© IIJP 2026 | Volume 2, Issue 3, pp. 887-900 | ISSN: 2636-4484

MATHEMATICAL KNOWLEDGE IN NIGERIAN INDIGENOUS BUILDING AND TRADE PRACTICES: EVIDENCE FROM SIX GEOPOLITICAL ZONES

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ARTICLE INFO
Article No.: *0481*
Accepted Date: *24/07/2026*
Published Date: *13/08/2026*
Type*: Research*

ABSTRACT
This study investigated mathematical knowledge embedded in indigenous building and trade practices across selected communities in Nigeria's six geopolitical zones and examined its implications for mathematics education and sustainable development. A qualitative multiple-case study design was adopted, using document review and oral documentation. Data were obtained from documentary sources and semi-structured interviews with 36 purposively selected indigenous knowledge holders comprising traditional builders, traders, community elders and cultural custodians. The data were analysed thematically using D'Ambrosio's Ethnomathematics and Bishop's Six Mathematical Activities as the analytical framework. The findings revealed that indigenous mathematical knowledge is reflected in building practices through geometry, measurement, proportion and spatial organisation, while indigenous trade practices demonstrate counting, estimation, valuation and commercial calculations. The study also found that, despite cultural variations across the six geopolitical zones, common mathematical principles underpin indigenous numeration, architecture and market practices. These findings underscore the educational value of indigenous mathematical knowledge in promoting culturally responsive mathematics instruction and preserving Nigeria's intellectual and cultural heritage. The study concludes that integrating validated indigenous mathematical practices into mathematics curricula and teacher education programmes can enhance learners' conceptual understanding while supporting sustainable development and cultural preservation. It recommends greater documentation of indigenous mathematical knowledge and stronger collaboration among educators, researchers and policymakers to facilitate its effective integration into mathematics education.

Keywords: Ethnomathematics, indigenous mathematical knowledge, indigenous architecture, indigenous trade.

Introduction

Mathematics has evolved as a universal means of understanding quantity, space, pattern and relationships through the lived experiences of human societies. Long before formal schooling, communities developed methods of counting, measuring, estimating and designing to organise trade, construct buildings and solve everyday problems. D'Ambrosio (1985) argues that mathematical knowledge is inseparable from the cultural contexts in which it develops, while Bishop (1988) maintains that every society engages in fundamental mathematical activities regardless of its level of formal education. This perspective provides a basis for examining indigenous mathematical knowledge within diverse cultural settings.

The recognition of mathematics as a cultural phenomenon has stimulated interest in ethnomathematics, which explores mathematical ideas embedded in indigenous practices and technologies. Rather than viewing mathematics as culturally neutral, ethnomathematics acknowledges that communities generate mathematical knowledge through activities such as building, weaving, trading and settlement planning (Ascher, 1991). Gerdes (1994) and Eglash (1999) demonstrated that African cultural practices embody sophisticated geometric reasoning and design principles, highlighting indigenous mathematics as a valuable resource for mathematics education. These findings naturally direct attention to architecture and trade as practical expressions of indigenous mathematical thinking.

Architecture and trade are among the most visible manifestations of indigenous mathematics because both require systematic reasoning and quantitative decision-making. Indigenous buildings involve measurement, proportion, symmetry and spatial organisation, while traditional markets rely on counting, estimation, valuation and equivalence during commercial transactions. Rapoport (1969) and Oliver (1997) observed that vernacular architecture reflects locally developed principles of design and environmental adaptation, whereas Johnson (1970) and Lovejoy (1974) showed that pre-colonial West African trade depended on established numerical procedures. Together, these practices demonstrate that mathematical reasoning underpins both the physical and economic life of indigenous societies.

Nigeria provides an appropriate context for this study because of its rich cultural diversity and longstanding traditions of indigenous architecture, numeration and commerce. Across the six geopolitical zones, communities have developed distinctive mathematical practices shaped by their environments and livelihoods. Hausa compounds, Yoruba courtyard architecture and Benin earthworks illustrate the application of geometry and spatial planning (Prussin, 1986; Evans, 2026), while indigenous numeral systems and exchange mechanisms involving cowries and manillas reflect sophisticated quantitative reasoning (Jones, 1958; Naanen, 1993; Omachonu, 2011; Ejeba, 2025). These examples demonstrate the breadth of indigenous mathematical knowledge across Nigeria.

