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# EFFECT OF ETHNOMATHEMATICS TEACHING STRATEGY ON ACADEMIC PERFORMANCE IN SOLID MENSURATION AMONG SENIOR SECONDARY STUDENTS

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## ABSTRACT

*The study investigated effect of ethnomathematics teaching strategy on academic performance in solid mensuration among senior secondary students in Katsina Zonal Education Quality Assurance, Katsina State. The research has two specific objectives, two research questions which were answered using descriptive statistic of mean and standard deviation. Two null hypotheses were formulated to guide the study were tested using t-test independent at 0.05 level of significance. The study adopted a quasi-experimental design of the pre-test post-test control group type. A sample size of 125 students were drawn from the target population of 17006 students using cluster and simple random sampling techniques. Intact classes from two schools were used for both the experimental and control groups. The experimental group with 50 students (27male, 23 female) were taught using the ethnomathematics teaching strategy while control group with 75 students (40 male, 35 female) were taught using lecture method. The instrument used for collection of data, the Solid Mensuration Performance Test (SMPT), was validated by experts and a reliability co-efficient of 0.74 was found. The findings of the study showed a significant difference between the mean academic performance scores of students taught Solid Mensuration using Ethnomathematics and those taught using lecture method. The result also revealed there was no significance difference between the mean performance scores of the male and female students taught Solid Mensuration using Ethnomathematics teaching strategy. The study recommends that authors of mathematics textbook should generally reflect the background of a typical Nigerian society and make sure that their illustrations and examples put into consideration the cultural knowledge rather than to use foreign setting to write their books in mathematics and also*

*mathematics teachers should look out and utilize Ethnomathematical materials and activities within the culture of the learner to ensure proper delivery of the mathematical concepts to enhance learners' performance. It was suggested by the researchers that there is need for other researchers to carry out their research in other levels of students and other areas of mathematics.*

**Keywords:** Ethnomathematics Teaching Strategy, Geometry, Solid Mensuration, Academic Performance

## Introduction

Students of today are growing up in a world permeated by mathematics. The technologies used in homes, schools and work places are all built on mathematical knowledge. Therefore teaching and learning of mathematics continues to be of high relevance to all school children. Learning mathematics can be successful if various components are considered in the pedagogical aspect including the student's cultural background (Nur et al, 2020). Incorporating the cultural context when teaching allows students to explore mathematics more realistically. Learning mathematics with understanding is the recommended vision for school mathematics (National Council of Teachers of Mathematics (NCTM), 2014).

As the science of structure, order and relation which has evolve from elemental practices of counting, measuring and describing the shapes of objects; mathematics deals with logical reasoning and quantitative calculation; and its development has involved an increasing degree of idealization and abstraction of its subject matter. Hence, its teaching calls for more realistic pedagogical approaches which will enhance students' capacity for understanding and making use of the idealization and abstraction in the subject matter.

However, Febrian and Perdana (2017) observe that, in reality, most students do not easily understand the concept of geometry, not easily understand the concept of Geometry, one of the four branches of mathematics which studies size, shapes, positions, angles and dimension of things. Further, Febrian and Perdana (2017) attribute this lack of understanding of Geometry to the weak practice of teaching it the classroom. Learning geometry helps humans have a complete appreciation of their world (Afgani and Paradesa, 2018) and its exploration can help develop problem-solving skills, it also play a major role in other fields of mathematics coupled with the fact that it's interestingly full of challenges.

To address the cause of lack of understanding of geometry as identified earlier (Febrian and Perdana, 2017), a variety of teaching methods (e,g discovery, expository, laboratory, inquiry method) have been employed in by different research studies (Omere & Ogedengbe, 2022). Despite this, literature and available data revealed that students' performance in Geometry in Nigeria is still very poor. Probably this has been partly due to the lack of inculcation of homemade teaching approaches. There is

need therefore to bring in a method devoid of foreign culture capable of arousing the learners' interests in order to yield a better performance. Towards this end, Ethnomathematics teaching strategy is proposed as a potent strategy.

