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Ethnomathematics and Academic Performance of Senior Secondary Students in Mathematics in Rivers State, Nigeria

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ABSTRACT

The study investigated ethnomathematics and academic performance of senior secondary students in mathematics in Rivers State Nigeria. Two thousand four hundred and eleven(2411)senior secondary two (SS2) mathematics students in twenty-one (21) co-educational public secondary schools in EmohuaLocal Government Area of Rivers State Nigeria served as the populations of this study. Two of these schools with a sample of 138 mathematics students were randomly assigned experimental condition (n=72) and control condition (n=66); their intact classes were utilized. The study utilizeda non-randomized pretest, post-test quasi-experimental research design. The research instrument for data collection was Mathematics Performance Test (MPT). MPT reliability was ascertained using Pearson Product Moment Correlation, r=0.78 was obtained. Mean scores and standard deviation were used to answer the research questions whereas Analysis of Covariance (ANCOVA) was used to test for significance of the null hypotheses at 0.05 alpha level. The result showed that the ethnomathematics method of instruction was more effective than the problem-solving method in facilitating students understanding of mathematics, gender had no effect statistically. The study recommended, among others that mathematics teachers should employ the ethnomathematics method of instruction during mathematics instructions.

KEYWORDS: *Ethnomathematics, Performance, Students*

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INTRODUCTION

Mathematics is a global subject that anchors an unavoidable role in the study of measurement, relationships and properties of quantities and sets. This is in line with Microsoft Encarta (2007) notion that mathematical studies deal with numbers relationships, shapes and quantities. Subsuming geometry and arithmetic, mathematics deals with scientific observations with inferences, deductions and proofs with mathematical models of natural phenomena of humans' and social systems. As an activity-oriented profession, mathematics is a science of pattern and order.

As a scientific subject of abstractions, mathematics dwells on logic instead of observation when pursuing its result correctness but utilizes simulation, practicals and observation as a path of achieving result correctness. Life by every individual is mathematically operated like scientific knowledge discovery about light, earth movements in geography, chemicals in chemistry, economics and sociology in social science, through proper mathematical knowledge applications. Beck (2008) posited that mathematics at large is a critical and necessary tool of a well-rounded education.

Ekwueme (2013) maintained that mathematics could be useful in the following areas:

- office and policymaking.
- creativity and peoples mind preparation.
- helps engineers, scientists, technologists in comprehending their various areas of speciality for building nations.
- as problem-solving measure and in character nourishment by active involvement personal success, opportunities for stimulating curiosity.
- creation of a favourable foundation for abstract thinking development as well as problem recognition capacity enhancement with its related resolution ideology.

These emphases reveal areas where mathematics can be applied that aid both human and societal development which is the pursuit of growing and advanced nations. This is to say that problem solvers mathematical application depends totally on their knowledge of mathematical operations principles and their concepts.

It is evident that the pervasive role of mathematics in societal development is attained through thorough mathematics instruction, whose success is determined through the learners' academic performance. Academic performance according to Maryam and James (2014) generally refers to students' ability to study and accomplish a given task. Regrettably, students academic performance across the senior secondary schools in science-oriented subjects especially mathematics has remained poor (Salan 2000). For example, mathematics students' results in West African Senior Secondary Certificate Examination (WASSCE) 2013, 2014, 2015, 2016, 2017, 2018 with corresponding percentage credit level and above as 36.00%, 31.30%, 38.68%, 52.97%, 59.22% and 49.98% whose average percentage credit level for these six years is 44.17% indicating below-average percentage credit level and above of students performance.