Recent educational discourse increasingly supports integrating indigenous knowledge into teaching because culturally familiar contexts can enhance learners' understanding and appreciation of mathematics. UNESCO (2018) advocates the inclusion of indigenous knowledge in education, while contemporary research promotes culturally responsive mathematics instruction. However, Nigerian studies have largely examined indigenous numeration, architecture and trade separately, with limited comparative evidence across the six geopolitical zones. This gap highlights the need for a systematic investigation of mathematical knowledge embedded in indigenous building and trade practices in Nigeria, providing the basis for the present study.

Statement of the Problem

Indigenous mathematical knowledge constitutes an important component of Africa's intellectual heritage because it reflects how communities have historically applied mathematical reasoning to architecture, trade, agriculture, crafts, language and environmental management. In Nigeria, numerous studies have documented aspects of indigenous numeration systems, vernacular architecture, traditional exchange systems and ethnomathematical practices among selected ethnic groups. These studies have demonstrated that indigenous communities possess rich mathematical ideas embedded in counting systems, market transactions, settlement planning, building technologies and artistic designs. Despite these contributions, the available literature remains fragmented, with most studies examining these cultural expressions independently rather than as interconnected manifestations of indigenous mathematical knowledge. Consequently, there is limited understanding of how mathematical reasoning simultaneously underpins indigenous building and trade practices across Nigeria's diverse cultural landscape.

Furthermore, existing research has concentrated largely on the major ethnic groups, particularly the Hausa, Yoruba and Igbo, while comparatively little scholarly attention has been given to minority communities whose indigenous mathematical knowledge remains insufficiently documented. Comparative studies that systematically examine mathematical knowledge across Nigeria's six geopolitical zones are also scarce. This gap limits a comprehensive appreciation of the similarities and variations in indigenous mathematical practices and reduces opportunities for developing culturally responsive mathematics education and preserving endangered indigenous knowledge systems. It is against this background that this study investigates mathematical knowledge embedded in indigenous building and trade practices across selected communities representing Nigeria's six geopolitical zones, with a view to providing a comparative understanding of indigenous mathematical ideas and their implications for mathematics education and sustainable development.

Objectives of the Study

The main objective of this study is to investigate mathematical knowledge embedded in indigenous building and trade practices across Nigeria's six geopolitical zones. Specifically, the study sought to:

1. examine the mathematical ideas embedded in indigenous building practices across selected communities in Nigeria's six geopolitical zones;
2. investigate the mathematical concepts reflected in indigenous trade and commercial practices across the selected communities;
3. compare the similarities and variations in indigenous mathematical knowledge across Nigeria's six geopolitical zones; and
4. examine the implications of indigenous mathematical knowledge for mathematics education and sustainable development in Nigeria.

Research Questions

The following research questions guided the study:

1. What mathematical ideas are embedded in indigenous building practices across selected communities in Nigeria's six geopolitical zones?
2. What mathematical concepts are reflected in indigenous trade and commercial practices across the selected communities?
3. What similarities and variations exist in indigenous mathematical knowledge across Nigeria's six geopolitical zones?

4. What are the implications of indigenous mathematical knowledge for mathematics education and sustainable development in Nigeria?

Literature Review

Indigenous Mathematical Knowledge

Indigenous mathematical knowledge refers to mathematical ideas, procedures and reasoning that emerge from the everyday practices, languages and technologies of particular cultural groups. Unlike formal school mathematics, which is organised around standardised symbols and universal conventions, indigenous mathematics develops from practical experiences such as counting, measuring, designing, constructing, trading and navigating within specific socio-cultural environments. D'Ambrosio (1985) described these culturally situated mathematical practices as ethnomathematics, arguing that every society develops mathematical knowledge to solve problems relevant to its way of life. More recently, Batiibwe (2024) observed that indigenous mathematical knowledge is embedded in cultural activities including number systems, buildings, weaving, games and commercial practices, making it an important resource for contextualising mathematics instruction.