Ethnomathematics was first introduced in 1978 by D'Ambrosio at the American Association for the Advance of Science (AAAS) annual meeting. D'Ambrosio used the term ethnomathematics to express the connection between culture and mathematics. He thus defined ethnomathematics as mathematics which is practiced among identifiable cultural groups such as national, tribal, societies, labor groups, children of certain age brackets, professional classes and religious tradition. The ethnomathematics approach to teaching of mathematics according to D'Ambrosio, is an approach or technique of teaching mathematics which builds on the students' previous knowledge, background, the role their environments play in terms of content, methods and past and present experience of their immediate environment. There exist in the immediate environment of the students, local aids and examples that teachers can fall back on, in order to make teaching and learning of mathematics more meaningful to them. However this is not being done as most teachers may not even be aware that mathematics content could be communicated to the understanding of the student with the use of local aids with particular reference to improvisation and creativity (Brandt & Chernoff 2015). By incorporating the personal culture of students, teachers will be able to demonstrate and encourage students to value the diversity of their colleagues in the classroom and society. Therefore the use of Ethnomathematics teaching approach possesses the capability of removing abstraction from both teachers and learners perception of mathematics.

This is premised in the logic that students learning outcomes are influenced by student performance, student performance is influenced by teacher performance, and teacher performance is influenced by experience, ability, commitment, infrastructure, and the availability of learning resources (Ya'u, 2018). Academic performance is the knowledge gained which is assigned by marks by a teacher or an educational goals set by students and teachers to be achieved over a specific period of time (Narad & Abdullahi, 2016). This means that performance measures the aspect of behavior that can be observed at a specified period. To determine performance, a performance test is conducted. One effort that has the potential to improve students' performance to make mathematics learning meaningful, in the sense of linking mathematics in the classroom with aspects of students' culture.it is based on this pedestal that this study was initiated and conducted.

Gender issues has continued to be of relevance to pedagogical – based studies designed to enhance performance of students in academic tasks primarily due to the fact that pedagogies must be gender inclusive. Consequently, many studies aimed at determining whether difference in gender has effect on pedagogical practices have been conducted and no definite conclusion in

favour of male or female has been realized. In mathematics for instance, Odo (2012) revealed that male students perform better than females, other studies (Ugwuanyi, 2014 & Kurumeh 2013) found no gender difference in the performance of male and female students; while in some (Onah, 2014 & Omere and Ogedengbe, 2022) found that female students performed better than male students. It therefore becomes necessary that any study, such as the current one, which is designed to investigate the effect of any pedagogical approach should also factor in the investigation of effect of gender on the approach. It is from this perspective that the study will also try to determine whether gender difference of the students will affect their performance after exposure to ethnomathematics teaching strategy. It is in the light of the above that in this study, the effect of ethnomathematics teaching on students' performance in solid mensuration will be investigated.

**Conceptual Framework**

In this study, it is conceptualized that the use of ethnomathematics teaching strategy to teach solid mensuration among senior secondary school students will result in enhanced performance of the students, irrespective of their gender in the content area taught them. This conceptualization is represented in the conceptual framework diagram in Figure 1.

