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Teachers' Knowledge and Usage of Ethnomathematics in Asokwa Municipality (Kumasi) of Ashanti Region of Ghana

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ABSTRACT

This study investigated teachers' knowledge and usage of ethnomathematics in Asokwa Municipality (Kumasi) in the Ashanti region of Ghana. The triangulation design of the mixed method was used. Purposive sampling was used to select all the 62 mathematics teachers from all the public junior high schools in the municipality. Results from the data analysis showed that mathematics teachers in Asokwa Municipality possess a high level of knowledge of ethnomathematics, with an overall mean score of 3.68 and a standard deviation of 0.61. The study recommended that Ghana Tertiary Education Commission (GTEC) should ensure that teachers' colleges of education train mathematics teachers on the integration of ethnomathematics in the teaching of mathematics

KEYWORDS

Ethnomathematics; cultural experiences; knowledge.

INTRODUCTION

The efficiency of mathematics education has been the subject of intense discussion in several nations over the last few decades (Bishop, 1994). More than any other subject, mathematics is seen to be unaffected by culture and morals, leading many mathematicians to conclude that it is not necessary to take the variety of the people who study it into account. Mathematics is a cultural product, and factors like the pupils' ethnicity may influence how they learn it (Presmeg, 1998). Ethnomathematics and cultural methods have grown significantly in popularity during the past few years. Ethnomathematics is no longer a supplemental subject or a topic for edging or enrichment.

To accommodate pupils from various backgrounds and with various learning styles, teachers must acquire specialized instructional techniques. It is widely understood that a pupils' culture can influence how they feel about participating in class discussions, asking questions, accepting authority, memorizing information, looking for creative methods to grasp concepts, and many other aspects of classroom instruction. Knowing pupils' understandings, interests, and experiences as well as the variety of ways that they might learn is essential for effective training. It also connects mathematics to the learners' local culture by adding local mathematics (Shirley, 1995). This may include the mathematics incorporated into their ancestral religion, works of art, crafts, textiles, music, or celebrations.

D'Ambrosio (2001) writes that "ethnomathematics is a technique of teaching and learning mathematics that relies on the pupils' prior knowledge, background, and the importance of his local environment in terms of both content and methodology, as well as his past and present experiences with that environment." According to Dolomite (2004) that it is important to emphasize that the goals of the ethnomathematics program should be incorporated as instructional practices in the school curricula.

Orey, D. C., & Rosa, M. (2008) contend that culturally relevant mathematics curricula should emphasize how mathematics plays a part in a sociocultural framework that includes the theories and notions found in ethnomathematics and how to approach contextualized

issues from an ethnomathematical perspective. This type of mathematics curriculum looks at how pupils' communities and schools are culturally compatible, which shows how much regard instructors have for their pupils' cultural backgrounds. Zeichner (2013) asserts that teachers must be aware of and respectful of the varied cultural traditions and languages of the pupils in their classrooms in order to execute the idea of cultural congruence. In order to recognize mathematics as a socially and culturally constructed field, teachers should accomplish this by developing a clear sense of their own ethnic and cultural identities in order to be able to comprehend and value those of their pupils. As a result of the debate above, research in Ghana and data specifically from the Asokwa Municipality will further our understanding. From the above discussion, it is clear that ethnomathematics is very important. This study will seek to determine the level of knowledge of teachers of Mathematics on ethnomathematics, how ethnomathematics is being used in the teaching and learning of mathematics in the municipality and also find out the effective ways in which ethnomathematics can be used to increase pupils' understanding in the teaching and learning of mathematics in the Asokwa Municipality, Ashanti Region, Ghana.

Research Objectives

The objectives of this study were to:

1. Determine the level of knowledge of teachers of Mathematics on ethnomathematics in the Asokwa municipality of Ghana
2. Find out how ethnomathematics is being used in the teaching and learning of mathematics in the municipality.
3. Determine the effective ways in which ethnomathematics can be used to increase pupils' understanding of mathematics in the municipality.

