Teacher Trainees' Perception of Indigenous Knowledge in Mathematics at Colleges of Education in Northern Ghana

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***Abstract*: The continuous search for better ways of improving the teaching and learning of mathematics in schools leading to improved learning out comes on the part of learners have posed a great strain on mathematics educators in the 21st century. This paper examines the perceived indigenous knowledge in mathematics within the Colleges of Education in Northern Ghana. The survey design was adopted for the study. Population was made up of teacher trainees' of Bagabaga, Tamale, St John Bosco and NJA colleges of Education. A sample size of 500 trainees was used for the study. Questionnaire was the main instrument used for data collection. Frequency counts and percentages and narratives were the main tools used for data analysis. It revealed that indigenous game (Man-to-Man) within the college communities contain concepts and skills in mathematics. It therefore recommended that mathematics teachers at the various colleges of education should tap and use these concepts during the teaching and learning of mathematics.**

***Keywords*; Indigenous knowledge, mathematics, teacher trainees, colleges of education, teaching and learning**

I. INTRODUCTION

Background

Cultural relevance matters because it directly impacts student engagement, learning, and achievement. In education, efforts have been made to include Western cultural traditions and knowledge and to promote cultural awareness and tolerance for diversity in our schools and nation. These efforts have led to the practice of teaching about cultures rather than grounding teaching and learning within the culturally relevant framework of a particular community. However, in response to the continuing gaps in academic performance, many indigenous communities and educators have developed culture-based pedagogy and strategies to improve the educational experiences and achievement of their children. These strategies have emerged through decades of theorizing and research about educational disconnects between indigenous and Western practices.

Maurial (1999) defined Indigenous knowledge as "the peoples' cognitive and wise legacy as a result of their interaction with nature in a common territory" (p. 62). Joey De La Torre (2004) defined Indigenous knowledge as the established knowledge of Indigenous nations, their worldviews, and the customs and traditions that direct them. This last definition demonstrates the close connection between Indigenous knowledge and worldviews. The connection is further evident when looking at the characteristics of Indigenous knowledge. Castellano (2000) described the characteristics of Indigenous knowledge as personal, oral, experiential, holistic, and conveyed in narrative or metaphorical language. Maurial (1999) identified three characteristics of Indigenous knowledge: local, holistic, and oral

Problem Statement

Indigenous teaching provides that every child is unique in his or her learning capacities, learning styles, and knowledge base. Knowledge is not what some possess and others do not: it is a resourceful capacity of being, that creates the context and texture of life. Thus knowledge is not a commodity that can be possessed or controlled by educational institutions, but is a living process to absorbed and understand.

Indigenous pedagogy values a person's ability to learn independently by observing, listening and participating with a minimum intervention or instruction. Teachers need to recognize that they must use a variety of styles of participation and information exchanges, adapt their teaching methods to the indigenous styles of learning that exist and avoid over-generalizing students capabilities based on generalized perceived cultural differences. To maximize participation in the educational process, teachers need to experiment with teaching opportunities to connect with the multiple ways of knowing, these students have and multiple intelligence (Linda Cleary and Thomas, collected wisdom)

Western thought of epistemology is defined as the theory of knowledge and pedagogy involving the processes by which children come to learn or know. Indigenous epistemology is found in theories, philosophers, histories, ceremonies and stories as ways of knowing, and these are found during talking or sharing circles and dialogues, participant observations, experiential learning modeling etc as ways of knowing and learning.

Blending the various knowledge systems in educational institutions especially in the Colleges of Education for effective teaching and learning is highly recommended. Tutors need to respectfully blend indigenous epistemology and pedagogy with the western epistemology and pedagogy to create an innovation in the Ghana education system. *The problem that this paper seeks to point to is to bring to the fore what teacher trainees perceive as indigenous knowledge in mathematics at the Colleges of Education in Ghana*

Objectives

To identify what Teacher Trainees' perceived as indigenous knowledge in mathematics

Research Questions

1. What indigenous knowledge in mathematics exists in the communities?

Indigenous Knowledge

It is difficult to agree on a legally and scientifically acceptable definition of indigenous knowledge (IK). IK is problematic because there is no universally accepted definition of the term, and because many analysts are uncertain who should be talking about this term (Semali and Kincheloe, 1999). Several researchers have shown that indigenous knowledge has been defined differently (i.e., Dei, 2000a; Mwadime, 1999; Odora-Hoppers, 2002; Ogunniyi, 2009b; Onwu & Mosimege, 2004; Semali 1999a; Semali & Kincheloe, 1999; Warren, 1991). However, none of the researchers define the term indigenous knowledge comprehensively, and several descriptions are afforded. What emerges from the definitions is that some researchers link indigenous knowledge that arise locally (i.e., Ogunniyi, 2009b; Semali & Kincheloe, 1999) the long term occupancy of a place (Dei, 2000a), or link the term with colonialism and indirectly focus on the differences between the two worldviews, namely Western science and indigenous knowledge (i.e., Mwadime, 1999).

