

# **INTEGRATION OF EXISTING INDIGENOUS KNOWLEDGE WITHIN MATHEMATICS CURRICULUM FOR PRIMARY SCHOOLS IN KENYA**

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## **ABSTRACT**

The current paradigm shift towards promoting education for sustainable development gravitates toward alternative approaches to school curricula in Kenya. To address some of the knowledge deficiencies that are currently formulated from the western perspective, this study focused on integration of existing indigenous knowledge within mathematics curriculum for primary schools in Vihiga County, Kenya. This study's objective was to identify the extent to which existing IK practices are applied in teaching of mathematical concepts. The study adopted Constructivism theory attributed to Piaget, Vygotsky's and Bruner. Cross-sectional design where both qualitative and quantitative data were collected concurrently using triangulation of tools such as; questionnaires, observation schedule and FGD guide. The target population were class six teachers of mathematics, for the purpose of getting a representative sample, proportionate sampling was used to select 10% (40) of the schools in the county. The sample comprised all the teachers of mathematics in the selected schools. Descriptive statistics was used to analyse quantitative data while qualitative data was analysed

thematically and reported through narration. Findings indicated that knowledge that can be derived from various forms of the Luhya tradition is abundant in traditional decorations, weaving, constructions, games, storytelling and many others. From the findings the researcher concludes that this study was viable since majority of the respondents 80% (32) agreed on the existence of indigenous knowledge that could be applied in teaching math so as to help bridge the gap between what is usually taught in the classroom and what exists in the society and to socialize learners with math concepts. It is recommended that the exploration of the indigenous mathematical knowledge should be part of the curriculum design process and indigenous mathematical knowledge should be integrated into the school Mathematics curricula for clear understanding of concepts and for long-term retention of mathematical knowledge. Further research should be done in order to find ways in which IK can blend with modern technology to solve current problems.

**Key Words:** *integration, existing, indigenous knowledge, curriculum*

## **INTRODUCTION**

Indigenous knowledge (IK) refers to the local knowledge that is unique to a given culture and acquired by local people through the accumulation of experiences, informal experiments, and intimate understanding of the environment in a given culture (Chikaire, Osuagwu, Ihenacho, Oguebuchulam, Ejiogu-Okereke, & Obi, 2012). Indigenous knowledge systems (IKS) are better understood as practical, personal and contextual units which cannot be detached from an individual, their community, or the environment both physical and spiritual (Howden 2001). IK is generally used synonymously with traditional and local knowledge to differentiate the knowledge developed by and within distinctive indigenous communities from the international knowledge systems generated through universities (Semali &

Kincheloe, 1999), government research centers, and private industry which is sometimes called the 'Western knowledge system' (Maurial, 1999).

Indigenous knowledge system (IKS) constitutes the core of community development processes such as agriculture; preservation of food; collection and storage of water; animal husbandry and ethnic veterinary medicine. It also forms the basis of indigenous interpretation of meteorological and climatic phenomena; orientation and navigation on land and sea as well as in management of natural resources. Indigenous knowledge is also very useful in local primary health care; preventive medicine and psychosocial care as well as in procreation. Recently, it has taken centre stage in poverty alleviation through community savings and lending, confection of clothing and tools as well as construction and maintenance of shelter (Kaino, 2013).

For thousands of years, the African indigenous knowledge systems existed and have their own education systems, long before Western education was introduced by the European colonialists and missionaries. Thaman, (2014) posits that it is very misleading when indigenous knowledge is separated from the modern education, since the content of education has value underpinning it and is associated with a particular culture. The introduction of Western education meant that learners faced the conflicting demands of the new education and those of their home cultures, because the purpose, content, and processes of knowledge transmission conflicts with those of indigenous education (Thaman, 2009). Thaman notes that the artifacts that are available in the traditional environments are important tools that can be used to bridge the gap between what is usually taught in the classroom and what exists outside in the society. Additionally, it is argued that education cannot exclude cultural knowledge, since the content of education has value underpinning it and is associated with a particular culture.