LITERATURE REVIEW

Knowledge of Teachers of Mathematics on Ethnomathematics

The experiences that pupils have and those that are common in their cultural surroundings are both included into the ethnomathematical curriculum in the classroom. Including cultural customs and experiences from individual pupils, societies and communities at large is the aim of ethnomathematics. Orey, D. C., & Rosa, M. (2008) claim that ethnomathematics uses these cultural experiences to increase the relevance of mathematics education for pupils and to provide them insights into how mathematics is ingrained in their social and cultural contexts. Ethnomathematics helps restore cultural dignity and gives individuals the intellectual tools to exercise their civic duty. It promotes creativity, elevates cultural self-respect, and offers a broad view of mankind. In practical words, it's a body of knowledge that opens the door to a more harmonious and beneficial interaction between humans and the natural environment (D'Ambrosio 1999).

According to Rosa, M. and Orey, D. C. (2011), the study of the cultural aspects of mathematics is known as ethnomathematics. The concepts in mathematics presented in the curriculum are taught in a way that connects the principles to the pupils' daily lives and cultural experiences. This enhances the pupils' understanding of maths and helps them make more meaningful connections. By making mathematics more engaging and relevant for pupils, ethnomathematical approaches to mathematics education aim to enhance the learning process for all involved. The incorporation of an ethnomathematical perspective in the mathematics curriculum aids pupils' intellectual, social, emotional, and political growth by using their own unique cultural reference to impart knowledge, skills, and attitudes. Through this curriculum, kids may succeed academically while maintaining their identities. The teacher facilitates all these.

Which the instructor uses their own ethnomathematics (often learned in college) and the pupils use their own is not neutral. Since their ethnographic knowledge is legitimized (accepted as useful) in the educational process, such a discussion might help pupils reinforce their sociocultural roots. This kind of instruction can also highlight the fact that mathematics is not a single, singular statement and cannot be seen as a "straight line." A forest, in which each tree would be viewed as a distinct manifestation of ethnomathematics, may serve as a better metaphor for the entire collection, created by society and culture. Dialogue does not imply that the instructor and pupils perform identical roles and instead should be viewed as having a horizontal rather than a vertical or hierarchical interaction. Equal doesn't necessarily equate to uniform. The instructor is distinct from the pupil, among other things, since the teacher is clearly trying to educate. As a teacher, we had worked and studied toward several objectives, one of which may be creating a democratic educational interaction between teacher and pupils that might aid in the formation of critical awareness in the pupils. Such a teacher feels that, in order to promote this growth, power must be shared with the pupils during the educational process.

RESEARCH METHODS

Population, Sample Size and Sampling Procedure

The study's population is made up of all sixty-tow (62) junior high school teachers of Mathematics in Asokwa Municipality. The study involved 31 junior high schools

Purposive sampling was used to select all the 62 teachers of mathematics for the study. Focus group discussion was used for the interview. The teachers of Mathematics in each school were interviewed together as one focus group. The researcher used Convenience sampling for the interview. They were coded from *FG1* to *FG13*.

Research Instrument

The study's instruments included a questionnaire and semi-structured interview guides. These resources were deemed suitable by the researcher to address the inquiry-driven study's research questions. The questionnaire addressed the quantitative component of the task, and the majority of the items were closed-ended inquiries. On the other hand, this extremely mixed-approach research's qualitative component benefited from a semi-structured interview. All of the interview questions posed were open-ended in character.

RESULTS AND DISCUSSION

The data collected during the study have been analysed in terms of descriptive statistics. The results are presented in Tables for easy presentation of data. The results are presented based on the research questions, which are;

1. What is the level knowledge of teachers of Mathematics on ethnomathematics in the Asokwa municipality?
2. How is ethnomathematics being used in their teaching of mathematics in the municipality?
3. What are some of the effective ways ethnomathematics contribute to pupils understanding of mathematics in the municipality?

This study employed 62 respondents who were all JHS teachers. The demographic characteristics of teachers are presented in Table 1.

