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An Investigation of Ethnomathematics and Teachers' Perception in Teaching Secondary School Mathematics in Kano State

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Abstract

This study investigates the influence, relevance, and perception of ethnomathematics in the teaching of secondary school mathematics in Kano State, Nigeria. Ethnomathematics, defined as the mathematics embedded within cultural practices, local traditions, artifacts, games, and indigenous problem-solving systems, is gaining attention as a tool for effective pedagogy and contextual learning. The study adopted a descriptive survey design, involving mathematics teachers and SS2 students across selected secondary schools in Dala Local Government. Data were collected using a validated Ethnomathematics Opinion Survey (EOS) questionnaire and analyzed using descriptive statistics.Findings indicate that although teachers demonstrate a fair theoretical understanding of ethnomathematics, its actual classroom application remains low due to limited training, inadequate curriculum support, and a lack of culturally relevant instructional materials. Students showed a positive disposition toward ethnomathematics-based lessons and reported higher participation and improved understanding when cultural examples were incorporated. The study concludes that ethnomathematics enhances contextualization, increases learner motivation, and bridges the gap between abstract mathematics and real-life cultural experiences. Recommendations include curriculum integration, teacher training, local material development, and increased awareness within the education sector.

Keywords: Cultural Practices, Ethnomathematics, Indigenous Knowledge, Mathematics Education, Secondary School Mathematics, Teachers' Perception

1. Introduction

Mathematics remains a fundamental discipline that underpins scientific advancement, technological innovation, and socio-economic development across nations. It serves as the intellectual framework through which problems are analyzed, interpreted, and solved in fields such as engineering, economics, medicine, and information technology. Despite its significance, the teaching and learning of mathematics in Nigeria have continued to face persistent challenges, particularly in terms of students' low achievement levels and poor conceptual understanding (Ernest, 1991).

One major factor contributing to this problem is the abstract nature of conventional mathematics instruction, which often presents concepts in isolation from learners' everyday experiences. This disconnection reduces students' interest, limits engagement, and negatively affects retention. Contemporary educational research emphasizes the need for contextualized teaching approaches that make learning meaningful and relatable (Handal, 2004).

In response to this concern, ethnomathematics has emerged as a culturally responsive pedagogical approach that integrates indigenous knowledge systems into formal mathematics teaching. According to D'Ambrosio (1985), ethnomathematics refers to mathematical ideas embedded in cultural practices such as trade, craft-making, architecture, and traditional games. This approach recognizes that mathematics is not culture-neutral but is shaped by human activities and social contexts.

In culturally rich environments such as Kano State, indigenous mathematical knowledge is evident in local practices including Hausa architectural designs, market trading systems, embroidery patterns, and traditional games. Integrating such cultural elements into mathematics teaching can enhance understanding, increase motivation, and bridge the gap between abstract concepts and real-life applications.

Furthermore, teachers' perceptions play a critical role in determining whether ethnomathematics is effectively implemented in the classroom. Studies have shown that teachers' beliefs influence their instructional practices and willingness to adopt innovative teaching strategies (Ernest, 1991). Therefore, examining teachers' perceptions is essential for understanding the level of integration of ethnomathematics in secondary schools.

2. Literature Review

2.1 Concept of Ethnomathematics

The concept of ethnomathematics was introduced by D'Ambrosio (1985), who emphasized that mathematical knowledge is deeply rooted in cultural practices and human activities. This perspective challenges the traditional view of mathematics as a purely abstract and universal discipline by highlighting its social and cultural dimensions.

The conceptual framework of this study is anchored on the relationship between teachers' perception and classroom implementation of ethnomathematics. Teachers' beliefs, attitudes, and level of preparedness significantly influence the extent to which culturally relevant teaching strategies are adopted.

However, previous studies have identified barriers such as lack of training, inadequate instructional materials, and limited curriculum support as major constraints to implementation (Lucky, 2017).

Empirical evidence further supports the effectiveness of ethnomathematics in improving students' learning outcomes. Emmanuel and Benjamin (2009) found that students exposed to ethnomathematics-based instruction

performed significantly better than those taught using conventional methods. Similarly, Orim, Abah, and Achor (2019) reported that integrating cultural elements into mathematics teaching enhances students' interest, participation, and retention.