Indigenous knowledge and Western science have many similarities as well as differences between them (Aikenhead, 1997a; George, 1999a; Jegede, 1995; Snively & Corsiglia, 2001). Indigenous knowledge and Western scientific knowledge are neither completely different nor entirely the same, but display both commonalities and differences. Western science is often portrayed as superior, universal, and as not having the 'cultural fingerprints' that appear to be much more conspicuous in other knowledge systems (Gough, 1998). Representations of Western science are used as criteria for declaring 'other' knowledges as non-science. This perspective of knowledge produces a perspective that indigenous knowledge may be recognised as a particular way of understanding the world, but that it is not science (Le Grange, 2004). Traditional Ecological Knowledge (TEK) tends to be associated with the diversity of knowledge innovations and practices that indigenous communities hold, and is also often defined in opposition of Western, modern scientific conceptions of knowledge (Reid, Teamey & Dillon, 2002).

Indigenous knowledge and Western science are similar in that they rely on empirical evidence gathered by experimentation (Aikenhead, 2006; Emeagwali, 2003). Accordingto Aikenhead (2006: 113), "experimentation can take place over many generations … and it relies on natural changes rather than on laboratory manipulations." However, the manner of knowledge acquisition in modern Western science is in an abstract manner (Studley, 1998). Both indigenous knowledge and Western science shows convergence in the fact that the physical universe can be understood by rational empirical means (Aikenhead, 2006). A characteristic shared by indigenous and Western knowledge is their localness, for example, their manifestation or expression in parochial or immediate contexts (Shapin, 1994; Turnball, 2000). Another similarity between indigenous knowledge and Western science is that "both local knowledge and science are based fundamentally on observations of the outside world which are in principle inter-subjectively accessible and communicable, in other words, they are not simply statements of faith (Antweiler, 1996).

Students bring to the classroom ideas based on prior experience and children of different cultural backgrounds frequently interpret science concepts differently than the standard scientific view and teachers need to begin instruction by determining the prior knowledge of the learners (Jegede and Okebukola, 1991; Ogawa, 1995; Snively and Corsiglia, 2001). Teachers need to probe for and incorporate the prior beliefs of indigenous children (Snively and Corsiglia, 2001). Cobern (1996a: 589) asserts that science education as it is conceptualised frequently has little or no meaning for many students because "it fails to teach scientific understanding within the actual world in which people live their lives". Researchers have pointed out that the prior knowledge of indigenous learners may actually conflict with Western science (Baker & Taylor, 1995; Cobern, 1996a). Cobern (1996a), for example, asserts that construction of knowledge involves interpretation influenced by prior knowledge. Therefore we should not expect for example Nigerian students to understand science exactly the way students in western countries understand.

II. METHODS AND PROCEDURES

Research design adopted for this study is survey research. Survey research according to Kerlinger and lee (2000) is a situation where an item of a population or information is studied in detailed with a view to generalize the outcomes on the entire population. The population for the study consists of teacher trainees, in the three northern regions including Upper East, Upper West and Northern. Teacher trainees were selected using the simple random sampling technique from trainees of the selected science and mathematics colleges.

Saunders, Lewis and Thornhill (2012) provide a rough guide to different minimum sample size of population given a 95% confidence level for different margin of error of 0.05 e.g. 500 a sample size will be 217 at 5% margin of error. From a population of 5542 trainees made up of 1586 Tamale College Education (TACE) Trainees, 1214 Bagabaga College Education (BACE) Trainees, 1480 St. John Bosco trainees and 1262 Nasart Jahan Ahamadiya College of Education (NJA) trainees, a sample size of 370 were drawn based on Saunders et al (2012) selecting sample size. However for proportionate representation, the sample was increased to 500. Hence 143,110,134 and 113 trainees were drawn from TACE, BACE, St John Bosco and NJA respectively. Questionnaire was the main instrument used for data collection. It was in three sections, A, B and C. It was made up of both open ended and closed ended items which elicited information on respondents personal data, indigenous mathematical knowledge in trainees daily life, how they perceived indigenous knowledge in mathematics within their environment, and indicating some of the indigenous knowledge in mathematics .

