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Development of Mining Engineering Skills Through Ethno-Mathematics Activities By Senior Secondary Schools Students In Kogi-Central, Nigeria

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Abstract

This study investigated the development of Mining Engineering skills through Ethnomathematics activities in Kogi-central of Kogi state. The study has two research questions. The population is all the 24,517 senior secondary school students in Kogi state, while the sample was 150 senior secondary school students which were selected using multi-stage sampling technique from all the five (5) local government area (30 from each LGA) of Kogi-central of Kogi state. Descriptive research techniques were used for the study; two instruments were used for data collection. The instruments were validated and reliability coefficient determined. Data were analysed using mean and standard deviation. The findings of the study reveal that students taught mathematics using ethnomathematics developed relevant mining Engineering skills such as identification of available minerals resources in Kogi state and Teamwork skills. Hence it was recommended that mathematics teachers should be trained on the utilization of ethnomathematics in senior secondary schools to be able to catch the mining engineers young from secondary schools.

Keywords: Development, mining engineering, skills, ethnomathematics, students

Introduction

Catch them young is the language of the progressive academics. The importance of mining in the development of any developing nation like Nigeria cannot be over-emphasized as most of our natural resources particularly in Kogi state remain untapped. This can be attributed to the fact that most of our young ones do not possess the skills of mining which could have triggered a revolution in the industry. Skills for mining engineering according to Encyclopedia (2022) include: Problem-solving and analytical skills, Strong technical skills including ability to use specialist mine planning software, Teamworking skills, Leadership skills, Commercial awareness, A commitment to safety and willingness to keep up to date with legislation and designing the layout of mining. At the secondary school levels, the importance of Mathematics towards the development of mining engineering skills cannot be over-emphasized. It has been fully established that a thorough knowledge of mathematics is fundamental to all engineering education and that the mathematical knowledge students brings to the tertiary institutions is the foundations upon which our five years engineering curriculum is built (Steinberg, 2022). Mathematics is a field of research that deals with quantity, structure, space, and change. It has evolved over time with abstraction and logical reasoning, starting from basic concepts like counting, calculation, measurement, and the examination of the shapes and movements of physical objects (Samuel & Sunday, 2024). In Nigerian educational system, Mathematics is considered a fundamental subject. Its integration into school curricula serves the purpose of equipping individuals with the necessary skills to proficiently apply mathematical knowledge in solving real-life problems daily. Mathematical skills are highly valued in civilizations due to their significant contributions to economic prosperity, as well as advancements in science and technology (Yadav, 2019). For individuals, it is needed to excel in many other disciplines and in a variety of responsibilities and vocations later in life (Yadav, 2019). However, mathematics is a topic that many students despise, which is associated to students finding it difficult and feeling uncertain about their skills (Harun et al., 2021). Mathematics involves the analysis of numerical values, measurements, structural conceptions, and broad quantities, making it vital for everyday existence, and its impact extends over a wide range of subjects, including science, social studies, music, and art (Wijaya et al., 2022).

Furthermore, showed that concentrating on math ideas becomes more stressful when students are prepared for arithmetic scenarios, which can generate anxiety and negative thoughts about their incapacity to handle problems.

However, students' performance in mathematics in Nigeria, particularly at the senior secondary school level, has been a cause for concern, due to negative attitudes, anxiety, fear of mathematics, inadequate teachers, poor teaching methods, inadequate materials, overcrowded classes, non-connection of Mathematics to local cultural values (ethno-mathematics) contribute to poor performance in mathematics among Senior secondary students (Salami, 2023). Ethnomathematics is the study of the relationship between mathematics and culture. It involves the exploration of how different cultures use mathematical concepts in their everyday lives. Ethnomathematics provides a unique and culturally relevant approach to teaching and learning mathematics. It recognizes the diverse ways in which mathematical knowledge is acquired, developed, and used in different cultural settings. (Durojaiye, 2023).