One of the most visible expressions of indigenous mathematical knowledge is indigenous numeracy. Indigenous numeral systems represent unique ways of conceptualising quantity, grouping, arithmetic operations and numerical relationships through language and culture. African societies have historically developed numeral systems that incorporate additive, subtractive, multiplicative and vigesimal structures depending on local linguistic traditions (Ascher, 1991). In Nigeria, studies of Yoruba, Igala and other indigenous numeral systems have shown that number expressions embody logical mathematical structures capable of supporting the teaching of place value, arithmetic operations and algebraic reasoning (Omachonu, 2011; Ejeba, 2025). Contemporary reviews further indicate that indigenous number systems provide meaningful links between learners' cultural experiences and formal mathematical concepts, thereby enhancing conceptual understanding and cultural relevance in mathematics education. These observations naturally extend to other practical domains where mathematical reasoning is applied.

Architecture provides another important manifestation of indigenous mathematical knowledge because traditional buildings embody principles of geometry, measurement, proportion, symmetry and spatial organisation. Indigenous builders employ practical mathematical reasoning in determining dimensions, angles, alignment, load distribution and material quantities without relying on formal engineering calculations. Gerdes (1994) demonstrated that African architectural forms reflect sophisticated geometric reasoning, while Eglash (1999) identified recursive and fractal patterns in traditional African settlements and architectural layouts. Recent Nigerian research equally highlights that indigenous building techniques, particularly mud architecture, possess environmental and cultural value despite challenges relating to modern perception, regulation and technological adaptation (Adetoro & Gambo, 2025). These findings reinforce the importance of examining architecture not only as cultural heritage but also as evidence of applied mathematical thinking.

Traditional trade systems similarly reveal indigenous mathematical competence through counting, estimation, pricing, measurement and exchange. Before the widespread adoption of modern currencies, Nigerian communities utilised cowries, manillas and other recognised media of exchange that required well-established systems of valuation and commercial arithmetic. Historical investigations by Jones (1958), Johnson (1970), Lovejoy (1974) and Naanen (1993) demonstrated that indigenous markets operated through systematic numerical reasoning that facilitated exchange across regions and cultures. Beyond their economic functions, these

commercial practices illustrate how mathematical ideas evolved to meet practical societal needs and remain valuable for understanding the historical development of numeracy and quantitative reasoning.

Indigenous mathematical knowledge also contributes to sustainability because it reflects generations of adaptation to local environmental conditions. Traditional architecture frequently employs locally available materials, passive ventilation, thermal regulation and resource-efficient construction methods that minimise environmental impacts. Recent studies on indigenous architecture in Nigeria indicate that sustainable building practices rooted in traditional knowledge can complement contemporary efforts to promote environmentally responsible construction, although greater institutional support and technological innovation are required for wider adoption. Consequently, indigenous mathematical knowledge should be viewed not only as cultural heritage but also as a contemporary resource for education and sustainable development, thereby providing a basis for examining empirical evidence from Africa and Nigeria.

Empirical Evidence from Africa and Nigeria

Empirical studies across Africa consistently demonstrate that mathematical concepts are embedded within indigenous cultural practices, although the emphasis varies across contexts. Gerdes (1994) documented geometric reasoning in African crafts and architecture, while Eglash (1999) illustrated mathematical structures in settlement patterns, design and artistic production. More recently, Batiibwe's (2024) review of 61 studies concluded that buildings, number systems, weaving, cultural games and symbolic calculations constitute the most frequently reported ethnomathematical activities linked to school mathematics. Similarly, Xu and Ball's (2024) scoping review identified a broad range of indigenous mathematical practices worldwide and argued that future research should move beyond merely identifying mathematical concepts towards systematically analysing and comparing them across cultural contexts.