A preliminary analysis was done in order to get a general sense of the data and reflected on its meaning. More detailed analysis was done and data divided into segment that reflected specific thoughts, attitude and experience of participants. Frequency counts were also used in data analysis as well descriptive statistics.

III. RESULTS AND DISCUSSION

Ogah (2013) contends that discussion of results aims at doing two things; first to show how the finding of the current study fit into existing knowledge, and secondly, to articulate the implication of the findings to life. The paper main objective is to examine teacher Trainees' perceived indigenous knowledge in mathematics in Colleges of Education in Ghana with particular emphasis in the three Northern Regions. The ensuring provides the results based on the research questions of the study.

Table 1; Gender of Respondents

Respondents	Number of respondents	Percent Missing system	Total
Trainees	Male Female 321 165	65.6 33.7 3(0.6%)	486 (100%)
Total	486		

Source: Field data, 2017

Table 1 represents the demographic background of teacher trainees according to their gender. As indicated in table 1. 321 (65.6%) of the teacher trainees were males while 165 (33.7%) of the remaining teacher trainees were females. This is an indication that on the average, male trainees were twice as the females in the College in Northern Ghana.

Statement	**Number Respondents and** Percentage					
	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**	**Missing System**	**Total**
There are many mathematical concepts in indigenous people daily life activities	**224**(45.8)	**209**(42.7)	**15** (3.1)	**15** (3.1)	**26**(5.3)	**489**(100)
My teacher uses indigenous mathematical concepts during teaching and learning	**58** (11.9)	**256**(52.4)	**108** (22.1)	**41** (8.4)	**26** (5.3)	**489**(100)
My teacher relates the mathematics he/she teaches to the environment and the community	**162** (33.1)	**222**(45.4)	**64** (13.1)	**15**(3.1%)	**26** (5.3)	**489**(100)
Mathematical ideas can be obtained from the cultural activities in your locality	**118** (24.1)	**284**(45.4)	**51** (10.4)	**10** (2.0)	**26** (5.3)	**489**(100)
Mathematical concepts of the indigenous people can be seen in their artifacts	**133** (27.2)	**256**(52.4)	**49** (10.0)	**20** (4.1)	**31**(6.3)	**489**(100

Research question 1: Sought to find out what indigenous knowledge in mathematics exists in the communities?

Source: Field data, 2017

On the question of there are many mathematical knowledge in indigenous people daily life. Table 2 provided detailed responses of respondents. 30 (6.2%) of the trainees disagreed with the assertion while 433 (88.5%) maintained that they agreed with the assertion. What this suggested was that teacher trainees acknowledge the fact that indigenous people daily life activities are made up of mathematical knowledge.

Table 2 indicated that 149 (30.5%) of the teacher trainees' contended that they disagree with the statement while 316 of the trainees representing 64.3% maintained that they agreed with the statement. What this implied was that more than half of the respondents agreed that indigenous knowledge was often used during teaching and learning of mathematics at the colleges of education. This finding agreed with the assertion that it will alert teachers to the other "world" that their students come from and the ways they see things might be different from those experiences of the teachers. Hence as a basic principle, do not assume anything other than these three truths: Your students know a lot. They are capable of learning a whole lot more in an environment

where high expectations abound and They bring a rich background and knowledge to the learning environment (Perso,2003)

Again in response to the question 'relating mathematics to the environment and the community, 79 (16.2%) of the trainees' respondents disagreed with the assertion while 384 of the representing 78.5 % respondent in the affirmative. What this meant was that trainees agreed that mathematics teaching at the Colleges of Education is related to the environment. However, a few of the trainees do not see the linkage of the mathematics taught and its relation to the community

Also, mathematical ideals that can be obtained from the cultural activity in the locality, 61 trainees representing 12.4 % disagreed with the assertion while 402 (82.2%) of them agreed with the statement as indicated in Table 1. What this suggested was that majority of the respondents agreed that cultural activities contained mathematical knowledge and ideas. Also in this approach, the ethno mathematical curriculum takes students' culture and uses it explicitly to integrate these outside experiences into the conventional mathematics curriculum. In such a classroom environment, students build on what they know as well as on the experiences they have from their cultural environments (González, Moll, and Amanti, 2005). These experiences are then used neither as motivation nor as an introduction but instead as part of understanding how mathematical ideas are developed and how they are built into systems, formulated, and applied in various ways within the culture. This mathematical knowledge is related to conventional mathematics in such a way that the underlying mathematical ideas are fully understood and the power and utility of conventional methods are appreciated.