Ethnomathematics refers to the mathematical knowledge embedded within different cultural practices, traditions, and indigenous societies; it studies the cultural aspects of mathematics. It presents mathematical concepts of the school curriculum in a way in which these concepts are related to the students' cultural and daily experiences, thereby enhancing their abilities to elaborate meaningful connections and deepening their understanding of mathematics. Ethnomathematics approaches to mathematics curriculum are intended to make school mathematics more relevant and meaningful for students and to promote the overall quality of their education. Students with learning disabilities struggle in Mathematics and addressing factors like learner characteristics and instruction issues can improve their performance. Academic achievement on Ethnomathematics lies in the cultural perceptions and values associated with mathematical ability. Ethnomathematics explores how different cultures perceive, use, and teach mathematics. In many cultures, including Western societies, there's a strong belief that proficiency in mathematics reflects general intelligence. This belief influences educational systems and contributes to the emphasis on academic achievement in mathematics. Ethnomathematics would examine how cultural beliefs about intelligence and mathematics impact students' attitudes, motivations, and ultimately, their performance in mathematical tasks. It would also consider how culturally relevant teaching methods and contexts can enhance mathematical learning outcomes for diverse student populations. Therefore, understanding the cultural aspects of mathematics and intelligence provides insights into the dynamics of academic achievement in mathematics among students.

Understanding how students' cultural backgrounds and experiences impact their learning of mathematics is crucial for developing more effective teaching strategies. By addressing the unique cultural needs of students in Kogi state educators can create a more inclusive and supportive learning environment that fosters a deeper understanding and appreciation for mathematics. This study aims to contribute to the on-going efforts to improve mathematics education in Nigeria by considering cultural diversity of the students and exploring the potential benefits of incorporating Ethnomathematics into the teaching of mathematics for mining engineering skills development (Muhtadi, Sukirwan, Warsito, & Prahmana, 2022).

The implication of this is that mathematics should be taught both for knowledge acquisition and focused on development of skills that are relevant to the society for work after schools such as Mining Engineering (Fitzmaurice, O'Meara & Johnson, 2021). The relationship between mathematics and engineering is obvious. As students who do not perform well in mathematics will not be allowed to study engineering at the tertiary level. Kogi state is blessed with different types of local mathematical shapes and activities which are yet to be explored for teaching and learning of mathematics for mining Engineering.

Theoretical Foundations of Ethnomathematics:

Ethnomathematics, as a field of study, is underpinned by various theoretical frameworks that provide insights into the cultural, social, and historical dimensions of mathematical knowledge and practices. This essay explores the theoretical foundations of Ethnomathematics in education, drawing on contemporary research and scholarly perspectives to elucidate key theoretical frameworks and their implications for teaching and learning mathematics in culturally diverse contexts.

Socio-Cultural Theory

One of the central theoretical frameworks that informs Ethnomathematics education is socio-cultural theory, particularly as articulated by Lev Vygotsky. Socio-cultural theory emphasizes the role of social interactions, cultural tools, and historical contexts in shaping cognitive development and learning (Gutiérrez, 2020). In the context of Ethnomathematics education, socio-cultural theory highlights the importance of considering students' cultural backgrounds and experiences in mathematics teaching and learning. By recognizing the cultural dimensions of mathematical knowledge and practices, educators can create more meaningful and relevant learning experiences for their students.

Zone of Proximal Development (ZPD)

Vygotsky's concept of the Zone of Proximal Development (ZPD) is particularly relevant to Ethnomathematics education. The ZPD refers to the range of tasks that students can perform with the assistance of more knowledgeable others, such as teachers or peers (Vygotsky, 1978). In the context of Ethnomathematics, the ZPD can be understood as the space in which students can engage with mathematical concepts and practices that are culturally familiar to them, while also being challenged to explore new mathematical ideas and techniques. By scaffolding students' learning experiences within their ZPD, educators can support their development of both cultural and mathematical competencies.

Cultural-Historical Activity Theory (CHAT)

Cultural-Historical Activity Theory (CHAT), derived from the work of Vygotsky and further developed to offers a framework for understanding the complex interactions between individuals, tools, and cultural practices within a given social context. In the context of Ethnomathematics education, CHAT provides a lens through which to analyze how mathematical knowledge is produced, distributed, and appropriated within cultural communities. By examining the cultural-historical roots of mathematical practices, educators can gain insights into the ways in which mathematical concepts are embedded within broader social and cultural systems.