Within Nigeria, available studies have largely focused on indigenous numeral systems, vernacular architecture or culturally responsive mathematics education. Research has demonstrated the mathematical sophistication of Yoruba, Igala and other indigenous numbering systems, while recent architectural studies have emphasised the sustainability potential of indigenous building technologies (Omachonu, 2011; Ejeba, 2025; Adetoro & Gambo, 2025). Nevertheless, relatively few investigations have undertaken comparative analyses across Nigeria's six geopolitical zones or examined indigenous numeracy, architecture and trade within a unified analytical framework. This fragmented body of evidence underscores the need for a comprehensive comparative study capable of synthesising diverse manifestations of indigenous mathematical knowledge across the country.

Theoretical Framework

This study is anchored in D'Ambrosio's Ethnomathematics and Bishop's Six Mathematical Activities, which together provide a complementary framework for interpreting indigenous mathematical knowledge. D'Ambrosio (1985) conceptualised ethnomathematics as the mathematics practised by identifiable cultural groups, emphasising that mathematical knowledge is generated through culturally meaningful activities rather than exclusively through formal schooling. Building on this perspective, Bishop (1988) identified six universal mathematical activities (counting, measuring, locating, designing, playing and explaining) that are present in every human society regardless of cultural background. Contemporary scholarship continues to recognise these complementary perspectives as foundational for integrating indigenous knowledge into mathematics education and analysing culturally embedded mathematical practices.

In the present study, D'Ambrosio's ethnomathematics provides the philosophical lens for recognising indigenous building and trade practices as legitimate mathematical knowledge systems, while Bishop's framework offers analytical categories for identifying and interpreting the mathematical ideas embedded in indigenous numeracy, architectural design and commercial activities across the six geopolitical zones. The integration of these frameworks therefore enables a systematic examination of both the cultural origins and the mathematical characteristics of indigenous knowledge, consistent with the objectives of the study.

Methodology

This study adopted a qualitative multiple-case study design using document review and oral documentation to investigate mathematical knowledge embedded in indigenous building and trade practices across selected communities in Nigeria. The design was considered appropriate because it enabled an in-depth exploration of indigenous mathematical knowledge within its natural cultural contexts while facilitating cross-case comparison among the selected communities (Yin, 2018). Documentary evidence complemented oral accounts and strengthened the credibility of the findings through data triangulation.

The study was conducted in Nigeria, which comprises six geopolitical zones with diverse cultural, linguistic and architectural traditions. One state was purposively selected from each zone: Kano (North-West), Borno (North-East), Nasarawa (North-Central), Lagos (South-West), Anambra (South-East) and Edo (South-South). These states were selected because they possess well-documented indigenous building traditions, established commercial systems and distinctive mathematical practices suitable for comparative analysis.

The cases were selected purposively using three criteria: (i) evidence of indigenous architectural and trade practices, (ii) availability of knowledgeable cultural custodians, and (iii) availability of documentary materials for triangulation. Data were obtained from primary and secondary sources. Primary data comprised oral interviews with indigenous knowledge holders, while secondary data were obtained from peer-reviewed journal articles, books, historical records, ethnographic reports and archival documents relevant to indigenous mathematics, architecture and trade.

Thirty-six participants were purposively selected, comprising six participants from each of the six states. Participants included traditional builders, experienced traders, community elders, language experts and cultural custodians with recognised knowledge of indigenous building, numeration and trade practices. Participants were selected based on their experience, community recognition and willingness to participate in the study.

Data were collected through semi-structured interviews conducted between January and March 2026 using an interview guide developed from the study objectives. Interviews were conducted in English or the participants' preferred indigenous language with interpreter support where necessary. With participants' consent, interviews were digitally recorded, while field notes were maintained to capture contextual observations. Audio recordings were transcribed verbatim, and interviews conducted in indigenous languages were translated into English before analysis.

Ethical approval was obtained from the relevant Institutional Research Ethics Committee before data collection. Permission was also obtained from community leaders in the selected communities. Written informed consent was obtained from all participants, who were assured of confidentiality, anonymity and their right to withdraw from the study at any stage. To enhance credibility, summaries of the interpreted findings were returned to selected participants for verification (member checking).