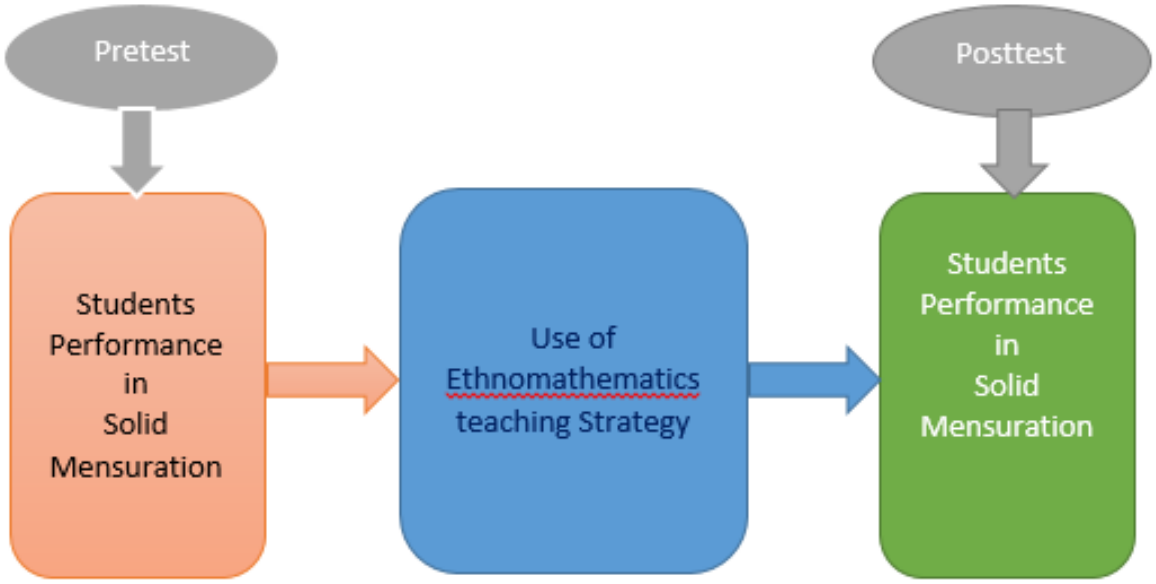



**Figure 1:** Conceptual Framework

**Theoretical Framework**

This study is predicated on two theories, viz: Lev Vygotsky's (1978) Socio-cultural Theory as well as John Dewey's (1916) and Lev Vygotsky's (1979) Constructivist theory. Vygotskys' (1978) socio-cultural theory posits that culture and social interaction plays a significant role in the cognitive development of people. This theory states that "a child learning ability and cognitive development can be guided and mediated by their social interactions". According to Vygostky, during learning children benefit greatly when being guided by a more knowledgeable member of the community. Towards this end, the theory holds that culture plays an important role in shaping learning ability and cognitive development and therefore this development varied across cultures. So, the ethnomathematics teaching strategy is based on this idea as it recognizes that mathematics is not purely an abstract discipline, but rather, it is influenced by the social and cultural context.

The constructivist schools of thought, of both Dewey (1916) and Vygotsky (1978), has great relevance to this study. The theory holds that learning is socially constructed, in which the learner is the key actor (Ornstein & Hunkins, 2017). Just like Dewey (1916), who maintains that knowledge is formed when humans actively interact with their environment, Vygotsky (1978) believes that children's thoughts and actions evolve from interacting with their sociocultural background. Therefore, the constructivist theory is relevant to the ethnomathematics approach, since it emphasizes the role of culture in students' development and learning and the importance of the students' interaction with cultural values and elements in order to acquire knowledge.

**Review of Related Empirical Studies**

There are a number of related empirical studies on the effect of ethnomathematics which has considerable bearing on this study. For instance, Yau (2018) investigated the impact of using ethnomathematics in teaching on performance and retention in mathematics among primary III pupils in Lere education district, Kaduna State, Nigeria. And found that the pupils taught using ethnomathematics teaching performed better than those taught with conventional teaching method. In addition, he (Yau, 2018) found no significant difference between the performance and retention of male and female primary III pupils taught mathematical concepts using ethnomathematics teaching strategy, signifying that ethnomathematics teaching strategy was gender friendly. The study therefore recommended, among others, that mathematics teachers should endeavor to use ethnomathematics in teaching primary III pupils for better performance of mathematical concepts.

In another study, Ozofor and Onos (2018) determined the efficacy of ethnomathematics on senior secondary school students' achievement in mathematics and found that it was more effective in facilitating students' achievement. They (Ozofor and Onos, 2018) also found that both gender benefited significantly in achievement after using the approach.

Omere and Ogedengbe (2022) investigated the effect of Ethnomathematics teaching method on mathematics students'

achievement in Geometry in Akoko Edo Local Government Area, Edo State. The result revealed that Mathematics students' achievement mean scores in Geometry taught with Ethnomathematics was significantly higher than when taught using the conventional method. Unlike in the other studies (Yau, 2017; Ozofor & Onos, 2018), Omere and Ogedengbe (2022) found significant difference based on gender with regards to the teaching method. In particular, the study revealed that female students achieved higher in Geometry when taught with ethnomathematics than their male counterparts.