However, despite its highly proclaimed importance and sound pedigree of recognition for strengthening native communities' preservation of social and traditional capitals towards more independence (Chahine & Kinuthia, in press), no clear effort has been cited that magnifies and exposes the contributions of indigenous cultures to the mainstream knowledge and epistemologies. There are many issues that come under play to effectively design and implement indigenous or culturally responsive curricula as pointed out by (Herbert, 2006). Some of the issues include; application of IK, teachers' perception towards integration of IK, learners' knowledge of IK, strategies of integrating IK and many challenges, ranging from language, resources, beliefs (both for teachers and students) and theoretical frameworks for the implementation of indigenous curricula.

Many African objects used in daily life embody mathematical concepts and a mathematical knowledge of forms, shapes, and symmetries. They reveal knowledge of the properties and relations of circles, angles, rectangles, squares, regular pentagons and hexagons, cones, pyramids and cylinders (Kaino, 2013). African geometrical exploration developed hand in hand with artistic and aesthetic exploration and the connection between beauty and geometrical exploration was a cultural value common throughout Africa.

A scan across several indigenous cultures reveals elements of knowledge, practices, artifacts that are closely associated with Science and technology, but colonialists did not often recognize them as worthwhile contributions to the global collection of knowledge and practices. Ocholla and Onyancha, (2005) in their study, processed infometrics on indigenous knowledge which cover a wide range of indigenous knowledge practices such as agriculture, environment, biodiversity, health and nutrition, just to mention a few. However, the low profile accorded to indigenous knowledge (although much) rendered such contributions valueless and resultantly, such knowledge never features as a commodity.

Hence, indigenous people have reaped nothing out of their contributions. Instead, they suffered some disruptions in their productive practices, since the Western knowledge deskilled them and immediately after deskilling them they had to reskill in order to become functional again. It was imperative for indigenous people to develop new skills under the changed socio-economic demands while living under colonialist governments (Katz, 2004; Maurial, 1999).

The greatest reason for neglecting indigenous knowledge was power. Since knowledge is power, money, and prestige (McKinley, 2005; Ocholla & Onyancha, 2005; Shizha, 2006), some schools of thought contended that recognition of indigenous knowledge (on the part of colonialists) would give indigenous people power to act or as an agency for identity. Therefore, to maintain power, the colonial masters' knowledge and voice had to remain superior to those of indigenous people.

Thus, such scholars lay pointers to or indeed reassemble the almost obliterated ideas, practices, and artifacts (produced by indigenous people) that are of scientific relevance (Sundar, 2002) while advancing the claim that Western Science is not a unilateral practice for the Westerners alone but a universal practice for all people in the world (Sithole, 2004). Indigenous knowledge is, however, locked up in spirituality because it “encapsulates the common good-sense ideas and cultural knowledge of local people concerning everyday realities of living”, according to (Dei, 2000).

Any type of Mathematics, including ‘Western’ Mathematics, is greatly influenced by ideas and activities that are important in specific cultures and therefore, should be respected and not taken as primitive. It is only when one comes closer to the people, interacts with them and establishes closer links that one can really appreciate the importance of what they are doing or involved in. Some of the mathematical skills observed at grass-root level are often taken for granted, and not considered important or appreciated. Such skills can be witnessed from the day-to-day activities taking place in the environments where uneducated people are continuously involved in income generating initiatives from local resources (Owour, 2007).

The Mathematics teachers apply ranges from simple to complex concepts without them being overtly aware of it. The importance of the cultural aspects of Mathematics in such cases can only be realized if studies are done on such activities and published. It should thus not be ignored that people in societies or cultures that do not use Mathematics in the way it is done

in the formal education systems, also do engage in many cultural mathematical activities that require complex reasoning about space, time, and number.

## **PURPOSE OF THE STUDY**

The purpose of this study was to explore the integration of existing indigenous knowledge in teaching of mathematical concepts in primary schools in Vihiga County, Kenya.

## **RESEARCH OBJECTIVE**

To identify the extent to which existing indigenous knowledge practices are applied in teaching of mathematical concepts.

## **RESEARCH QUESTION**

To what extent is existing indigenous knowledge practice applied in teaching of mathematical concepts?

## **RESEARCH METHODOLOGY**

### **Research Design**

The study was conducted in public primary schools in Kenya. This study used mixed method approach which involved the use of a cross-section survey design. Using cross-section survey design the researcher focused on understanding the extent to which IK is applied in teaching of mathematical concepts.