Adamu (2022) study examined the effect of ethno-mathematics and conventional teaching approaches on students' achievement, interest and retention in geometry in selected secondary schools in Makurdi metropolis, Benue State, Nigeria. Quasi experimental research design and survey research design which follows quantitative methodology were adopted for the study. The sample of 270 respondents was used for the study. The researcher used primary data obtained using a structured questionnaire. The data collected were analyzed using inferential statistics such as simple linear regression and analysis of covariance (ANCOVA). The result of the study indicates that a negative effect was established between ethno-mathematics teaching approach and students' achievement in geometry. The effect is not statistically significant ($p > 0.05$) and the effect is in line with a priori expectation. For the second and third model of the study, ethnomathematics teaching approach have a positive and significant effects ($p < 0.05$) on students' interest and students' retention in geometry in selected secondary schools in Makurdi Metropolis, Benue State, Nigeria. In a study, Omere & Ogedengbe (2022), the study investigated the effect of Ethnomathematics teaching method on mathematics students' achievement in Geometry in Akoko Edo Local Government Area, Edo State. The study population comprise all Junior Secondary School students in Akoko Edo Local Government. The sample consisted of 200 Junior Secondary School Mathematics students selected using simple random sampling technique. Four schools were selected, two each for experimental and control groups. The instrument used for the study was Geometry Achievement Test (GAT). Two research questions were raised with two corresponding hypotheses formulated and tested. Data were analysed using descriptive and inferential statistics. 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.

The Impacts of using ethnomathematics in teaching on performance and retention in mathematics among primary iii pupils, Lere education district, Kaduna, Nigeria is a study carried out by Ya'u, (2021). The study was conducted based on four specific objectives. Four research questions were constructed, and four null hypotheses were formulated to guide the study. A pre-test, post-test and post-post-test quasi experimental design was adopted. From a target population of two hundreds and ninety-five 295 public primary Schools with 11,289 pupils (5,862 males and 5,427 females) simple random sampling techniques were used to select the schools and the class of the pupils respectively. 207 pupils were selected for the study in accordance with Central Limit Theorem that regarded a minimum of 30 sample size appropriate for experimental research. Mathematics Performance Test 1 (MPT1), Mathematics Performance Test 2 (MPT2) and Mathematics Retention Test (MRT) were the instruments used in collecting data as Pretest, Post-test and Post-post-test respectively. A Spearman-Brown coefficient of $r = 0.89$ was found. The data were analysed using mean, standard deviation and t-test Analysis at 0.05 level of significance using statistical package for social sciences (SPSS), version 2016. Results of the study indicated that primary III pupils taught using ethnomathematics teaching performed and retained mathematical concepts better than those taught with conventional teaching method. The result also revealed no significant difference between the performance and retention of male and female primary III pupils taught mathematical concepts using ethnomathematics teaching strategy. In a study by Umar, Tudunkaya and Muawiya (2019) to determine the effectiveness of Ethno-mathematics Teaching Approach on Performance and Retention in Trigonometry in Zaria LGA of Kaduna state, Nigeria. The study Used a sample size of 103 Senior Secondary 2 (SS 2) students out of (1350) SS2 students in 26 Public Senior Secondary School in the area. The study adopted quasi-experimental research design which involve experimental and control groups of which Experimental Group was exposed to Ethno-mathematics Teaching Approach and Control Group was exposed to Conventional Approach. The study was guided by two research questions and two research hypotheses. Trigonometry Concept Performance Test

(TCPT) and Trigonometry Concepts Retention Test (TCRT) items with a reliability coefficient of 0.78 and 0.75 were used for pre-test and post-test. Answers to the research questions were given using Mean and Standard Deviation while the hypothesis one was tested at 0.05 level of significance using independent sample t-test analysis for performance and Man-Whitney u-test analysis for retention. The results from the analysis revealed that students exposed to Ethno-Mathematics Teaching Approach were superiors in performance and retention than those taught with Conventional Approach. Thus, there were significant differences between the mean performance scores and retention scores of the students taught Trigonometry concepts with Ethno-Mathematics Teaching Approach and those taught with Conventional Approach.

