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ETHNOMATHEMATICS AND THE PRIMARY SCHOOL PUPILS' ACHIEVEMENT IN MATHEMATICS IN OGBIA LOCAL GOVERNMENT AREA, BAYELSA STATE, NIGERIA

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Abstract
This study investigated the effect of the ethnomathematics approach on pupils' achievement in mathematics (plane shapes) in the Ogbia Local government area of Bayelsa State, Nigeria. One research question and one null hypothesis guided the study. The study employed the pretest-posttest nonequivalent control group design on a sample size of seventy-four (74) pupils in two primary schools randomly sampled from the sixty-two (62) primary schools in the LGA. The researcher constructed an instrument titled EthnoMathematics Test (EMT) with ten (10) multiple-choice items validated by two (2) Mathematics Educators and one (1) lecturer in Measurement and Evaluation from the Federal University, Otuoke, Bayelsa State. The EMT was trial tested on thirty (30) pupils who were not part of the study; the responses from the trial testing were used to determine the internal consistency of the items using Kuder- Richardson Formula 20 (KR20), and the reliability coefficient obtained is 0.78. The test items were first distributed to the subjects to determine the initial differences between the respondents, after which the two groups of subjects were treated with the ethnomathematics and the traditional methods, respectively. After the experiment, the test items were distributed to the subjects after the reshuffling of the items. The responses were analyzed using mean and standard deviation to answer the research question, while t-test statistics were used to test the hypothesis at alpha level ≤ 0.05. The results revealed, among others, that the ethnomathematics approach was more effective in facilitating pupils' achievement in plane shapes. The finding had severe implications for mathematics teachers and stakeholders in mathematics education. Therefore, it was recommended, amongst others, that teachers should endeavour to teach mathematics by incorporating elements of culture (songs, food, language, tools, and equipment) of the environment so that the pupils can comprehend.

Keywords: Ethnomathematics, Achievement, Mathematics, Pupils, Plane- Shapes

Introduction

Mathematics came to solve different human problems with indigenous knowledge, as its existence can be linked to early man. Omere and Ogedengbe (2022), defined mathematics as science of magnitude, shapes and number as well as the science that sustains the daily practices of man while Yadav (2017) defined mathematics as the study of assumptions, its properties and applications. In describing the use of mathematics, Ziegler and Loos (2017) stated that through the use of abstraction and logic, mathematics developed from counting, calculation, and measurement to the systematic study of shapes and motion of physical objects likewise the theories and concepts given in mathematics help in understanding and solving various types of problems in academic as well as in real life. Hence, Mathematics can be simplified as means to learn or to study or gain knowledge. The Federal Government of Nigeria realized the role of mathematics in individual fulfilment and national developmental goals regarding scientific and technological breakthrough and this led the educational policymakers to position mathematics as a compulsory and core subject at primary and secondary levels of education in the National Policy on Education, (FRN, 2013). The Primary school mathematics objectives are the acquisition of functional numeracy on how and when to use arithmetic operations on both whole and decimal fraction numbers; the acquisition of certain mental attitudes, which facilitate the development of problem-solving attitudes and strategies; acquisition of techniques of representation and interpretation of numerical and other data; an indication of abilities in measurement, approximation, estimation of number and quantity, development of spatial concepts and the ability to represent these using such tools as maps and scale drawing. To achieve these objectives, the Nigeria National curriculum included the three basic languages in Nigeria (Igbo, Hausa, and Yoruba) as core subjects in Primary school to enable teachers to adopt elements of

cultures, which are rich with kinds of activities such as dances, songs, riddles games, crafts, events, folklores, customs, objects, and other traditional festivals for the teaching of mathematics. However, all these cultural activities require certain level of knowledge for the individuals to function effectively in them because teaching and learning constitute a socially guided event, positioning a teacher and pupils as key educational participants. Within this conceptualization, practical teaching of mathematics in the classroom is an instructional interconnection between students' social backgrounds and cultural consciousness. This interconnection should recognize the educational value of a local dialogue and language to negotiate a shared meaning of certain symbolic representations that are mathematically implicated. This brings about the notion of ethno mathematics, which is the study of mathematics that illuminates the value of learning mathematics within one's culture, the culture in which a teacher and pupils could be located. To this, there is a need to culturalize the mathematics curriculum to improve its quality and upgrade the cultural confidence of all learners.