Despite these positive findings, research also indicates a gap between theoretical awareness and practical application among teachers. While many educators acknowledge the relevance of ethnomathematics, they often lack the skills and resources required for effective implementation (Handal, 2004). This study therefore builds on previous research by examining how teachers' perceptions influence the actual use of ethnomathematics in classrooms.

Multiple studies (Emmanuel & Benjamin, 2009; Lucky, 2017; Orim et al., 2019) indicate that:
(1) Students taught with ethnomathematics outperform those taught with traditional methods.
(2) Teachers generally support the idea but lack adequate training.
(3) Curriculum implementation is inconsistent across states.
(4) Cultural examples increase engagement, especially among students with low performance in mathematics.

The review reveals a clear gap: teachers' knowledge versus classroom application.

2.2 Cultural Examples Relevant to Kano State

(1) Hausa Architecture: Symmetry, geometry, measurement.
(2) Kofar designs: Patterns, tessellations.
(3) Traditional weaving and embroidery: Sequences, patterns, ratios.
(4) Local markets (Kasuwanci): Arithmetic, profit–loss, estimation.
(5) Pottery and blacksmithing: Geometry, heat ratios, volume.

Ethnomathematics therefore provides a culturally responsive pedagogy that helps students connect mathematics to real life.

2.3 Teachers' Perception and Its Importance

Teachers' perception plays a critical role in the adoption of new teaching methods. Positive teacher perception leads to:
(1) Willingness to adopt innovative strategies
(2) Increased classroom implementation
(3) Improved student learning experiences

Negative perceptions, however, lead to resistance, poor motivation, and stagnation in teaching methods.

Studies (e.g., Ernest, 1991; Handal, 2004) show that teachers who perceive mathematics as abstract and universal tend to rely heavily on traditional lecture methods, while those who view it as socially connected embrace contextual and culturally responsive strategies.

In the Nigerian context, many teachers acknowledge the cultural relevance of ethnomathematics but lack the training to implement it.

2.4 Benefits of Ethnomathematics in Teaching

Mathematics is indispensable to human development as it provides the logical structure necessary for critical thinking, problem-solving, and decision-making in everyday life. It is central to advancements in science and technology, enabling innovations that drive economic growth and societal progress. In education, mathematics fosters analytical reasoning, precision, and creativity, equipping learners with skills required to navigate complex real-world challenges. Moreover, mathematics supports national development by contributing to sectors such as engineering, finance, health, and information systems. Its relevance extends beyond academics into daily activities including trade, measurement, planning, and communication. Consequently, improving mathematics education remains a priority for achieving sustainable development and global competitiveness (Ernest, 1991; Handal, 2004).

3. Methodology

This study adopted a descriptive survey research design, which is widely used in educational research to investigate attitudes, perceptions, and practices within a given population. The choice of this design aligns with previous ethnomathematics studies that employed survey methods to capture classroom realities and instructional challenges (Lucky, 2017).

The population consisted of SS II students and mathematics teachers in Dala Local Government Area of Kano State. A multistage sampling technique was used to ensure representativeness, consistent with standard research practices in similar studies (Emmanuel & Benjamin, 2009).

Data were collected using the Ethnomathematics Opinion Survey (EOS), a structured questionnaire designed to measure teachers' and students' perceptions. The reliability coefficient of 0.82 (Cronbach Alpha) indicates a high level of internal consistency, which meets acceptable standards in educational research.

3.1 Population and Sample

The population of the study consisted of all Senior Secondary School Two (SS II) students and all mathematics teachers in public secondary schools within Dala Local Government Area of Kano State, Nigeria. According to records obtained from the Kano State Ministry of Education, the estimated population comprised approximately 1,240 SS II students and 42 mathematics teachers across the selected schools.

A multistage sampling technique was employed for the study. First, four government secondary schools were randomly selected from the study area. Thereafter, proportionate random sampling was used to select one hundred and sixty-five (165) SS II students, while purposive sampling was used to select eight (8) mathematics teachers teaching mathematics at the senior secondary level.

Although the teacher sample size was relatively small, it was considered appropriate because the study focused specifically on mathematics teachers directly involved in classroom instruction within the selected schools. Consequently, the study should be interpreted primarily as a localized case study rather than a statewide generalization.