On the issue of indigenous knowledge seen in their artifacts, 69 (14.1%) of the trainees disagreed with the statement while 389 (79.6%) of the tutor's agreed with the statement what this implied was that majority of the respondents contended that indigenous people knowledge are well expressed in their artifacts'.

In order to obtain in-depth information on indigenous knowledge in mathematics within the community which have direct influence on mathematics at the college of Education, respondents were asked to write down some of the indigenous activities and games which contained mathematical knowledge. The research revealed the following:

'Too-Man-To' Game

This game is an indigenous game played as both in-door and out- door, it can be created on the floor where it is a bit sandy or not hard floor, it is usually done on ground where it is not cemented with sticks to mark the lines and in some instances sooth is used to trace the lines to make it legible. It is constructed by creating a starting zone, making three squares of the same size in Column form, 2 squares horizontally attached to the 3 squares then a square attached in between 2 horizontal squares. The squares are then zone as 1,2 3,4,5 ….8 as shown in figure 1.

Figure 1. This shows an indigenous 'too-man-to' game

How the game is played

Two or more people can play the game, here a decision is arrived at as to who will start the game. The starter stands upright at the starting zone and throw's a marble or a counter in zone 1 and hop to zone two landing on one leg then hop to zone 3, to 4 and 5 where s/he lands in the two horizontal squares with each leg in zones 4 and 5. S/he hops to zone 6 then to 7 and 8 to make a return journey, on approaching zone 1 where the marble is, with one leg step in zone 2 and the other leg hung s/he picks the marble and hop over the zone .to the starting zone. This continuous until the last zone 8 is successfully finished, then you are entitled to own a zone or house. The procedure for owning a zone/house is that you are given three chances to stand at the starting zone with your back facing the remaining zones, you throw your marble over your head and where it lands in any zone then you own that house.

Rules and Regulation of the Game

- At the starting point/zone, if you throw your marble and it lands outside the target zone, you missed the chance to continue
- While hoping, you are not allowed to step on any of the lines. If you do then you will miss the chance to continue
- You are not allowed to hop on two legs
- A winner is declared if the game comes to an end; the one who owns more zones is the winner.

The ensuing shows a 7 year old boy and 10 years girl engaged in the game of 'too-man-to'

Figure 2. This shows a 10 year old girl involved in 'too-man-to' Game

Figure 3. This shows a 7 year old boy involved in 'too-man-to' Game

Mathematical Significance of the Game

- It makes one to be creative and innovation
- It makes one to be tolerant
- It builds the analytical skills of the individual
- It teaches about number pattern

These finding collaborate the assertion made by the sampled trainees who maintained that the indigenous games contained mathematical skills and knowledge and hence should be integrated into the mathematics curriculum of Colleges of Education in Ghana. This is in lined with the assertion that mathematics should be focused on engaging tasks that encourage critical thinking and problem solving leads to teachers developing lessons that promote discourse between learners and making sense of concepts and procedures deepening understanding of mathematical concepts (New B Ed programme, 2018)

IV. CONCLUSIONS AND RECOMMENDATION

Based on the findings of the study, the following conclusions and recommendation were made.

Conclusions

- Teacher trainees' perception of indigenous knowledge in Mathematics within the communities is seen in the peoples' artifacts' and their daily activities which includes: Games such as 'owari', draught, 'too-man-to '. 'Failaa', ' Three-in-a-row' and smock making, Basketry, Beads and pattern in their painting
- Local symbols, local ways of counting, tales, proverbs, riddles. Wise sayings all have mathematical knowledge in them.

Recommendations

Indigenous games should be inculcated into the entire mathematics curriculum for Colleges of Education. Mathematics teachers should make it part of the teaching and learning in the classroom. This should be supervised for its trick implementation at the colleges' by both internal and external supervisors of colleges.

Ministry of Education, Universities and Curriculum experts', should re-construct, re-vitalize and re-create the mathematics curriculum by adapting the Endogenous Mathematics Curriculum Development processes which considers the holistic approach to curriculum development in which both indigenous and relevant portions of western knowledge is blend to develop the mathematics curriculum for colleges of education.

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