Hence, mathematics is described in different modes of thought and can be studied in different forms, such as ethnomathematics. D'Ambrosio (2001) defined ethnomathematics as the study of the relationship between mathematics and culture and how cultures structure the teaching and learning of mathematics. Pais (2010) described ethnomathematics as a shift from mathematics that is strictly domiciled in school and university to within the world of people, their cultures, and everyday activities, while Fouze and Amit (2023) defined ethnomathematics as a part of mathematics that links the formal mathematics concepts to practice in culture so that students understanding of material is easier because the material is directly related to culture which is their daily activity. Adamu (2022) posited that ethnomathematics enables students see mathematics as a natural extension of their daily activities and it is the mathematics practiced among identifiable cultural groups. Brandt and Chernoff (2015) listed the benefits of teaching mathematics using ethnomathematics in schools, which include improved academic achievement, promotion of social justice, cultural diversity, reduction in education barriers, and reduction in racism bias. With all these benefits, unfortunately, mathematics teaching in Nigerian schools has been hollow because more focus is on the Greeks and other European cultures while ignoring indigenous knowledge and participation, thereby losing its story, context, and history in Nigeria. Therefore, to create a holistic and integrated unit of study that will help expand and develop a broader and in-depth understanding of the role of mathematics in the world, ethnomathematics is required for the promotion of a more inclusive and equitable learning environment relevant to the pupils and improvement of their academic achievement.

Academic achievement represents performance outcomes that indicate the extent to which a pupil/student has accomplished specific goals that were the focus of activities in instructional environments. Academic achievement is the result obtained from a standardized test or examination in a subject or subjects over a long period and is indicative of a future career path. For this study, the exploration of academic achievement has led to numerous empirical studies and fundamental progress, such as the development of the first intelligence test by Binet and Simon. In an educational system, academic achievement defines cognitive goals that apply across multiple subject areas, such as critical thinking, or include acquiring knowledge and understanding in a specific intellectual domain, such as mathematics and science. Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning. The field of academic achievement is broad and covers a wide variety of educational outcomes; the definition of academic achievement depends on the indicators used to measure it. Among the many criteria that indicate academic achievement, there are very general indicators such as procedural and declarative knowledge acquired in an educational system, such as curricular-based criteria on an educational achievement test that would be obtained in this study using ethnomathematics tests on plane shapes. All criteria have in common that they represent intellectual endeavours and mirror a person's intellectual capacity. In Nigeria, academic achievement plays an essential role in everyone's life. Hence, academic achievement, as measured by the instrument of this study, determines whether a pupil will have the opportunity to continue his or her lesson in mathematics. Therefore, academic achievement is affected by numerous levels, including pupil factors, interactions with others such as parents, teachers, and administrators, and the larger systems surrounding the pupil.

Matang and Owens (2014) reported that that learning is more effective and meaningful if teaching begins from what the students already know and are familiar with likewise formal classroom environments affect academic achievement. Outside of the formal classroom, other educationally significant factor which has the potential to either enhance or retard effective teaching and learning of mathematics and subsequent achievement of pupils in school mathematics is cultural diversity. However, when embedded into the educational system, will create and sustain peace by making each pupil in the classroom feel valued, reduce intimidation and harassment, and create

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a connection between the pupils and the environment or origin. In Nigerian primary schools, it is observed that the mathematics taught needs more cultural diversity because indigenous knowledge and participation are ignored. Hence, educational reforms in Mathematics teaching at the primary school level should be garnished with Nigeria's culture, which supports the view that the mathematical competencies learned at home and in the first years of schooling are essential for everyday life and labour because this early education instills a sense of responsibility and dependency in pupils.

Nonrecognizing this knowledge as a construct of an individual experience and interaction with the environment, including cultural background, may lead the pupils to learn by rote memorization devoid of reasoning and logical ability, resulting in disconnection of mathematics from reality, which leads to consistent failure of pupils in internal and external examination, weak foundation for secondary and tertiary mathematics and reduction in career choices by pupils. Hence, to improve mathematics teaching and learning, the researcher sought to investigate the effect of ethnomathematics on pupils' academic achievement in plane shapes in mathematics among primary three (3) pupils in Ogbia local government area, Bayelsa state, Nigeria.

Statement of the problem

The conventional mathematics curriculum in Nigerian primary schools does not incorporate elements of culture, hindering the pupils' ability to relate mathematical concepts to their own lived experiences and cultural context. The absence of cultural relevance in mathematics teaching may contribute to low academic achievement among primary school pupils. Understanding and applying mathematical concepts within one's cultural framework could potentially enhance comprehension and academic performance. Despite the potential benefits of ethnomathematics – the study of the relationship between mathematics and culture – there is a dearth of its application in primary school mathematics education. The study aims to explore the effectiveness of the ethnomathematics approach in improving pupils' achievement in plane shapes.