Milambo and Sakala, (2019) assessed the effect of incorporating Ethno-mathematics strategies on students' achievement in functions among the eleventh grade students of Mpongwe Day Secondary school in Mpongwe District, Copperbelt Province, Zambia. The results showed that students taught functions using ethnomathematics were associated with a significantly higher mean achievement than those taught using other conventional strategies ($t(120) = 5.669$, $p = 0$). However the research findings, revealed that gender was not associated with any statistically significant effect on achievement in ethno-mathematics ( $t(60) = 1.651$, $p = 0.107$).

Sunzuma et al (2021) compared the effectiveness of Ethnomathematics and Traditional Lecture Approaches in Teaching Consumer Arithmetic in one secondary school in Bindura district in Zimbabwe. Findings of the study showed that learners taught using the ethnomathematics approach achieved significantly higher in the test than those taught consumer arithmetic using the traditional approach. The study further revealed that teachers appreciated the use of ethnomathematics approaches in the teaching of consumer arithmetic as their learners were motivated, actively involved and interested in learning the concepts.

From the literature encountered during literature review process in the study, it was discovered that despite the fact many studies have shown that ethnomathematics has great potentials in enhancing students' performance in mathematics, in general and geometry, in particular at both the primary and secondary levels; no study was carried out on the effect of ethnomatics in this location where this study was conducted. Also, the only similar study found to have focused on geometry found gender difference, in favour of females, in the students' performance. This finding needs to be substantiated with similar studies conducted in other location so that a basis for generalization could be provided. Owing to these reasons, the conduct of study could be justified.

**Statement of the Problem**

Most secondary school students in Nigeria view mathematics as problematic because they have great difficulty in understanding, assimilating and retaining its concepts taught to them in the classroom (Ya'u, 2018). This has resulted in poor performance in the subject. Onudiaku, (2013), Kurumeh, (2012) and Abiodun, (2015), observed that persistence low academic performance in mathematics continue to exist. Despite several innovative strategies adopted by the teachers such as discovery, expository, laboratory, inquiry on the use of hands-on

minds-on activities in teaching the subject, the poor academic performance, low retention of the learned concepts persist, as reported by Chief Examiners WAEC (2016, 2017, 2018 and 2019).

Students have great difficulty understanding its abstractness coupled with the fact that it is taught in a foreign language – English. They neither understood the basic computations, logic or fundamental principles nor the underlying processes that gave rise to the mathematical facts. So, they resort to learning by rote memorization, which results in consistent poor performance. This lack of understanding and consistent poor achievement robs students of interest in Mathematics. If the school Mathematics can be established on the foundation that draws upon the type of Mathematics to which the child's local environment exposes him, then there is a reason to believe that he might exhibit performance and retention in Mathematics. The study resort to this home-based and cultural-based strategy called Ethnomathematics teaching strategy since both the teacher and the learner would use familiar materials from their environment and their cultural activities to teach and learn.

## Objectives of the Study

The general objective of this study was to investigate the effect of ethnomathematics teaching strategy on academic performance in solid mensuration among Senior Secondary Students in Katsina Zonal Education Quality Assurance, Katsina State

Specifically, the study was undertaken to:

1. determine the effect of Ethnomathematics teaching strategy on the students' Academic performance in Solid Mensuration in Katsina zonal quality assurance; and
2. find the effect of Ethnomathematics teaching strategy on the Male and Female students' academic performance in Solid Mensuration.

## Research Questions

The following research questions were formulated to guide the research:

1. What is the difference between the mean academic performance scores of the students taught Solid Mensuration using Ethnomathematics teaching strategy and those taught using lecture method?
2. What is the difference between the mean academic performance scores of the male and female students taught Solid Mensuration using Ethno mathematics teaching strategy?

## Hypotheses

The following null hypotheses were formulated and will be tested at 0.5 significance level:

**$Ho_1$:** There is no significance difference between the mean academic performance scores of the students taught Solid Mensuration using Ethno mathematics teaching strategy and those taught using lecture method.

