		7.83		16.30		8.47

Table 2 is the various mean on interest scores of students exposed to EIA and CLM. The mean of 53.17 and 68.85 were obtained as pre-interest and post-interest mean respectively for EIA group, while pre-interest mean of 45.34 and post-interest mean 52.55 were obtained for CLM group. The difference in the mean interest scores between the EIA and CLM group is 8.47. The gain in mean of 15.68 and 7.21 were obtained for EIA and CLM respectively. From the gains in mean obtained, EIA was effective in improving the interest of students exposed to it than CLM on the students exposed to it.

Table 3: Analysis of Coveriance (ANCOVA) on Achievement Scores of Students Taught Mathematics using EIA And Those Taught using CLM

Dependent Variable: posttest

Source	Type III sum of square	Df	Mean of square	F	p-value
Corrected model	25078.93 ^a	2	12539.47	267.34	.000
Intercept	3204.15	1	3204.15	68.31	.000
Pretest	18943.17	1	18943.17	403.86	.000
Method	1426.76	1	1426.76	30.42	.000
Error	4549.82	97	46.91		
Total	330481	100			
Corrected total	29628.75	99			

Table 3 shows that there is a significant difference between the mean achievement scores of students taught mathematics using EIA and those taught using CLM with $F = 30.42$, $P = 0.000 < \alpha = 0.05$. The null hypothesis that there is no significant difference between the mean achievement scores of students taught mathematics using EIA and those taught using CLM is

rejected. There is a significant difference between mean achievement scores of the students which favoured EIA group.

Table 4: Analysis of Covariance (ANCOVA) on interest Scores of Students Taught Mathematics using EIA And Those Taught using CLM

Dependent Variable: post-interest

Source	Type III sum of square	Df	Mean of square	F	P-value
Corrected model	28455.67 ^a	2	14227.84	24.94	.000
Intercept	3583.53	1	3583.53	62.95	.000
Pre-interest	21840.69	1	21840.69	383.68	.000
Method	2156.64	1	2156.64	37.89	.000
Error	5521.72	97	56.93		
Total	408399	100			
Corrected total	33977.39	99			

Table 4 shows the significant difference between the mean interest scores of students exposed to mathematics using EIA and CLM. From the table, $F = 37.89$, $P = .000 < \alpha = 0.05$ shows that there is a significant difference between the mean interest scores of students taught mathematics using EIA and those taught with CLM in favour of EIA group. As a result of this, the null hypothesis that there is no significant difference between the mean interest scores of students taught mathematics using EIA and those taught using CLM is rejected.

Discussion

The results of the study revealed that the students exposed to EIA showed superiority in their achievement in mathematics over those taught with CLM. Their superiority in achievement was significant based on the result of the study. The effectiveness of EIA can be attributed to the fact that EIA used materials that students are conversant with in their daily activities and relate it in solving problems for the students within the classroom environment. The findings of this study is in line with that of Abiam, Abonyi, Ugama and Okafor (2016) that ethnomathematics based instructional approach is superior to conventional method in fostering pupil's achievement in geometry.

The effect of the method of teaching on interest of the students was also examined by this study. It was found out that students taught using Ethnomathematics Instructional Approach (EIA) showed higher interest in mathematics than those taught with CLM. The difference in mean interest scores was significant showing that EIA was effective in increasing the interest of the students. It is important to note that when students are taught with materials and method that are indigenous to them, it enhances their level of interest which brings about creativity and curiosity that sustain their ability to achieve their learning goals. There was an enhanced interest from the students taught with EIA which was intrinsically sustained all through the teaching and learning process. Unodiaku (2013) opined that ethnomathematics teaching method, is such method that students will find quite reinforcing and interesting to use and will hopefully increase their participation and wipe out their phobia in mathematics learning. Also, Davison (2000) asserted that the interaction of native culture and mathematics ideas can be mutually reinforcing. As a result, the application of native culture situations to the mathematics classroom helps the students to see the connection between mathematics and culture thereby enhances their interest and achievement. The works of Abiam (2006), Kurumeh (2006) and Abiodun & Nchelem (2015) showed that ethnomathematics instructional approach was effective in increasing the interest of the students in mathematics and this is in agreement with the findings of this study.

Conclusion

The findings of this study have shown that EIA was effective in the improvement of achievement of students in mathematics. Also, the use of EIA was significant in improving the interest of the students in mathematics. It is therefore pertinent to say, that EIA is a significant approach of teaching and its benefit in contributing to achievement and interest of students in mathematics outweighs that of CLM. By implication, when this approach is properly implemented in the teaching and learning of mathematics, students will be more active in class and the issue of poor achievement witnessed in mathematics examinations will be greatly reduced. Again, Mathematics phobia which is associated with lack of interest that students face while learning the subject will be reduced.

Recommendations

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

1. Ethnomathematics Instructional Approach should be used by mathematics teachers to teach students the subject as this will ensure that their achievement and interest are enhanced.
2. Book publishers should write books based on Nigeria setting, and make sure that their illustrations and examples put into consideration the cultural knowledge rather than use foreign setting to write their books in mathematics.

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