In a study was conducted by Unodiaku(2019) to ascertain the effect of ethno-mathematics teaching materials on students' achievement in mathematics. The sample for the study was 156 Senior Secondary Schools two (SSS 2) students, which were randomly selected from 16 Senior Secondary Schools in Igbo-Etiti Local Government Area of Enugu State through multi-stage sampling technique. The instrument used for the study was ethno-mathematics achievement test (ETHNOMAT). The data obtained with the instrument were analyzed using mean and Analysis of covariance (ANCOVA). Mean was used to answer the research questions posed, while ANCOVA statistic was employed in testing the null hypothesis at 0.05 significant level. Findings of the study showed that the ethno-mathematic achievement test was effective in enhancing students' achievement in mensuration with reference to volumes of cylinder and hemisphere. It was recommended among others that ethno-mathematics teaching materials should be incorporated in the Senior Secondary School mathematics curriculum as technique to be used by teachers in teaching the concepts of volumes of cylinders and hemispheres. One of the key insights of contemporary scholarship is the recognition of mathematics as a cultural practice. Rochelle Gutiérrez (2020) argues that mathematics is inherently embedded within cultural contexts and reflects the values, beliefs, and norms of the societies in which it is practiced. This perspective challenges the notion of mathematics as a neutral and objective discipline, highlighting its entanglement with human culture. The cultural context also influences the development and conceptualization of mathematical ideas. For example, the concept of number varies across cultures, with some languages having distinct numerical systems and counting practices (Gómez, 2019). Furthermore, cultural metaphors and symbols often shape mathematical discourse, as evidenced using geometric motifs in Islamic art and architecture (D'Ambrosio, 2019).

Scholars such as Marcia Ascher (2024) have explored the intricate relationship between mathematics and culture, arguing that cultural practices influence the development and application of mathematical concepts. Ascher's research on traditional weaving patterns among the Navajo people of the United States demonstrates how mathematical principles are embedded within indigenous art forms, challenging the Eurocentric view of mathematics as a purely abstract and universal discipline. In the field of mathematics education, Ethnomathematics offers a framework for promoting culturally relevant pedagogy and curriculum development. Gloria Gilmer and Marilyn Frankenstein (2019) emphasize the importance of incorporating Ethnomathematical perspectives into classroom instruction to engage students from diverse cultural backgrounds and foster a deeper understanding of mathematical concepts. By integrating cultural artefacts, rituals, and practices into mathematics lessons, educators can create meaningful learning experiences that resonate with students lived experiences.

From the reviewed literatures, the potency of Ethnomathematics in aiding teaching, learning and performance of students in mathematics was very evident. However, none of the studies went further in exploring the usefulness of ethnomathematics in the development of mining engineering skills of the students in secondary schools in Kogi state. Hence this study intends to investigate the impact of Ethnomathematics on senior secondary schools' students' development of mining engineering skills in Kogi state. Hence this study intends to investigate the impact of Ethno-mathematics on senior secondary school students' development of mining Engineering skills.

Statement of the Problem

Mining Engineering is primarily about recognizing and capitalising on available mineral resources, harvesting and utilizing them for the development of the society. Its core purpose is to equip students with the knowledge, motivation and skills necessary to earn a living and be useful to themselves and society. Ethnomathematics helps students to engage with and understand mathematical concepts in a way that is culturally relevant and meaningful to their experiences and develop entrepreneurship skills for their personal use and that of the society, but the absence of white-collar job has dealt a huge blow to the graduates' ability to make a living after secondary schools. In this ideal situation, the integration of Ethnomathematics into the mathematics curriculum would lead to increased student engagement, improved understanding of mathematical concepts, higher academic performance and high development of entrepreneurship skills. 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 some interest in Mathematics. It must move from culturally known to unknown "culturally familiar to unfamiliar", "from cultural past to present". 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 mathematics effectively. Some studies have shown that Ethnomathematics have helped students to understand mathematics and perform well in them, but none of the studies have investigated how Ethnomathematics activities can help in development of mining engineering skills of senior secondary school students in Kogi state. Hence the need for this study.