These results were generated from the existing teaching methods, the traditional teaching methods where the teacher do the talking as students listen and copy notes. Ogunkunle (2007) stated that mathematics teaching dwells in talk and chalk syndrome at the secondary school stage. This instructional style disconnects the connection of classroom mathematics and real-life applications where students are not developed mathematically to solve cultural base problems. Sidhu (2006) opined that this coerces mathematical meaningful learning. This triggers the routine negative perception of mathematical concepts to be difficult. Mathematics in its application is pragmatic but encapsulated in abstraction as a subject matter. This connotes that mathematics instruction lies squarely on European structure, contents and as well algorithm. Its reverse remains that western educational practise as enforced in their colonies did not include their cultures and general views of the people. This resulted ina Eurocentric curricula pattern, which has projected mathematics to be western culture-oriented as against indigenous cultures. Bocher (1966) in Ogunkunle and George (2015), however, observed that before 1600 AD there was Greek mathematics, Indian mathematics, as well as Chinese mathematics. Bocher might have observed that there is African mathematics if the study had been furthered. Since no culture can survive without mathematical operations, every society irrespective of its civilization level exist among mathematical activities that assist its citizens in solving life problems. This indigenous cultural base mathematics is an area of interest in mathematics for scholars to research in, and to resolve its inclusion during mathematical studies as to enhance students performance academically, so that mathematics will be seen as learners' culture-oriented and not foreign. This suggests why D'Ambrosio (1977) in Okpobiri (2005) propounded ethnomathematics and its utility in enhancing students' mathematics achievement.

Ethnomathematics is a studying style that takes cognisance of cultural inherence where mathematics is in existence (Kurumeh, 2006). Rosa and Orey (2011) posited that one of the aims of ethnomathematics exercise is to show that traditional environments loaded with their cultural inherent is full of mathematical activities. This corroborates the fact that various economies develop a mathematical ideology that helps to cope with reality on ground with the aid of various instruments from a culture like measuring instruments, segmentation, quantification, inference and modelling. Ogunkunle and George (2015) defined ethnomathematics as a branch of academics that studies mathematical ideas (knowledge), activities and practice which can be seen in a socio-cultural context. This signifies that ethnomathematics deals with the cultural merger to the study of mathematics. The re-occurring record of poor performance in mathematics requires immediate attention ifa country like Nigeria must succeed scientifically and technologically considering the practical nature of the mathematical field of study, the inclusion of environmental aid with inherited cultures such as ethnomathematical practice is essential. However, this study investigated the ethnomathematics and academic performance of senior secondary students in mathematics in Rivers State, Nigeria. Ethnomathematics method of instruction (EMOI) maintains the utilization of learners' immediate and familiar environment to teach the learner mathematics. The Ethnomathematics method of instruction transforms foreign (Euro-centric) mathematical concepts more suitable to the learner's environment and background of the learner towards enhancing mathematical learning. Of particular benefit, it is a practically oriented method. The study employed the reach cultural environment of secondary school students in Emohua Local Government Area of Rivers State Nigeriain enhancing academic performance in every mathematics assessment and general competence that will enable students to be absorbed in mathematics-related opportunities after educational career.

Statement of the Problem

Mathematics as a science of quantities and numbers is rooted in culturally free teaching method, mostly method of teaching evolving within chalk and talk method (Ogunkunle, 2007). This cultural free teaching method has infused a re-occurring scenario of poor performance of senior secondary students in various mathematical assessments. One imagines why these various methods utilised so far are unable to change this continuous poor performance trend.

Scholars affirmed that consistent bonds exeunt between mathematics and culture in the learning process of mathematics. A concept that mitigates mathematics and culture through the use of students' subjected surroundings, (ethnomathematics). This ethnomathematics method of teaching has attracted serious concern by scholars to see if it could reverse the poor performance syndrome of students in mathematics. It is then needful to ascertain whether the ethnomathematics method of teaching mathematics can change the trend of poor academic performance by the students.

Aim and Objectives of the study

The study aimed at investigating ethnomathematics andacademic performance of senior secondary students.

The objectives of this study include;

1. Ascertain if any difference exists in the academic performance mean score of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using problem-solving method (PSM).
2. Analyse gender effect on the mean score performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI).

Research questions

The research questions for this study were;

1. What is the difference in academic performance mean score of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using problem-solving method (PSM)?
2. What is the effect of gender on the mean score performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI)?