Table 1. Distribution of Teachers According to Their Characteristics

Characteristic	Category	Frequency (N)	Percentage (%)
Gender	Male	36	58.1%
	Female	26	41.9%
Age Group	20-30Yrs	29	46.8%

	31-40Yrs	22	35.5%
	41 and above	11	17.7%
Years of Teaching	1-5Yrs	36	58.1%
	6-10Yrs	6	9.7%
	11-15Yrs	14	22.6%
	16-20Yrs	6	9.7%
Level of Education	Diploma	8	12.9%
	Degree	39	62.9%
	Master's Degree	12	19.4%
	Cert "A"	3	4.8%

Table 2. Scale of Interpretation for a Five-point Likert Scale Questionnaire

Point	Scale Range	Level of Agreement	Interpretation
5	4.10 – 5.00	Strongly Agree	Highest
4	3.10 – 4.00	Agree	High
3	2.10 – 3.00	Neutral	Moderate
2	1.10 – 2.00	Disagree	Low
1	0.10 – 1.00	Strongly Disagree	Lowest

Scale for interpretation; Adapted from *Brown (2010)*

Using Brown's scale of interpretation, the items were ranked in their level of knowledge on their mean scores, as presented in Table 3.

Table 3. Descriptive statistics of scores of the Level of Knowledge of Teachers of Mathematics on Ethnomathematics in Questionnaire

Item No.	Knowledge of teachers of Mathematics on ethnomathematics	Mean	Std. Dev.	Mean Rank	Inter pretation
1	I have heard of the term "Ethnomathematics" before this survey	3.35	1.319	9	High
2	I have received formal training or professional development related to Ethnomathematics during my teaching career	2.63	1.296	10	Moderate
3	I am familiar with different cultural mathematical practices or traditions from around the world	3.52	1.156	7	High
4	I have specific cultural mathematical practices or traditions that I am interested in learning more about	3.53	1.112	6	High
5	I understand Mathematics symbols involved in mathematics	4.26	.676	2	Highest
6	I see polygons in some of the cultural drawings	4.00	.868	3	High
7	I see culture drawings in geometry topics	3.81	.902	5	High
8	I see drawings in the environment such as in buildings	4.27	.632	1	Highest
9	Basic arts are good foundation for learning mathematics	3.98	.878	4	High
10	Culture is embedded in basic school mathematics curriculum	3.47	1.036	8	High
Overall Mean		**3.68**	**.61**		**High**

From Table 3 and following the Scale of interpretation adapted from Brown (2010) that Teachers of Mathematics in Asokwa Municipality possess a high level of knowledge of ethnomathematics, with an overall mean score of 3.68 and a standard deviation of 0.61. Specifically, the highest ranked level of knowledge reported by Teachers of Mathematics on ethnomathematics in the Asokwa municipality was found to be items 5 and 8 with mean

scores of 4.26(SD=0.68) and 4.27(SD=0.63). Also, items 1, 3, 4, 6, 7, 9, and 10 were found to be highly ranked level of knowledge reported by Teachers of Mathematics in Asokwa Municipality in ethnomathematics, while item 2 was found to be at a moderately ranked level of knowledge on ethnomathematics reported by Teachers of Mathematics in Asokwa Municipality.

To validate the quantitative findings, semi-structured interview was conducted to solicit teachers' views on their level of knowledge possessed by Teachers of Mathematics in the Asokwa Municipality to effectively integrate ethnomathematics in the teaching and learning process. For these teachers, some knowledge and skill levels were suggested, with all name being pseudonyms. For instance, a teacher from *FG 4*, a JHS Mathematics teacher who had taught for twelve years said:

"*…Oh yea, I have heard of ethnomathematics, knowing its meaning and relevance in the teaching and learning of Mathematics, sometimes as I walk about, I try to find some symbols and events which define ethnomathematics so that I can incorporate them into my lessons*".

Also, a teacher from *FG 6*, a JHS Mathematics teacher who had taught Mathematics at the JHS for six years stated that:

"*For me, it's been a while since I heard and read of ethnomathematics. And you know as a mathematics teacher at the JHS level, I need to be updated in the field. Since then, I try to research how it can be applied in the context of teaching Mathematics to my pupils. Because, I think, relating Mathematical concepts to the cultural activities and events of the pupils is very key since pupils are already leaving with these materials and events which will improve their understanding in Mathematics*"

Furthermore, two teachers from *FG 11* and *FG 13* expressed that:

"*Ethnomathematics is a common term to me. In our school for instance, we are currently undergoing weekly in-service training on how we can incorporate it into our teaching and learning. I know that, since pupils were raised by their parents or guardians in their cultural contexts, pupils are more familiar with what they were brought up with. Therefore, linking those ideas and events into the teaching and learning will be good in my opinion*".