Research Questions

The following research questions were raised to guide this study:

1. What is the impact of Ethnomathematics activities on students' abilities to identify resources for mining in their immediate environment?
2. What is the impact of Ethnomathematics activities on students' development of teamwork skills?

Methodology

This study will utilize both qualitative and quantitative approach. This will involve the use of questionnaires, observation, checklist and interview. The population of the study is all the 24,517 senior secondary school students in Kogi state, Nigeria. Kogi state has 21 local governments spread across the three senatorial districts (Source: MFEST, 2024). The sample of the study will be the 500 students that will be selected from the five (5) local government in Kogi-central of Kogi state using multistage sampling techniques. This will involve selecting two public schools from each of the five local government areas of Kogi-central in Kogi state. Then selecting 50 senior secondary school two (2) students from each school from each of the selected schools that will participate in the study. Five instruments will be used for data collection. Ethno-mathematics teachers training manual, Ethnomathematics students mining training guide, Mining Engineering checklist, Observation and Structured interview. The Instruments was taken to the National Mathematical Centre Abuja for face and content validity of the instruments. Also, the instruments will be given to five other experts in mining engineering, Test and measurement for their inputs in Federal University of Technology, Akure and Federal University of Technology Minna. All their inputs were examined and carefully applied. The instruments were trial tested for four weeks in schools which were not part of the original research at two weeks interval and Cronbach Alpha and Pearson's moment correlation coefficients will be used to determine the correlation coefficients of the instruments. The researchers trained all the 10 selected mathematics teachers at the selected schools on how to use ethnomathematics in the development of students' mining engineering skills in a workshop that will last for five days. The Ethno-mathematics teachers training manual was used for the training. After the teachers training, the teachers were equipped with the necessary raw materials to enable them to teach the selected students in their schools mining engineering skills using Ethnomathematics for six weeks 3-days in week for 3hours per contact. Three months after the students training and mobilization, the researchers went back to the schools to collect data using mining engineering checklists, observation and structured interviews to collect data. All collected data were analyzed using, coding, mean and standard deviation.

Results

Research Question One: What is the impact of Ethnomathematics activities on students' abilities to identify resources for mining in their immediate environment?

Table 1: Responses of students to abilities to identify resources for mining because of Ethnomathematics activities

S/NO.	Statement	A	D	$\bar{x}$	STD	Remark
1	I can identify coal in my area due to Ethnomathematics activities	114	36	3.9	0.9	Agreed
2	I can identify sharp sand in my area due to Ethnomathematics activities	111	39	3.4	0.6	Agreed
3	I can identify laterite in my area due to Ethnomathematics activities	133	17	4.2	0.8	Agreed
4	I can identify limestone in my area due to Ethnomathematics activities	124	26	4.1	0.7	Agreed
5	I can identify particles of gold in my area due to Ethnomathematics activities	111	39	3.4	0.5	Agreed
s6	I can identify iron ore in my area due to Ethnomathematics activities	132	18	4.1	0.6	Agreed
7	I can identify tantalite in my area due to Ethnomathematics activities	144	16	4.4	0.4	Agreed
8	I can identify columbite in my area due to Ethnomathematics activities	131	29	4.0	0.7	Agreed

9	I can identify kaolin in my area due to Ethnomathematics activities	112	38	3.5	0.6	Agreed
10	I can marble in my area due to Ethnomathematics activities	109	41	3.2	1.2	Agreed
Grand mean		3.9				

Source: TETfund Institutional-Based Research Field Work

From Table 1, Students' responses after been exposed to Ethno-mathematics activities indicated that the can identify coal ($\bar{x}=3.9$, $STD=0.9$), laterite($\bar{x}=3.4$, $STD=0.6$), sharp sand($\bar{x}=4.2$, $STD=0.8$), limestone($\bar{x}=4.1$, $STD=0.7$), particles of gold($\bar{x}=3.4$, $STD=0.5$), iron ore($\bar{x}=4.1$, $STD=0.6$), tantalite($\bar{x}=4.4$, $STD=0.4$), columbite($\bar{x}=4.0$, $STD=0.7$), kaolin($\bar{x}=3.5$, $STD=0.6$), and marble($\bar{x}=3.2$, $STD=1.2$) with a grand mean of 3.9.