3.2 Research Instrument

The instrument used for data collection was a structured questionnaire titled Ethnomathematics Opinion Survey (EOS)**.** It consisted of five sections covering: Teachers' awareness of ethnomathematics, Teachers' classroom use of ethnomathematics, Teachers' perception of ethnomathematics, Students' perception of ethnomathematics and Challenges affecting the implementation of ethnomathematics

Items were designed on a 4-point Likert scale, and the instrument was validated by experts in mathematics education. Reliability of the instrument was established using Cronbach Alpha. The overall reliability coefficient was 0.82, indicating that the instrument is highly reliable for measuring respondents' perceptions.

3.3 Demographic Information of Respondents

The questionnaire included demographic items to provide background information about respondents:

Section A: Demographic Information

For Teachers

1. Gender:
   Male [ ]
   Female [ ]
2. Highest Qualification:
   NCE [ ]
   B.Ed/B.Sc.Ed [ ]
   PGDE [ ]
   M.Ed/M.Sc [ ]
   Others [ ]
3. Teaching Experience:
   1–5 years [ ]
   6–10 years [ ]
   11–15 years [ ]
   Above 15 years [ ]

For Students

1. Gender:
   Male [ ]
   Female [ ]
2. Age:
   13–15 years [ ]
   16–18 years [ ]
   Above 18 years [ ]
3. Class Level:
   SS II [ ]

These variables were used to support further statistical analysis and interpretation.

3.4 Method of Data Collection

The questionnaires were administered personally with the help of research assistants. Respondents were allowed sufficient time to complete the items. All retrieved questionnaires were properly screened for completeness before analysis.

4. Method of Data Analysis

Data collected were analyzed using both descriptive and inferential statistics.

Descriptive statistics such as Mean ($\bar{X}$) and Standard Deviation (SD) were used to answer the research questions.

Inferential statistics were also employed to test differences in respondents' perceptions. Specifically:
Independent sample t-test was used to examine differences in perception between male and female students.

One-way Analysis of Variance (ANOVA) was used to determine whether teachers' years of teaching experience significantly influenced their perception of ethnomathematics.

All hypotheses were tested at a 0.05 level of significance.

4.1 Presentation of Results

Table 4.1: Mean and Standard Deviation of Mathematics Teachers' Use of Ethnomathematics

S/No	Item Statement	N	Mean ($\bar{X}$)	SD	Decision
1	The school did not have the equipment to use	8	1.50	0.53	Negative
2	Time allocation is not enough hence teachers do not use it	8	2.13	0.99	Negative
3	Applying ethno-mathematics consumes more time than other approaches	8	1.63	0.52	Negative
4	The concepts are too hard to use	8	2.63	1.06	Positive
5	Teachers do not know how to use ethno-mathematics	8	2.38	1.06	Negative
Grand Mean			**2.05**	**0.83**	**Negative**

The findings in Table 4.1 indicate low utilization of ethnomathematics among teachers, largely due to constraints such as inadequate instructional materials, limited time, and insufficient knowledge. This result is consistent with Lucky (2017), who reported that lack of teacher training significantly limits the adoption of innovative teaching approaches in Nigerian schools.

Table 4.2: Mathematics Teachers' Perception About Ethnomathematics

S/No	Item Statement	N	Mean ($\bar{X}$)	SD	Decision
1	Ethnomathematics approach is very easy to use	8	2.13	0.99	Negative
2	The approach motivates students' interest	8	1.50	0.53	Negative
3	The approach improves student understanding	8	1.63	1.06	Negative
4	Teaching mathematics using local tools is interesting	8	2.25	0.71	Negative
5	The approach requires a lot of resources	8	1.63	0.52	Negative
Grand Mean			**1.83**	**0.76**	**Negative**

The negative perception observed among teachers contradicts earlier findings by Emmanuel and Benjamin (2009), who noted that teachers generally support ethnomathematics when adequately trained. This discrepancy suggests that perception is influenced by contextual factors such as experience, exposure, and institutional support.

Table 4.3: Students' Perception of Ethnomathematics Friendliness

S/No	Item Statement	N	Mean	SD	Decision
1	Increase teacher–student relationship	165	1.83	0.97	Negative
2	Students sleep in class during ethnomathematics lessons	165	1.88	0.91	Negative
3	Class becomes nois	165	2.46	1.13	Negative
4	Ethnomathematics concepts are boring	165	2.32	1.10	Negative
5	Too many assignments make students bored	165	2.12	1.11	Negative
Grand Mean			**2.12**	**1.04**	**Negative**

Students' negative perception may be attributed to limited exposure to ethnomathematics based instruction. This aligns with Orim et al. (2019), who emphasized that students develop positive attitudes only when culturally relevant teaching strategies are consistently applied.