Data were analysed using thematic analysis following Braun and Clarke's (2022) procedures. Interview transcripts, field notes and documentary evidence were coded and organised into themes relating to indigenous numeracy, architecture, trade and sustainability. Cross-case comparisons were subsequently undertaken to identify common and unique mathematical practices across the six geopolitical zones. The analysis was guided by D'Ambrosio's Ethnomathematics, which provided the philosophical basis for recognising indigenous mathematical knowledge, and Bishop's Six Mathematical Activities, which informed the identification of mathematical ideas relating to counting, measuring, locating, designing, playing and explaining within the indigenous practices examined.

Results and Discussion

Table 1: **Mathematical Ideas Embedded in Indigenous Building Practices Across Selected Communities in Nigeria**

Geopolitical Zone	Community	Mathematical Practice	Evidence	Educational Implication
North-West	Hausa	Geometric layout and proportional room arrangement	Rectangular compounds with measured courtyards and aligned walls	Demonstrates geometry and measurement concepts
North-East	Kanuri	Circular planning and spatial organisation	Circular compounds with calculated spacing and orientation	Illustrates spatial reasoning and geometric design
North-Central	Alago	Symmetry and proportional construction	Uniform room dimensions and balanced structural layout	Supports teaching of symmetry and proportion
South-West	Yoruba	Courtyard planning and modular measurement	Compound design based on functional spacing and proportional units	Reinforces geometry and practical measurement
South-East	Igbo	Linear settlement planning and land measurement	Building alignment reflects organised spatial planning	Enhances understanding of measurement and scale
South-South	Edo	Geometric planning and earthwork construction	Planned layouts and defensive earthworks requiring precise measurement	Demonstrates geometry in engineering and construction

Table 1 indicates that indigenous building practices are founded on systematic mathematical reasoning rather than intuitive construction methods. Across the six geopolitical zones, traditional builders consistently applied concepts of measurement, proportion, symmetry and spatial planning to achieve structural stability, efficient use of available materials and adaptation to local environmental conditions. While the architectural forms reflected regional cultural differences, the mathematical principles underpinning construction were remarkably similar, suggesting that

indigenous communities independently developed practical mathematical solutions to comparable building challenges.

These findings corroborate the ethnomathematical perspective of D'Ambrosio (1985), which recognises culturally developed practices as legitimate forms of mathematical knowledge. They also reflect Bishop's (1988) mathematical activities of measuring, designing and locating, all of which were evident in the planning and construction of indigenous buildings across the selected communities. The findings are consistent with Gerdes (1994), who demonstrated that African indigenous architecture embodies sophisticated geometric reasoning, and Eglash (1999), who identified mathematical patterns in traditional African settlement designs. They further support the observations of Adetoro and Gambo (2025), who reported that indigenous Nigerian building techniques integrate mathematical reasoning with environmentally sustainable construction practices. The widespread application of these mathematical ideas in indigenous architecture underscores their relevance for culturally responsive mathematics education and provides a logical basis for examining the mathematical concepts embedded in indigenous trade and market practices presented in the next section.

Table 2: **Mathematical Concepts Reflected in Indigenous Trade and Commercial Practices Across Selected Communities**

Geopolitical Zone	Community	Mathematical Practice	Evidence	Educational Implication
North-West	Hausa	Counting and commodity valuation	Standardised measures used in grain and livestock trade	Reinforces arithmetic and estimation skills
North-East	Kanuri	Exchange and unit measurement	Indigenous units applied in market transactions	Demonstrates practical measurement concepts
North-Central	Alago	Counting and barter equivalence	Commodity exchange based on agreed quantitative values	Develops logical reasoning and comparison
South-West	Yoruba	Cowry-based calculations	Cowries used for pricing and commercial exchange	Supports number operations and mental computation
South-East	Igbo	Market numeracy and pricing	Counting systems applied in trade negotiations	Enhances quantitative reasoning and problem-solving
South-South	Edo	Currency conversion and valuation	Manillas and indigenous currencies used in commercial exchange	Demonstrates applied mathematics in everyday life

Table 2 shows that indigenous markets functioned through organised mathematical systems rather than informal commercial practices. Across the six geopolitical zones, traders consistently employed counting, estimation, measurement and proportional reasoning to determine prices, compare values and regulate exchanges. Although the media of exchange differed among communities, the mathematical principles underpinning commercial activities were broadly comparable, reflecting well-developed indigenous systems of quantitative reasoning that supported regional trade and economic interaction.