### **Population and Sample**

The research population constituted teachers of mathematics in class six and class six pupils in Vihiga County, Kenya. To get a representative sample, proportionate sampling was used to select 10% (40) of the schools in the county. The sample comprised all the class six teachers of mathematics in the selected schools.

### **Instruments and Procedures**

Two research instruments were used in data collection; questionnaire for teachers containing 10 items which measured the extent to which IK is applied on a 5-point likert scale and an observation schedule on the existing IK in the classroom. The two research instruments were administered to the participants by the researcher. Permission to collect data was obtained from head teachers and teachers involved.

### **Data Analyses**

The completed instruments were coded and the responses scored and keyed in to a computer data file. All the statistical analyses were run using the Statistical Package for Social Science (SPSS) computer programme. Descriptive statistics was used to analyse quantitative data while qualitative data was analysed thematically and reported through narration.

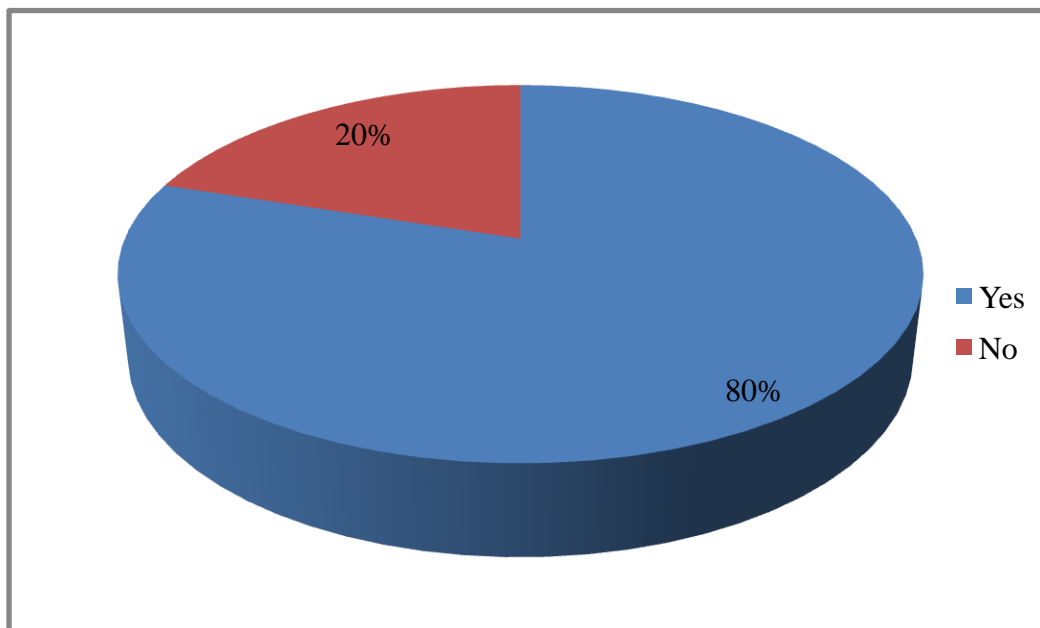
## **RESEARCH FINDINGS**

### **Application of Existing Indigenous Knowledge**

The researcher sought to identify application of existing indigenous knowledge in mathematical concepts in the classroom. The respondents were asked the following question items; Q1 (Can you find existing indigenous knowledge in from you community that could be incorporated in teaching of mathematical concepts?), Q2 (If yes, to what extent is the existing community indigenous knowledge is incorporated in teaching of mathematical concepts?) and Q3 (respondents were provided with various statement on the indigenous knowledge/artifacts on a 5-point likert scale.)

### **Existing Indigenous Knowledge in Vihiga County**

This section discussed question item Q1 (Can you find existing indigenous knowledge in from you community that could be applied in teaching of mathematical concepts?) The findings are as shown in figure 1.



**Figure 1: Existing Indigenous Knowledge in Vihiga County**

Figure 1 shows that 32(80%) of the respondents agreed that there is indigenous knowledge in Vihiga County that could be incorporated in teaching of mathematical concepts in primary schools. On the other side, 8(20%) of the respondents disagreed on the availability of IK in Vihiga County. This study was therefore more viable since the majority of the respondents agreed that there is IK that could be integrated in teaching mathematical concepts.