Research Questions Two: What is the impact of Ethnomathematics activities on students' development of teamwork skills?

Table 2: Responses of students to development of teamwork skills due to ethnomathematics activities.

S/NO	STATEMENT	A	D	$\bar{x}$	STD	REMARK
1	Ethno-mathematics helped me to develop good communication skills	143	7	4.1	1.1	Agreed
2	Ethno-mathematics helped me to develop individual talents	108	42	3.7	0.6	Agreed
3	Ethno-mathematics helped me to develop sense of belonging	130	20	3.9	0.8	Agreed
4	Ethno-mathematics helped me to develop clear mental structure	134	16	3.9	0.9	Agreed
5	Ethno-mathematics helped me to develop strong leadership style	132	28	3.7	0.8	Agreed
6	Ethno-mathematics helped me to develop achievable goals	142	8	4.0	0.9	Agreed
7	Ethno-mathematics helped me to develop feedback policy	139	11	3.9	1.2	Agreed
8	Ethno-mathematics helped me to develop positive attitude	145	5	4.2	0.6	Agreed
9	Ethno-mathematics helped me to develop solution focused Team	134	16	3.9	0.9	Agreed
10	Ethno-mathematics helped me to develop trust among my peers	140	10	3.7	0.7	Agreed
11	Ethno-mathematics helped me to develop friendship in diversity	149	1	4.7	0.3	Agreed
12	Ethno-mathematics helped me to develop problem-solving skills	143	7	4.3	0.8	Agreed
13	Ethno-mathematics helped me to develop respect for others	139	11	3.9	0.6	Agreed
14	Ethno-mathematics helped me to develop shared values	137	13	3.8	0.8	Agreed
15	Ethno-mathematics helped me to understand delegation of responsibility	142	8	4.2	0.4	Agreed
16	Ethno-mathematics helped me to recognise individuals' difference	142	8	3.9	0.8	Agreed
17	Ethno-mathematics helped me to understands each one role	135	15	3.6	0.7	Agreed
18	Ethno-mathematics helped me to develop empathy towards others	142	8	4.3	0.4	Agreed
19	Ethno-mathematics helped me to develop creativity and innovation	134	16	3.7	0.8	Agreed
20	Ethno-mathematics helped me to develop commitment and accountability	147	3	4.4	0.7	Agreed
Grand mean						

Source: TETfund Institutional-Based Research Field Work

From Table 2, Ethno-mathematics helped me to develop good communication skills($\bar{x}=4.1$, $STD=1.1$), individual

talents($\bar{x}=3.7, \text{STD}=0.6$), sense of belonging($\bar{x}=3.9, \text{STD}=0.8$), clear Mental structure($\bar{x}=3.9, \text{STD}=0.9$), strong leadership style($\bar{x}=3.7, \text{STD}=0.8$), achievable goals($\bar{x}=4.0, \text{STD}=0.9$), feedback policy($\bar{x}=3.9, \text{STD}=1.2$), positive attitude($\bar{x}=4.2, \text{STD}=0.6$), solution focused team($\bar{x}=3.9, \text{STD}=0.9$), trust among my peers($\bar{x}=3.7, \text{STD}=0.7$), friendship in diversity($\bar{x}=4.7, \text{STD}=0.3$), problem-solving($\bar{x}=4.3, \text{STD}=0.8$), respect for one another($\bar{x}=3.9, \text{STD}=0.6$), shared values($\bar{x}=3.8, \text{STD}=0.8$), delegation of responsibility($\bar{x}=4.2, \text{STD}=0.4$), recognition of individuals differences($\bar{x}=3.9, \text{STD}=0.8$), each one roles($\bar{x}=3.6, \text{STD}=0.7$), empathy towards other($\bar{x}=4.3, \text{STD}=0.4$), creativity and innovation($\bar{x}=3.7, \text{STD}=0.8$), commitment and accountability($\bar{x}=4.4, \text{STD}=0.7$).