Table 4. Descriptive Statistics of Scores of The Use of Ethnomathematics in the Teaching of Mathematics in Asokwa Municipality Questionnaire

Item No.	How ethnomathematics is being used in the teaching and learning of mathematics (EMU)	Mean	Standard Deviation	Mean Rank	Inter pretation
1	I define Ethnomathematics in the context of my teaching to my pupils	2.97	1.228	8	Moderate
2	I incorporated Ethnomathematics or cultural mathematical practices into my teaching	3.23	1.165	7	High
3	Ethnomathematics in increasing pupils' understanding (	3.56	.952	4	High
	mathematics				
4	My pupils respond well to the inclusion of Ethnomathe	3.27	1.074	6	High
	matics in my teaching				
5	I easily use culture in the mathematics	3.31	1.065	5	High
6	Mathematics becomes more easier when taught culture	3.65	.977	3	High
7	I used Mathematics in our daily life to teach	4.19	.902	1	Highest
8	I get my pupils attention and they score high marks when teaching with culture	3.77	.931	2	High
Overall Mean		**3.43**	**.71**		**High**

As presented in Table 4, Teachers of Mathematics in Asokwa Municipality reported that they highly use ethnomathematics in their teaching of mathematics per Brown's (2010) interpretation since the overall mean score of the EMU questionnaire was 3.43(SD=0.71). Specifically, item 7 was found to be highest ranked way in which ethnomathematics is being

used by Teachers of Mathematics in Asokwa Municipality in the teaching and learning of Mathematics at the JHS level. Items 1, 2, 3, 4, 5, 6, and 8 were found to be highly ranked way in which ethnomathematics is being used by Mathematics teachers, while item 1 was found to be moderately ranked item.

Table 5. Descriptive statistics of scores of The Effective Ways Ethnomathematics can contribute to Pupils Understanding of Mathematics in Asokwa Municipality Questionnaire

Item No.	Effective ways in which ethnomathematics can be used to increase pupils' understanding of mathematics (EWM)	Mean	Standard Deviation	Mean Rank	Inter pretation
1	Culture should be used to start the teaching of mathematics	3.90	.804	1	High
2	Most of the illustration should relate to culture	3.82	.779	2	High
3	Encourage pupils to come out with culture in mathematics	3.65	.889	8	High
4	Diagrams used should be culture based	3.65	.870	8	High
5	Encourage pupils to give examples that relate to culture	3.66	.922	7	High
6	Culture aspect of mathematics should be used to start a lesson	3.68	.785	6	High
7	Culture aspect of mathematics should be used to conclude a lesson	3.56	.952	10	High
8	Culture aspect of mathematics should be used to during a lesson	3.81	.786	4	High
9	Ethnomathematics should be part of the curriculum	3.77	.999	5	High
10	Culture aspect of each topic should be stated in the curriculum	3.82	.859	2	High
Overall Mean		**3.7323**	**.69842**		**High**

As presented in Table 5, Teachers of Mathematics in Asokwa Municipality reported that in general, the effectiveness of teaching Mathematics with ethnomathematics was high, per Brown's (2010) interpretation, since the overall mean score of the EWM questionnaire was 3.73(SD=0.698). Specifically, item 1 was found to be highest ranked effective way in which ethnomathematics contributes to pupils' understanding of mathematics in Asokwa municipality, while item 7 was the least ranked effective ranked effective way in which ethnomathematics contributes to pupils' understanding of mathematics in Asokwa municipality. Again, to validate the quantitative findings, semi-structured interview was conducted to solicit teachers' views on some of the effective ways ethnomathematics contribute to pupils' understanding of mathematics in Asokwa municipality. Teachers reported diverse ways which contributed to pupils' understanding of mathematics in Asokwa municipality. According to teachers, by incorporating ethnomathematics into the curriculum and teaching methods in Asokwa Municipality, teachers can develop a more meaningful and comprehensive mathematics education that not only improves pupils' mathematical skills but also strengthens their cultural identity and appreciation for their heritage. Some representative statements are stated below with all names being pseudonyms.