Aim and objective of the study

This study examined the effect of the ethnomathematics approach on pupils' achievement in mathematics (plane shapes) in the Ogbia Local Government Area of Bayelsa State. Specifically, the study was designed to:

- Determine the difference in the mean achievement scores of pupils taught mathematics using ethnomathematics approach and those taught using without the ethnomathematics approach

Research Question:

- What is the difference in the mean achievement scores of pupils taught mathematics using ethnomathematics approach and those taught using without the ethnomathematics approach?

Hypothesis:

- HO1: There is no significant difference in the mean achievement scores of pupils taught mathematics using ethnomathematics and those taught without the ethnomathematics approach.

Methodology

This study adopted the Quasi-experimental research design. The Quasi-experimental design is an empirical interventional study used to estimate the effect of an independent variable on a target population without random assignment. Specifically, the researcher adopted a Pretest Posttest nonequivalent control group design. The study population consisted of all the two thousand three hundred (2,300) primary III pupils in all the sixty-two (62) government-owned primary schools in Ogbia Local Government Area. Two primary schools were selected using the random sampling technique, while the ballot sampling technique was used to assign schools into experimental and control groups. A total of seventy-four pupils from an intact class in each selected school were used for the study. The instrument used for data collection was the Ethnomathematics Test (EMT). The test blueprint was used as a guide for constructing the ten(10) multiple-choice test items, with option A containing three distractors and one correct answer. Each correct item attracted one mark, ten (10) marks as the maximum, and zero (0) as the minimum. The research instrument was validated by two (2) Mathematics Educators and one (1) lecturer in Measurement and Evaluation, all from the Federal University Otuoke, Bayelsa State. The validators' comments were used to produce the final copy of the EMT. The instrument was subjected to trial testing on thirty (30) pupils in a different primary

school that was not part of the sample schools. The pupils' responses from the trial testing were used to determine the reliability coefficient of the items using the Kuder Richardson Formula 20 (KR20), which was found to be 0.78.

During the first two days of the study, permission was obtained from the head teachers of the two schools selected (control and experiment groups), and with the help of the class teachers, the EMT was administered to the pupils as a pretest to establish the entry level of the students. The mathematics teachers who served as research assistants taught the pupils lessons on plane shapes. From the last three days of the first week to the third week, the control group was taught plane shapes without the use of elements of culture in their environment. The other group, the experimental group, was taught plane shapes (rectangles, circles, and squares) using fishing and farming tools and equipment that are common in the area because the main occupation of the area is fishing and farming (ethnomathematics approach). The EMT was reshuffled and administered to both groups as a posttest on the fourth week. Each test lasted for 20 minutes, and at the end of the experiment, the scores collected were used for data analysis.

Results

Research question 1: What is the difference in the mean achievement scores of pupils taught Mathematics using the ethnomathematics approach and those taught with the traditional approach?

Table 1: Mean ($\bar{X}$) and standard deviation (SD) of pupils taught Mathematics using the Ethnomathematics approach and those taught with the traditional approach.

Groups	N	Pre - Test		Post - Test		Mean
		($\bar{X}$)	SD	($\bar{X}$)	SD	Gain
Experimental	35	4.59	1.78	8.53	3.04	3.94
Control	39	4.31	1.67	6.22	2.50	1.91

Table 1 shows that the experimental groups had a higher mean score (8.53) than the control group (6.22) in the post-test. It indicated the mean gain differences of 2.03 in pupils' achievement on plane shapes in favour of those taught using the ethnomathematics approach.

Hypothesis 1: There is no significant difference in the mean achievement scores of pupils taught Mathematics using the ethnomathematics approach and those taught without the ethnomathematics approach.

Table 2: t-test of significance of mean difference of scores of pupils taught Mathematics with the ethnomathematics approach and those taught without the ethnomathematics approach.

Groups	N	Mean	SD	t-cal.	t-crit.	df	p
Experimental	35	8.53	3.04	5.72	2.00	72	0.05
Control	39	6.22	2.50				

Table 2 shows a significant difference between the mean scores of the experimental groups and those of the control group. The computed test statistic value exceeds the critical value (t-calculated = 5.72 > t-critical = 2.00). Hence, the null hypothesis was rejected, implying a significant difference exists between the mean achievement scores of pupils taught Mathematics with the ethnomathematics approach and those taught without the ethnomathematics approach.

Discussion

The study aimed to find whether the ethnomathematics approach in teaching plane shapes in mathematics to primary three (3) pupils will improve achievement in mathematics. Table 1 revealed that though both groups (experiment and control) had the same entry level, the experimental group had a higher mean score than the control group in the posttest. It indicated that the mean difference in pupils' achievement on plane shapes favoured those taught using the ethnomathematics approach.