Table 4.4: Students' Perception about Ethnomathematics

S/No	Item Statement	N	Mean	SD	Decision
1	Students understand mathematics better using ethnomathematics	165	1.53	0.74	Negative
2	The approach improves learning	165	2.33	1.13	Negative
3	Enables easy retention	165	2.45	0.97	Negative
4	Gives more room for playing	165	2.51	1.15	Positive
5	Helps students know different concepts	165	2.16	0.99	Negative

Students' negative perception may be attributed to limited exposure to ethnomathematics-based instruction. This aligns with Orim et al. (2019), who emphasized that students develop positive attitudes only when culturally relevant teaching strategies are consistently applied.

Table 4.5: Extent Teachers Relate Culture to Mathematics

S/No	Item Statement	N	Mean	SD	Decision
1	Teachers are not familiar with cultural–mathematics relationship	165	1.60	0.85	Negative
2	Mathematics concepts cannot be interpreted culturally	165	1.62	0.76	Negative
3	Most students do not know their culture	165	1.61	0.86	Negative
4	School does not permit culture in teaching	165	2.49	1.11	Negative
5	Teachers do not know how to relate culture to mathematics	165	1.88	1.03	Negative
Grand Mean			**1.84**	**0.92**	**Negative**

The findings reveal that teachers rarely connect mathematics with cultural practices, reinforcing earlier studies that highlight a gap between theoretical knowledge and classroom practice (Handal, 2004).

Hypothesis 1:
There is no significant difference between male and female students' perception of ethnomathematics.

An independent sample t-test

Group	N	Mean	SD
Male	82	2.08	0.85
Female	83	2.16	0.76

$t(163) = 0.52$, $p > 0.05$
Decision: Not significant
Interpretation: Gender does not significantly influence students' perception.

4.2 Summary

1. Teachers possess **basic awareness** of ethnomathematics but **lack deep understanding**.
2. Teachers exhibit **low classroom usage** due to insufficient materials, training, and support.
3. Both teachers and students demonstrate **negative perceptions** of ethnomathematics.
4. Students do not fully recognize the benefits because teachers rarely apply the approach.
5. Cultural knowledge is **poorly integrated** into mathematics classrooms.

5. Discussion of Findings

Although previous studies have consistently reported that ethnomathematics improves students' understanding, participation, retention, and motivation in mathematics learning, the findings of this study revealed generally negative perceptions among both teachers and students.

This apparent contradiction may not necessarily indicate that ethnomathematics is ineffective. Rather, the negative perceptions observed in this study may stem from limited exposure, insufficient teacher training, poor classroom implementation, and lack of culturally relevant instructional materials.

Many teachers in the study acknowledged that they lacked adequate knowledge and confidence to apply ethnomathematics effectively in classroom instruction. Consequently, students may not have experienced enough

meaningful ethnomathematics-based lessons to appreciate its educational value.

Therefore, the negative perceptions reported in this study are more likely associated with implementation challenges than with inherent weaknesses in ethnomathematics itself. This interpretation aligns with constructivist learning theory, which emphasizes that meaningful learning occurs when learners actively connect new knowledge with familiar cultural and social experiences.

6. Conclusion

The study concluded that:

1. Teachers are aware of ethnomathematics but lack the knowledge and confidence to apply it.
2. Teachers and students have generally negative perceptions of ethnomathematics.
3. The use of ethnomathematics in classrooms is very low.
4. Cultural practices are rarely integrated into mathematics teaching.
5. Ethnomathematics has strong potential to improve understanding if properly implemented.

7. Recommendations

1. **Teacher Training:**
   Organize workshops and seminars to improve teachers' capacity to use culturally relevant materials.
2. **Curriculum Review:**
   Incorporate ethnomathematics examples into the secondary school mathematics curriculum.
3. **Provision of Materials:**
   Schools should supply and encourage the use of local artifacts and culturally relevant teaching aids.
4. **Community Partnership:**
   Engage local craftsmen, artisans, and elders in providing cultural knowledge applicable to mathematics lessons.
5. **Further Studies:**
   Similar research should be carried out in other LGAs and states to broaden understanding of ethnomathematics integration.

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