**$Ho_2$:** There is no significance difference between the mean academic performance scores of the male and female senior secondary

students taught Solid Mensuration using Ethno mathematics teaching strategy.

## Research Method

**Research design:** The design used for the study was quasi-experimental design of the pre-test post-test control group type. The experimental group was taught Solid Mensuration using ethnomathematics while the control group was taught using lecture method, both for a period of six weeks. **Research location and Setting:** The study was undertaken in Katsina Zonal education Quality assurance (KZEQA) of Katsina state (latitudes $11^0$07'49N and $13^o$22'57 N, longitudes of $6^0$52'03 E and $9^0$9'02 E) in the northern part of Nigeria. **Population, Sample and Sampling Procedure:** The Population of the study comprised all the 17006 senior secondary II (SSII) mathematics students in Katsina Zonal Education Quality Assurance (KZEQA). SSII students are students at their second year of studies in the senior section with an average age of 17years.There are 25 public senior secondary schools from the three local governments under KZEQA (Jibia, Kaita and Katsina). A sample size of 125 SSII students was selected from two of the Secondary schools by means of the clustered sampling and random sampling techniques, with one group being assigned to the experimental group and the other to the control group. In each group, intact class was used for the study. **Treatment and Treatment Administration:** The study involved two different treatments, which are ethnomathematics teaching strategy and lecture method administered to the experimental and control groups. During the experimental groups' treatment application, the researchers conducted the lesson using ethnomathematics teaching strategy by following the instructions and procedures contained in the lesson plan constructed on ethnomathematics steaching strategy. This entails incorporating the students' cultural practices into aspects of the contents being taught. Both the local language of the students and English were jointly used as the medium of communication. In some instances, students were exposed to geometric cultural artifacts. Thus, the use of Ethnomathematics allows students to explore their culture for the purpose of discovering some mathematical principles, patterns or process. For the control group, the researchers administered the treatment using lecture method of teaching and English language was the sole medium of communication. The researchers conducted the teaching of control group in the normal classroom setting. A lesson plan was also designed for the lecture method of teaching. **Instrumentation:** For the collection of data needed in this study, Solid Mensuration Performance Test (SMPT) was designed and used. The Solid Mensuration Performance Test (SMPT) was developed by the researcher to measure the performance between the students. The instrument consists of two sections (section A&B). Section A contains the bio data of the respondent while Section B contains 30 multiple choice test items which are based on the topic covered (Solid mensuration with four alternative options (A-D) with one correct answer and the remaining as distracters. The SMPT was used as pre-test,

post-test and Follow up test in both experimental and control group. The instrument was validated by experts and has the reliability coefficient of 0.74. **Data Collection and Analysis Procedure:** The data collection process began with the administration of a pre-test (SMPT) to both experimental and control group. SMPT was administered as pretest to establish equivalence in performance between the experimental and control groups signifying that selection of samples are not significantly different in abilities in terms of academic performance before treatment. At the completion of the experiment, a post- test was administered to measure performance of the students.

**Results and Discussion**

The research questions were answered using descriptive statistics in the form of mean and standard deviation while the hypotheses were tested using Independent sample t-test at 0.05 level of significance.

**Results relating to difference between the mean academic performance scores of the senior secondary students taught Solid Mensuration using Ethnomathematics teaching strategy and those taught using lecture method**

**Table 1**: Descriptive Statistics and Independent t-test Analysis of Academic Performance Scores of Experimental and Control Group

| Variables | N | Mean | S.D | MD | DF | t | P | Decision |
|---|---|---|---|---|---|---|---|---|
| **Experimental** | 50 | 18.22 | 5.396 | 7.127 | 123 | 7.178 | .00 | Rejected |
| **Control** | 75 | 11.09 | 5.465 | | | | | |

*Significant at P<0.05 level of significance

Table 1 shows that the difference between the mean academic performance scores of the students taught Solid Mensuration using ethnomathematics teaching strategy ( M=18.22, SD= 5.396) and those taught using lecture method (M=11.09, SD= 5.465) is 7.127, and this difference is significant [ t(123)=7.178, P<0.05]. Therefore, the null hypothesis was rejected.