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Also, in Table 2, the result of the tested hypothesis showed significant differences between the control and experimental groups. These differences implied that pupils taught using ethnomathematics achieved higher than those taught the traditional approach. Thus, it was found that the mathematics approach was more effective in facilitating pupils' achievement in plane shapes. This result aligns with the findings of Johnson et al. (2022) on using Bayesian networks to provide educational implications: mobile learning and ethnomathematics to improve sustainability in mathematics education using learning apps developed using ethnomathematics modules based on the Emirati culture and revealed that incorporating cultural elements had a positive change in students liking and learning mathematics even without a mobile device also Unodiaku (2013) researched the effect of ethnomathematics teaching materials on students achievement in mathematics in Enugu state and reported that ethnomathematics method was effective in enhancing students achievement in mensuration especially in volumes of cylinder and hemisphere. This current study agrees with the research findings of Achor et al. (2009), who reported that students exposed to the ethnomathematics teaching approach (ETA) were superior in achievement and retention than those taught with the conventional approach on Locus in senior secondary schools. The students in the experimental group achieved significantly better than the control group because mathematics concepts were explained with tools and equipment found in the students' environment. The control group exhibited a lower achievement because of the teaching method employed. From the analyses, interpretation, and discussion presented, the conclusions are that ethnomathematics has relative effects on pupils' achievement in mathematics, and it can enhance pupil achievement more in learning plane shapes. Also, in this process, the researchers showed the value of mathematics instruction grounded on a proper conceptualization of ethnomathematics in Nigerian classrooms. Hence, this study provided a model that shows the relevance and applicability of ethnomathematics as a teaching approach to generate efficient and effective teaching in mathematics classrooms.

Conclusion

In recent years, the use of ethnomathematics as an instructional approach has grown internationally. Using ethnomathematics in our schools can foster diverse thinking and creativity, improve pupils' critical thinking and problem-solving abilities, and prepare them to compete in their preferred work positions. A necessity has emerged for teachers to educate pupils in applying their cultures in learning different subjects, such as mathematics, to meet their future needs. Therefore, how to help pupils improve their mathematical skills is one of the most critical topics of interest to educators. Sternberg (2017) advocated for replacement of traditional cumulative view of scientific knowledge with an experiential change view in addition to pedagogical approaches that focus on including pupils' cultural and community contexts, which are attractive and motivating to pupils' culture. Wickstrom and Yates (2021) pointed out that Pupils/ students are more engaged in learning activities if they discover a connection between mathematics and the natural world. More importantly, pupils' everyday life experiences enrich learning activities by allowing them to form assumptions, make decisions, and apply mathematical operations, analyses, and refinements to authentic problems in real-world contexts (English, 2021). Though one of the many challenges that primary school teachers face is how to teach pupils complex solutions to unusual problems in the context of ethnomathematics education, the researcher argues that ethnomathematics should be conceptualized and recognized in mathematics classrooms as a teaching approach that moves pupils' background into pupils' immediate environments and is integrated with the culture-centric mathematics practically and responsively to the curriculum.

Recommendations

1. This study revealed that ethnomathematics can improve the understanding and application of mathematical concepts, leading to better and higher achievement. Therefore, this approach should be introduced into teacher training programs so pre-service mathematics teachers will be conversant with the approach.
2. Also, there is a need to retrain the in-service primary school teachers through workshops, seminars, conferences, and refresher/inductive courses for proper and adequate teacher preparedness to use the method in the classroom. On the part of the pupils, it will reduce rote memorization as mathematics concepts learned in class can easily be related to their environment and everyday activity.
3. Primary school education is the foundation upon which other education lays; therefore, a sound and firm understanding of primary mathematics will reduce the abstractness that leads to rote memorization of mathematics in secondary and tertiary education. This study has shown that if mathematics is taught in primary schools using ethnomathematics approach, the pupils' understanding of mathematical concepts and principles will improve. Thus, teachers should endeavour to teach mathematics by incorporating the culture of the environment so that the pupils can comprehend.

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4. Professional bodies such as the Science Teachers Association of Nigeria (STAN) and The Mathematical Association of Nigeria (MAN) should include sessions for ethnomathematics in the association conferences. At the same time, government agencies mandated with the curriculum formation, such as the Comparative Education Study and Adaptation Centre(CESAC) and Nigeria Education Research and Development Council(NERDC) should incorporate ethnomathematics approach.
5. Finally, more research should be conducted to cover other areas of mathematics, other educational levels, and other locations, as this will help compile data on Ethnomathematics.

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