Findings of the Study

1. Ethnomathematics activities help the students to identify available resources that can be mined in Kogi state such as coal, laterite, sharp sand, limestone, particles of gold, iron ore, tantalite, columbite, kaolin and marble.
2. Ethnomathematics activities help the students to develop teamwork skills such as good communication skills, individual talents, sense of belonging, clear Mental structure, strong leadership style, achievable goals, feedback policy, positive attitude, solution focused team, trust among my peers, friendship in diversity, problem-solving, respect for one another, shared values, delegation of responsibility, recognition of individuals differences, each one roles, empathy towards other, creativity and innovation, commitment and accountability.

Discussion of Findings

This study investigated the impact of Ethnomathematics activities on senior secondary school's students' development of mining skills in Kogi State, Nigeria.

The findings from the research question one indicated that students were able to identify mineral resources for mining activities in Kogi state after been through ethnomathematics activities. Such mineral resources which are all available in Kogi state are: coal, laterite, sharp sand, limestone, particles of gold, iron ore, tantalite, columbite, kaolin and marble. This shows that allowing mathematics to be taught using local resources and materials can help them to identify resources in their environment which can be mined. This finding is corroborated by the findings of D'Ambrosio (2019) who revealed that cultural metaphors and symbols often shape mathematical discourse, as evidenced using geometric motifs in Islamic art and architecture. This is also in line with the findings of Steinberg (2022) whose study established that a thorough knowledge of mathematics is fundamental to all engineering education and that the mathematical knowledge students brings to the tertiary institutions is the foundations upon which our five years engineering curriculum is built.

Furthermore, findings from the second research question indicated that ethnomathematics activities help the students to develop teamwork skills such as good communication skills, individual talents, sense of belonging, clear Mental structure, strong leadership style, achievable goals, feedback policy, positive attitude, solution focused team, trust among my peers, friendship in diversity, problem-solving, respect for one another, shared values, delegation of responsibility, recognition of individuals differences, each one roles, empathy towards other, creativity and innovation, commitment and accountability. This might be because of students constantly interacting with each other all through the period of ethnomathematics activities. This finding is supported by Marcia Ascher (2024) whose study explored the intricate relationship between mathematics and culture, arguing that cultural practices influence the development and application of mathematical concepts. Ascher's research on traditional weaving patterns among the Navajo people of the United States demonstrates how mathematical principles are embedded within indigenous art forms, challenging the Eurocentric view of mathematics as a purely abstract and universal discipline.

Conclusion

Based on the findings of this study, it was concluded that ethnomathematics activities positively influenced students' development of mining engineering skills at the senior secondary schools in Kogi state Nigeria.

Recommendations

Based on the findings of this study, it was recommended that:

1. Mathematics teachers should be properly trained to use Ethnomathematics in the teaching and learning of mathematics to help senior secondary schools students develop relevant mining engineering skills that will help them harness mineral resources in their states and country at large.
2. Government and all stake holders should include the utilization of ethnomathematics in the mathematics curriculum teaching strategies to boost the development of mining engineering skills of students at the senior secondary schools.