The finding above revealed that the experimental group (i.e., those that were exposed to ethnomathematics teaching strategy) had significantly higher mean score than the control group (i.e., those that are exposed to lecture method) leading to the rejection of first null hypothesis. This result is in line with the findings of Yau (2018) who conducted a study investigating the impacts of using ethnomathematics in teaching on performance and retention in mathematics among primary III pupils in Lere education district, Kaduna State, Nigeria. Results of the study (Yau, 2018) indicated that primary III pupils taught using ethnomathematics teaching performed better than those taught with conventional teaching method. The result also revealed significant difference between the performances of primary III pupils taught mathematical concepts using ethnomathematics teaching strategy and lecture method. The result is also in line with the finding of Sunzuma et al (2021) who conducted a research comparing the

effectiveness of Ethnomathematics and traditional lecture approaches in teaching consumer arithmetic: Learners Achievement and Teachers' views. Sunzuma et al (2021) result showed that learner taught using ethnomathematics approach achieved significantly higher than those taught using the traditional approach.

**Results relating to difference between the mean academic performance scores of the male and female senior secondary students taught Solid Mensuration using Ethnomathematics teaching strategy**

**Table 2:** Descriptive Statistics and Independent t-test Analysis of Academic Performance Scores of the Male and Female Students in the Experimental Group

| Gender | N | Mean | S.D | MD | DF | t-cal | P | Decision |
|---|---|---|---|---|---|---|---|---|
| **Male** | 27 | 18.93 | 5.916 | | | | | |
| | | | | 1.535 | 48 | 1.002 | .321 | Accepted |
| **Female** | 23 | 17.39 | 4.707 | | | | | |

*Not significant at P>0.05 level of significance

Table 2 shows that the difference between the mean academic performance scores of the Male students (M=18.93, SD= 5.916) and Female students (M=17.39, SD= 4.707) taught Solid Mensuration using ethnomathematics teaching strategy is 1.535, and this difference is not significant [ t(48)=1.002, $p$ = .321 > .05]. Therefore, the null hypothesis was accepted.

The finding above revealed that the male and female students in the experimental group (i.e., those that were exposed to ethnomathematics teaching strategy) had equivalent mean scores leading to the non-rejection of second null hypothesis. This result is in line with the findings of Ozofor (2018) who investigated the efficacy of ethnomathematics on senior secondary school students' achievement in mathematics. Ozofor (2018), amongst other results, found that ethnomathematics approach was more effective in facilitating students' achievement irrespective of their gender; i.e., both gender benefited significantly in achievement using ethnomathematics approach. The result was also supported by the finding of Milambo and Sakala (2019) in their study aimed to assess the effect of incorporating Ethno-mathematics strategies on students' achievement in functions among the eleventh grade students. In addition, this study sought to examine gender differences on achievement and attitude. However the research findings, revealed that gender was not associated with any statistically significant effect on achievement in ethnomathematics (t(60) = 1.651, p = 0.107). But the result argued with the finding of Omere and Ogedengbe (2022), who investigated the effect of Ethnomathematics teaching method on mathematics students' achievement in Geometry. The result

revealed that Mathematics students' achievement mean scores in Geometry was high when taught with Ethnomathematics. There was also significant difference based on gender and teaching method. The study revealed that female students achieved higher in Geometry when taught with ethnomathematics than their male counterparts.

**Conclusion and Recommendations**

The students exposed to Ethnomathematics teaching strategy to produced higher performance in solid mensuration than their counterpart taught with lecture method; and that both males and females in the experimental group performed equally well. It could therefore be concluded that the use of ethnomathematics teaching strategy to teach SSII students solid mensuration has the potential to enhance their performance irrespective of gender. Based on the findings of this study, it is recommended that mathematics teachers should source for and utilize Ethnomathematical materials and activities within the culture of the learners to ensure the proper delivery of mathematical concepts to enhance learners' performance. Also, curriculum planners and authors of mathematics textbook and other subjects should generally reflect the background of the students' society in their work.

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