Hypotheses

Ho_1: There is no significant difference in mean score performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using problem-solving method (PSM).

Ho_2: There is no significant difference in male and female senior secondary students mean score performance taught mathematics using ethnomathematics method of instruction (EMOI).

Methodology

The study design wasa 'quasi-experimental non-randomized pre-test, post-test, control research design'. Experiment (treatment) was carried out on the students by the researcher with the help of the two schools mathematics teachers trained by the researcher. Two intact classes (namely; one experimental group and one control group) were utilised for this study. The experimental group was treated by the ethnomathematics method of instruction (EMOI) during mathematics instruction via demonstration/discussion while the control group was treated by a non-ethnomathematics method of instruction (Conventional Problem solving method (PSM)).

The study was executed in Emohua Local Government Area, which is part of the twenty-three (23) local government area in Rivers State inthe South-South geopolitical zone in Nigeria. The population of this study include 2411 senior secondary two (SS2) mathematics students in twenty-one(21) co-educational public senior secondary schools in Emohua Local Government Area of Rivers State Nigeria. Two intact classes made of the experimental and control group in two(2) of these schools namely Community Secondary School (CSS)Rumuji and Odegu Community Secondary School (OCSS) Rumuewhorwere used and 138 senior secondary two (SS2) mathematics students (i.e., 72 for the experimental group and 66 for the control group) served as the sample size of this study. These were achieved utilising a simple random sampling technique. ''Mathematics Performance Test" (MPT) is the researchers developed instrument used for the study.

MPT is the performance test instrument that was used for pre-test, and post-test for the study. MPT contained 50 multiple-choice item questions with four options lettered A to D for senior secondary two (SS2) students. Each test item was allotted 2 marks and this gave a total of hundred (100) marks for the 50 item test. The content of MPT was derived from five mathematical concepts (Angle, lines, circle geometry, properties of plane shapes, and curved/total surface area of hemisphere) which are related to angular formations in the production of traditional baskets weaving, garri sifter and fish trap. The instrument validation was carried out by three experts

in mathematics education and measurement & evaluation. The experts made professional inputs through thorough assessments, comments, and suggestions in upgrading the instrument both in content and face validation before the instrument was produced for this study. The test-retest method was used to ascertain the stability of the instrument (MPT). To carry out this, twenty (20) senior secondary two (SS2) mathematics students were used. Twenty copies of the ''MPT'' were administered to the SS2 mathematics students in an interval of two weeks and retrieved. The instrument was as well re-administered to the same group of students followed by retrieval, marking and scoring. ''Pearson Product Moment Correlation, (PPMC)'' was used to obtain a stability coefficient of 0.78 of the first and second test scores.

Data collections methods were sequentially carried out in three (3) phases as below;

Pre-treatment Phase: At this phase, the researcher ensured thorough familiarization with the students and immediately pre-test of MPT was administered to the students of (both groups) with the help of a mathematics teacher in each of the schools.

Treatment Phase: At the treatment phase, instructional sessions (ethnomathematics method of instruction for the experimental group and conventional problem-solving method for the control group was carried out). Forty (40) minutes per period of four (4) periods per week for two weeks were used for the treatment phase of the study.

Post Treatment Phase: At the post-treatment phase, a post-test of MPT was given to both the experiment and control group. Mean and standard deviation was used in answering the research questions based on the data collected from the instrument whereas Analysis of covariance **(ANCOVA)** was used for hypotheses **(Ho_1, and H_{02})** test at 0.05 alpha level.

Results

Research Question One: What is the difference in mean scores performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using problem-solving method (PSM).

Table 1: Summary of mean, standard deviation and mean gain scores of senior secondary students' performance in Mathematics taught using EMOI and those taught using PSM.

Method/Strategy	N	Pretest Mean	SD	Posttest Mean	SD	Gain
Ethno mathematics	72	28.61	9.57	61.89	14.75	33.28
Problem-solving method	66	23.39	10.29	45.21	10.98	21.82

Table 1. showed that the mean gain performance of senior secondary students taught mathematics using the Ethnomathematics method of instruction (EMOI) was 33.28 while the mean gain performance of senior secondary students taught mathematics using the problem-solving method (PSM) was 21.82.