These findings align with D'Ambrosio's (1985) view that mathematical knowledge develops from the practical needs of society and is shaped by cultural experiences. The observed market practices illustrate Bishop's (1988) mathematical activities of counting, measuring and explaining, as traders applied numerical reasoning to quantify goods, determine equivalent values and communicate commercial information. The findings are consistent with the historical studies of Jones (1958), Johnson (1970), Lovejoy (1974) and Naanen (1993), which documented the mathematical organisation of indigenous currencies and commercial systems in Nigeria. They also support recent ethnomathematics literature highlighting indigenous trade as an authentic context for developing numeracy and problem-solving skills (Batiibwe, 2024). The widespread application of mathematical concepts in indigenous commerce demonstrates that market practices provide valuable cultural contexts for mathematics education and forms a basis for comparing indigenous mathematical knowledge across Nigeria's six geopolitical zones.

Table 3: **Comparative Analysis of Indigenous Mathematical Knowledge Across Nigeria's Six Geopolitical Zones**

Geopolitical Zone	Mathematical Practice	Evidence	Educational Implication
North-West (Hausa)	Decimal numeration, geometric building design and commodity measurement	Structured counting, rectangular compounds and standard market measures	Demonstrates applications of arithmetic, geometry and measurement
North-East (Kanuri)	Sequential counting, circular settlement planning and unit measurement	Indigenous counting expressions and organised spatial layouts	Enhances spatial reasoning and quantitative skills
North-Central (Alago)	Morphological numeration, proportional construction and barter valuation	Language-based number formation and proportional building techniques	Connects language with mathematical reasoning
South-West (Yoruba)	Vigesimal numeration, courtyard architecture and cowry-based trade	Base-20 counting, modular compound design and commercial calculations	Strengthens mental computation and problem-solving
South-East (Igbo)	Decimal counting, land measurement and market pricing	Organised settlement planning and structured pricing systems	Promotes numeracy and practical mathematics
South-South (Edo)	Indigenous currency, geometric earthworks and measurement	Manilla currency, engineered earthworks and planned urban layouts	Illustrates mathematics in engineering and commerce

The comparative analysis as shown in Table 3 demonstrates that indigenous mathematical knowledge is both culturally diverse and conceptually interconnected. Across all six geopolitical zones, communities consistently applied mathematical ideas involving counting, measuring, designing and explaining to address practical challenges in construction, trade and social organisation. The principal variations occurred in the linguistic representation of numbers, architectural forms and systems of commercial exchange, reflecting differences in historical development and environmental conditions rather than differences in mathematical sophistication. These findings indicate that indigenous mathematics is a shared national heritage expressed through culturally distinctive practices.

The findings support D'Ambrosio's (1985) proposition that mathematics develops within specific cultural contexts while remaining universally applicable to human problem-solving. They also reflect Bishop's (1988) six mathematical activities, particularly counting, measuring, locating, designing and explaining, all of which were evident across the six geopolitical zones. The observed similarities are consistent with Gerdes (1994) and Eglash (1999), who argued that African societies developed comparable mathematical principles despite cultural differences. Likewise, Xu and Ball (2024) reported that indigenous mathematical knowledge worldwide exhibits shared conceptual foundations while retaining distinctive cultural expressions. The cross-case evidence generated in this study therefore demonstrates that integrating examples from different Nigerian cultures into mathematics teaching can enrich learners' understanding of mathematical concepts while promoting cultural appreciation and national cohesion. These findings provide a basis for examining the educational implications of indigenous mathematical knowledge in the final research question.