Two teachers from *FG 2* and *FG 8* whom they all had taught Mathematics at the JHS level for five years stated that:

> "For me, *ethnomathematics offers practical, experiential learning opportunities. Most of the times, in order to make abstract ideas more concrete, I give pupils the opportunities to interact with traditional instruments, artifacts, and activities that represent mathematical principles. This makes what they learn become real to them and I always observe that such lessons are much interesting to pupils*".

In his view, a teacher from *FG 5*, JHS Mathematics teacher who had taught Mathematics for six years also added that:

"*I always observe that when pupils can connect mathematical concepts to their own lives and experiences, they develop a greater knowledge of the subject. Pupils can see how Mathematics is embedded in their cultural traditions through ethnomathematics, including geometric patterns, measurement, and counting*".

Also, two teachers from *FG7* and *FG 9*, whom they all had taught Mathematics at the JHS level for seven years stated:

"*The use of culturally relevant examples and activities can increase pupils' engagement with mathematics, making it a subject they look forward to studying*". Mrs. Danso further added that, "*the integration of ethnomathematics into other topics, such as history, geography, or social studies, enables pupils to understand the connections between maths and other facets of their culture and education*".

The results are discussed according to the research questions.

The Level of Knowledge of Teachers of Mathematics on Ethnomathematics in the Asokwa Municipality?

This research question sought to determine the level knowledge of Teachers of Mathematics on ethnomathematics in the Asokwa municipality. Using Brown's scale of interpretating Likert scale questionnaire, descriptive statistics of scores from KMTE questionnaire which measures the level of knowledge of Teachers of Mathematics on ethnomathematics in the Asokwa municipality revealed that Teachers of Mathematics in Asokwa Municipality possess a high level of knowledge of ethnomathematics, with an overall mean score of 3.68 and a standard deviation of 0.61. Teachers therefore revealed that, they understand Mathematics symbols involved in mathematics as well as see drawings in the environment such as in buildings which constituted the highest ranked level of knowledge in ethnomathematics possessed by Teachers of Mathematics in Asokwa Municipality. These were confirmed in the semi-structured interview as teachers revealed that they were being trained to integrate ethnomathematics. This finding agrees with that of Dhlamini's (2016) who also found similar findings.

In addition, teachers disclosed that the greatest degree of ethnomathematics knowledge held by math teachers in Asokwa Municipality was the understanding of mathematical symbols and the ability to recognize designs in the surrounding environment, such as those found in structures. Teachers who disclosed that they were receiving training on integrating ethnomathematics in the semi-structured interview corroborated this.

The Effective Ways Ethnomathematics can contribute to Pupils Understanding of Mathematics in Asokwa Municipality

This research question sought to determine how ethnomathematics is being used by Teachers of Mathematics in teaching mathematics in Asokwa municipality. Using Brown's scale of interpretating Likert scale questionnaire, descriptive statistics of scores from EMU questionnaire which measures how ethnomathematics is being used by Teachers of Mathematics in their teaching of mathematics in Asokwa municipality revealed that they highly use ethnomathematics in their teaching of mathematics. Per Brown's (2010) interpretation since the overall mean score of the EMU questionnaire was 3.43(SD=0.71). Teachers thus, revealed that they include knowledge of traditional counting systems, measurement methods, and geometric patterns specific to the Municipality. This finding also agrees with Bayar (2021) who also reported similar findings. Again, teachers disclosed that their expertise included customary counting systems, measuring techniques, and geometric patterns unique to the Municipality.

The Use of Ethnomathematics in the Teaching of Mathematics in Asokwa Municipality

This research question sought to discuss some of the effective ways ethnomathematics contribute to pupils understanding of mathematics in Asokwa municipality. Using Brown's scale of interpretating Likert scale questionnaire, descriptive statistics of scores from EWM questionnaire which measures effective ways ethnomathematics contribute to pupils' understanding of mathematics in Asokwa municipality revealed that the effectiveness of teaching Mathematics with ethnomathematics was high, per Brown's (2010) interpretation, since the overall mean score of the EWM questionnaire was 3.73(SD=0.698). Teachers reported diverse ways in which the inclusion of ethnomathematics contribute to pupils' understanding of mathematics in Asokwa municipality include; offering practical, experiential learning opportunities, developing a greater knowledge of the subject, increasing pupils' engagement with mathematics. This finding also agrees with Bayar (2021). Also, teachers in the Asokwa municipality reported a variety of ways in which the inclusion of ethnomathematics enhances pupils' understanding of mathematics. These ways include providing opportunities for hands-on, experiential learning, expanding pupils' subject-matter knowledge, and boosting pupils' engagement with mathematics.