Research Question Two: What is the effect of gender on mean score performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI)?

Table 2: Summary of mean, standard deviation and mean gain scores on the effect of gender on senior secondary students' performance taught Mathematics using EMOI.

Treatment	Gender	N	Pretest Mean	SD	Posttest Mean	SD	Gain
Ethno mathematics	Male	39	29.90	10.72	65.08	15.40	35.18
	Female	33	27.09	7.91	58.12	13.21	31.03

Table 2. displayed that the mean gain performance of male senior secondary students taught mathematics using ethnomathematics was 35.18 while the mean gain performance of female senior secondary students taught mathematics using the Ethnomathematics method of instruction was 31.03.

Hypotheses

$H0_1$: There is no significant difference in mean scores performance of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using problem-solving method (PSM).

$H0_2$: There is no significant difference in mean score performance of male and female senior secondary students taught mathematics using ethnomathematics method of instruction (PSM).

Data Analysis/test of Hypotheses

Table 3: Summary of ANCOVA on the difference in the performance of senior secondary students in Mathematics based on Treatment and Gender

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	23573.270[a]	4	5893.318	84.302	P<.05
Intercept	13021.993	1	13021.993	186.275	P<.05
Pretest	13116.687	1	13116.687	187.629	P<.05
Treatment	4113.510	1	4113.510	58.842	P<.05
Gender	177.024	1	177.024	2.532	P>.05
Error	9297.686	133	69.907		
Total	433984.000	138			
Corrected Total	32870.957	137			

Table 3 unveiled that there is a significant difference in the performance mean scores of senior secondary students taught mathematics using ethnomathematics method of instruction and those taught using problem-solving method F(1, 133=58.842, p<.05). The null hypothesis one was rejected at .05 alpha level.

More so the result from Table 3 further unveiled that there is no significant difference between the male and female senior secondary students mean performance score taught mathematics using ethnomathematics method of instruction F(1, 133=2.532, p>.05). The null hypothesis two was not rejected at 0.05 alpha level.

Discussion

The result from Table 1 revealed that the mean gain performance of senior secondary students taught mathematics using the ethnomathematics method of instruction (EMOI) was higher than those taught mathematics using the problem-solving method (PSM). When put to the statistical test, the ANCOVA result on Table 3 unveileda significant difference in the mean performance scores of senior secondary students taught mathematics using ethnomathematics method of instruction (EMOI) and those taught using the problem-solving method (PSM). The null hypothesis one ($\mathbf{H_{01}}$) was rejected at .05 significance levels. The present finding was consistent with earlier findings by Odili and Okpobiri (2011) on ethnomathematics resources for teaching mathematics in Ikwerreprimary school which unveiled that there is a significant difference in the learning achievement of pupils in the two groups which was in favour of the experimental group.

The result in Table 2 showed that male senior secondary students who taught mathematics using the ethnomathematics method of instruction (EMOI) had a higher mean gain in learning when compared to their female counterparts. However, when put to statistical test, the ANCOVA result in Table 3 showed that there is no significant difference in mean performance scores of male and female senior secondary students taught mathematics using the ethnomathematics method of instruction. The present finding was consistent with an earlier finding by Ezeamenyi (2002) on the effect of games on ethnomathematical achievement, interest and retention which established that male students benefited more using games than their female counterparts.

Recommendations

The recommendations made based on the findings of this study include;

1. Mathematics teachers' during mathematics instruction should look out and utilise ethnomathematical materials/activities within the culture of the learners' to ensure the proper delivery of mathematical concepts to enhance learners' performance.
2. Students should be subjected to consistent utilisation of ethnomathematical operations within their culture in carrying out mathematical tasks.
3. Mathematics teachers should take cognisance of gender disparity during the teaching and learning of mathematics and ensure that proper attention is given to the female students to ensure the enhancement of their performance during mathematics instruction.

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