Table 4: Educational and Sustainability Implications of Indigenous Mathematical Knowledge

Indigenous Mathematical Practice	Evidence	Educational Implication	Sustainability Implication
Indigenous numeration systems	Structured counting and arithmetic principles	Improves number sense and culturally relevant mathematics instruction	Preserves indigenous languages and mathematical heritage
Indigenous building practices	Application of geometry, measurement and proportion	Enhances the teaching of geometry and measurement	Encourages environmentally responsive and resource-efficient construction
Indigenous trade and market systems	Counting, valuation and commercial calculations	Strengthens numeracy, estimation and problem-solving skills	Promotes sustainable local economic practices
Cross-cultural mathematical knowledge	Shared mathematical ideas across communities	Supports culturally responsive curriculum development	Encourages preservation of indigenous knowledge systems

The results in Table 4 suggest that indigenous mathematical knowledge provides authentic learning experiences capable of strengthening mathematics instruction by connecting school mathematics with learners' cultural environments. Participants emphasised that familiar examples drawn from

indigenous architecture, markets and numeral systems make mathematical concepts more meaningful and easier to understand than abstract classroom illustrations. The findings further indicate that documenting indigenous mathematical practices contributes to preserving cultural heritage while providing locally relevant examples that support curriculum innovation. Beyond education, traditional building practices demonstrate sustainable approaches to construction through the use of locally available materials, climate-responsive designs and efficient utilisation of natural resources.

These findings reinforce D'Ambrosio's (1985) argument that mathematics education should recognise culturally developed knowledge systems as legitimate sources of learning. They also reflect Bishop's (1988) proposition that mathematical activities emerge from everyday human experiences and therefore provide appropriate foundations for classroom instruction. The results are consistent with Batiibwe (2024), who concluded that ethnomathematics promotes learners' engagement by linking mathematical concepts to familiar cultural practices. They also support the findings of Adetoro and Gambo (2025), who demonstrated that indigenous Nigerian architecture contributes to sustainable development through environmentally adaptive construction methods. Collectively, the findings indicate that integrating indigenous mathematical knowledge into mathematics education can simultaneously improve conceptual understanding, preserve Nigeria's cultural heritage and promote sustainable development. This synthesis highlights the value of indigenous mathematics as both an educational resource and a national intellectual asset deserving greater recognition in research, curriculum development and policy.

Educational Implications

The findings suggest that indigenous mathematical knowledge can enrich mathematics education by providing culturally relevant contexts for teaching abstract concepts. Teacher education programmes should prepare teachers to incorporate indigenous examples into classroom instruction, while curriculum developers should integrate validated indigenous mathematical practices into school curricula. Classroom instruction can benefit from examples drawn from indigenous architecture, trade and numeration systems to improve learners' engagement and conceptual understanding. However, successful implementation will require improved documentation of indigenous knowledge, appropriate teaching resources and continuous teacher professional development.

Limitations of the Study

This study was limited to six purposively selected cases representing Nigeria's six geopolitical zones. The findings were based mainly on preliminary oral documentation and documentary evidence with limited field data. In addition, the study did not include a classroom intervention to evaluate the effectiveness of integrating indigenous mathematical knowledge into mathematics teaching. These limitations should be considered when interpreting the findings.

Conclusion

This study demonstrated that indigenous building practices, trade systems and numeration across Nigeria embody rich mathematical knowledge applicable to mathematics education and sustainable development. Despite cultural variations, common mathematical principles of counting, measuring, designing and spatial reasoning were evident across the six geopolitical zones. The study contributes to ethnomathematics by providing a comparative perspective on indigenous mathematical knowledge in Nigeria and highlights its relevance for culturally responsive mathematics education. Future studies should extend the investigation to more communities and evaluate classroom applications of indigenous mathematical knowledge.

Recommendations

Based on the findings, the study recommends that:

1. NERDC should integrate validated indigenous mathematical examples into the school mathematics curriculum.
2. Teacher education institutions should strengthen teacher preparation in ethnomathematics and culturally responsive pedagogy.
3. Researchers and universities should document indigenous mathematical knowledge from underrepresented Nigerian communities.
4. Government and cultural agencies should support the preservation and dissemination of indigenous mathematical knowledge through educational and community initiatives.

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