CONCLUSION

The present study investigated into teachers' knowledge and usage of ethnomathematics in Asokwa Municipality in Ashanti Region of Ghana. The methods used in mathematics by the Asokwa people in the course of dealing with their traditional activities and the following conclusions were reached from the results of this study.

From the findings of the study, the following conclusion were drawn.

1. Both the male and female teacher's respondents involved in the Asokwa traditional activities said that the teaching and learning procedures in the classroom needed to incorporate the Asokwa pupils' traditional mathematics practices and activities. They explained that this would establish a better relationship between the school and out of school as well as enhance learners' performance in mathematics.
2. The participants recognized an array of customary items and pursuits, including games, sewing patterns, building houses, and so forth, as components of Asokwa customary activities that may be incorporated into mathematics classes to guarantee pupils' comprehension of academic mathematics.
3. Junior high school teachers of Mathematics agreed that mathematics and culture go hand in hand and said that a curriculum that takes cultural sensitivity into account might help pupils perform better in math classes and become more self-assured.
4. Most of the respondents insisted ethnomathematics should be introduced in their schools.

RECOMMENDATIONS

The following recommendations emerge from the results of this study based on the findings of the study. From research questions and its findings, the researcher recommended the following:

i. Ghana Tertiary Education Commission (GTEC) should ensure that Teachers' colleges of education should train teachers of Mathematics on the integration of ethnomathematics in the teaching of mathematics.
ii. Pre service teachers should be encouraged to be familiarized with the learners' cultural activities if they will to be able to incorporate them in effective teaching.

iii. Regional and municipal directors of education through the heads of Junior High schools to encourage teachers of Mathematics to implement ethnomathematics in their various schools when teaching mathematics.
iv. Ghana education service and National council for curriculum and assessment (NaCCA) should add cultural aspect of any topic in the curriculum.

REFERENCES

Bayar A. (2021) The Effects of School Culture on Pupils Academic Achievements, Amasya University College of Education, Amasya, Turkey

Bishop, A. (1994). Cultural conflicts in mathematics education: Developing a research agenda. *For the Learning of Mathematics*, 14(2), 15-18.

Brown, T. (2010). Construct validity: A unitary concept for occupational therapy assessment, evaluation, and measurement. *Hong Kong Journal of Occupational*, 20 (1), 30-42, https://doi.org/10.1016/S1569-1861(10)70056-5

D'Ambrosio, U. (1999). Ethnomathematics and its First International Congress. *Zentralblatt für Didaktik der Mathematik*, 31:50–53. https://doi.org/10.1007/s11858-999-0008-8

D'Ambrosio, U. (2001). What is Ethnomathematics and how can it help children in schools? Teaching Children Mathematics, 7(6), 308-310.

Dhlamini, Joseph. (2009). Connections between Mathematics and Arts & Culture: An exploratory Study with Teachers in a South African school.

Dolomite J. (2004).: occurrence, evolution and economically important associations. *Earth-Science and mathematics Reviews*, *52*(1-3), 1-81.

Orey, D. C., & Rosa, M. (2008). Ethnomathematics and cultural representations: Teaching in highly diverse contexts. Acta Scientiae. Revista de Ensino de Ciências e Matemática, 10(1), 27-46.

Presmeg, N. C. (1998). Ethnomathematics in teacher education. *Journal of Mathematics Teacher Education, 1*(3), 317-339.

Shirley, L. (1995). Ethnomathematics as a fundamental of instructional methodology. *Zdm*, *33*(3), 85-87.

Zeichner, K. M., & Liston, D. P. (2013). Reflective teaching: An introduction. Routledge.