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References

1. Adamu, G. (2022). Effect Of Ethno-Mathematics and Conventional Teaching Approaches on Students' Achievement, Interest and Retention in Geometry in Selected Secondary Schools in Makurdi Metropolis, Benue State, Nigeria. *Ijrdo -Journal of Mathematics*, 8(4), 1-10. <https://doi.org/10.53555/M.V8i4.5031>
2. D'Ambrosio, U., & Rosa, M. (2019). Ethnomathematics and its pedagogical action in mathematics education. *Ethnomathematics and its diverse approaches for mathematics education*, 285-305.
3. Cambridge University Press (2022), Aria. In R.M. Marvin(ed), *The Cambridge Verdi Encyclopedia* (p.15).
4. Fitzmaurice, O., O'Meara, N. & Johnson, P. (2021). Highlighting the Relevance of Mathematics to Secondary School Students. -Why and how? *European Journal of STEM Education*, 6(1), 07
5. Gloria Gilmer and Marilyn Frankenstein (2020). Art-integration through making dioramas of women mathematicians' lives enhances creativity and motivation." *Journal of STEM Arts, Crafts, and Constructions* 1.2 (2016): 8.
6. Gómez, D. M., (2019). The effect of inhibitory control on general mathematics achievement and fraction comparison in middle school children. *Zdm*, 47, 801-811.
7. Harun, et al (2021). "Green washing" or "authentic effort"? An empirical investigation of the quality of sustainability reporting by banks. *Accounting, Auditing & Accountability Journal*, 34(2), 338-369.
8. Marcia Asher (2024). Improving low-performing schools: A meta-analysis of impact evaluation studies. *American Educational Research Journal*, 59(5), 975-1010.
9. Ministry For Education Science and Technology (2024)
10. Muhtadi, D, Sukirwan, Warsito & Prahmana, R. (2019) December). The Integration of Technology in teaching mathematics. In *Journal of Physics: Conference Series* (Vol. 943, No. 1, p. 012020). IOP Publishing.
11. Omere, P.S. & Ogedengbe, S. (2022). Effect of Ethnomathematics Teaching Method on Mathematics Achievement in Geometry Among Secondary School students in Edo State. *Rivers State University Journal of Education* Volume 25 (1):99-105
12. Rajkumar, R., & Hema, G. (2020). Assessing General Intelligence in Influencing Performance of Mathematics. *Journal of Educational Psychology*, 12, 19-24. <https://doi.org/10.26634/JPSY.12.1.14143>.
13. Salami, D. (2023). Adopting Virtual learning: Its impact on Performance among Colleges of Education Mathematics Students in North-central, Nigeria. *Journal of Science, Technology and Mathematics Pedagogy*, (1), 200-208
14. Samuel, S.S. & Sunday, Y. (2024). Influence of Schol Type and Gender on students' performance in Mathematics in Damaturu Education Zone, Yobe state, Nigeria. *Journal of Science, Technology and Mathematics Pedagogy*, 2(1), 52-63
15. Steinberg, S.S. (2022). The Relation of Secondary Mathematics to Engineering Education. *The Mathematics Teacher*, 97(8), 306-317
16. Sunday, Y., Ampka S. A., Abdulwaheed, O. A. & Olorunnishola, O.A. (2023). Impact of Mathematics Teachers Training on Setting-up Mathematics Laboratory for Entrepreneurship Education on Senior Secondary School's studentss' entrepreneurship skills in Kogi State, Nigeria. *Proceedings of Mathematical Association of Nigeria*, 120130.
17. Sunday, Y., Akanmu, M.A. & Fajemidagba, M. O. (2016). Fostering Entrepreneurship in Education: The Impact of Mathematics Laboratory Approach. *Journal of National Mathematical Centre, Abuja, Nigeria*. Volume 10 Number 1, 47-54
18. Umar, I.O, Tudunkaya, M. S. & Muawiya H. U. (2019). Effect Of Ethno-Mathematics Teaching Approach on Performance and Retention in Tribometry Among Secondary School Students in Zaria Local Government Area Kaduna State, Nigeria. *Abacus*, Vol. 44, No 1, 104-112
19. Unodiaku, S. S. (2019) Effect of Ethno-Mathematics Teaching Materials on Students' Achievement in Mathematics in Enugu State. *Journal of Education and Practice* 9(2), 70-71
20. Vygotsky (1978). Development of mathematical thinking through integration of Ethnomathematics folklore game in math instruction. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(2), 617-630.
21. Wijaya et Al (2022). Applying the UTAUT model to understand factors affecting micro-lecture usage by mathematics teachers in China. *Mathematics*, 10(7), 1008.
22. Yadav, M. (2019). Association of financial attitude, financial behavior and financial knowledge

- towards financial literacy: A structural equation modeling approach. FIIB Business Review, 8(1), 51-60.
23. Ya'u, S. (2021) Impacts of Using Ethnomathematics in Teaching on Performance and Retention in Mathematics among Primary 3 Pupils, Lere Education District, Kaduna, Nigeria. Unpublished PhD Thesis of the Department of Science Education, Ahmadu Bello, University, Zaria.