A scan across several indigenous cultures reveals elements of knowledge, practices, artifacts that are closely associated with Science and technology, but the colonialists did not often recognize them as worthwhile contributions to the global collection of knowledge and practices. In their study, Ocholla and Onyancha, (2005) processed infometrics on indigenous

knowledge which cover a wide range of indigenous knowledge practices such as agriculture, environment, biodiversity, health and nutrition, just to mention a few.

However, the low profile accorded to indigenous knowledge (although many) rendered such contributions valueless and resultantly such knowledge never featured as a commodity. Hence, indigenous people have reaped nothing out of their contributions. Instead, they suffered some disruptions in their productive practices, since the Western knowledge deskilled them and immediately after deskilling them they had to reskill in order to become functional again. Therefore, it is imperative for indigenous people to develop new skills under the changed socio-economic demands while living under colonialist governments (Katz, 2004; Maurial, 1999). Table 1, shows across tabulation for gender and application of existing Indigenous Knowledge in Vihiga County

**Table 1: Cross Tabulation for Gender and Application of Existing IK**

Descriptions				Can you find existing IK in Total your community		
				Yes	No	Total
Gender	Male	Count	22	5	27	
		% Existing Indigenous Knowledge	68.8%	62.5%	67.5%	
	Female	Count	10	3	13	
		% Existing Indigenous Knowledge	31.2%	37.5%	32.5%	
Total	Count	32	8	40		
	% Existing Indigenous Knowledge	80.0%	20.0%	100.0%		
	% of Total	100.0%	100.0%	100.0%		

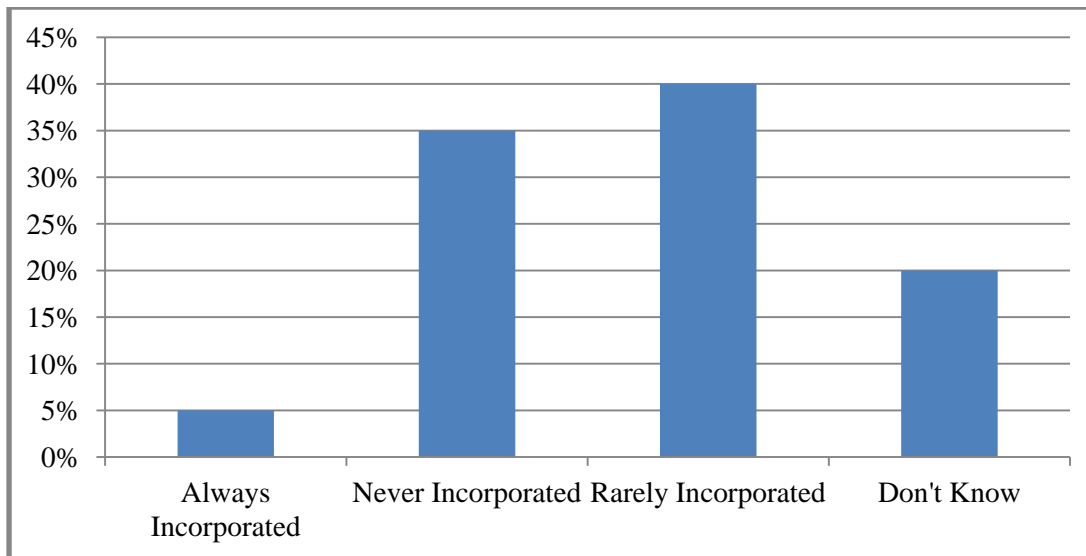
Table 1, shows a cross tabulation on gender and existing indigenous knowledge in Vihiga County. It is apparent that 22(68.8%) of male teachers agreed that indigenous knowledge exists in Vihiga county while 10(31.2%) of female teachers agreed that indigenous knowledge exists in Vihiga county.

This finding agrees with a body of literature that suggest that male teachers have positive perception towards Mathematics which also reflect on the perception of integrating indigenous knowledge in Mathematics curriculum (Brophy, J. 1985).

**Extent to Which Existing IK is Integrated in teaching Mathematics**

The findings on question item Q2 (If yes, to what extent is the existing community indigenous knowledge incorporated in teaching of mathematical concepts?) are displayed in figure 2 below.





**Figure 2: Extent to Which Existing IK is Integrated in Mathematics**

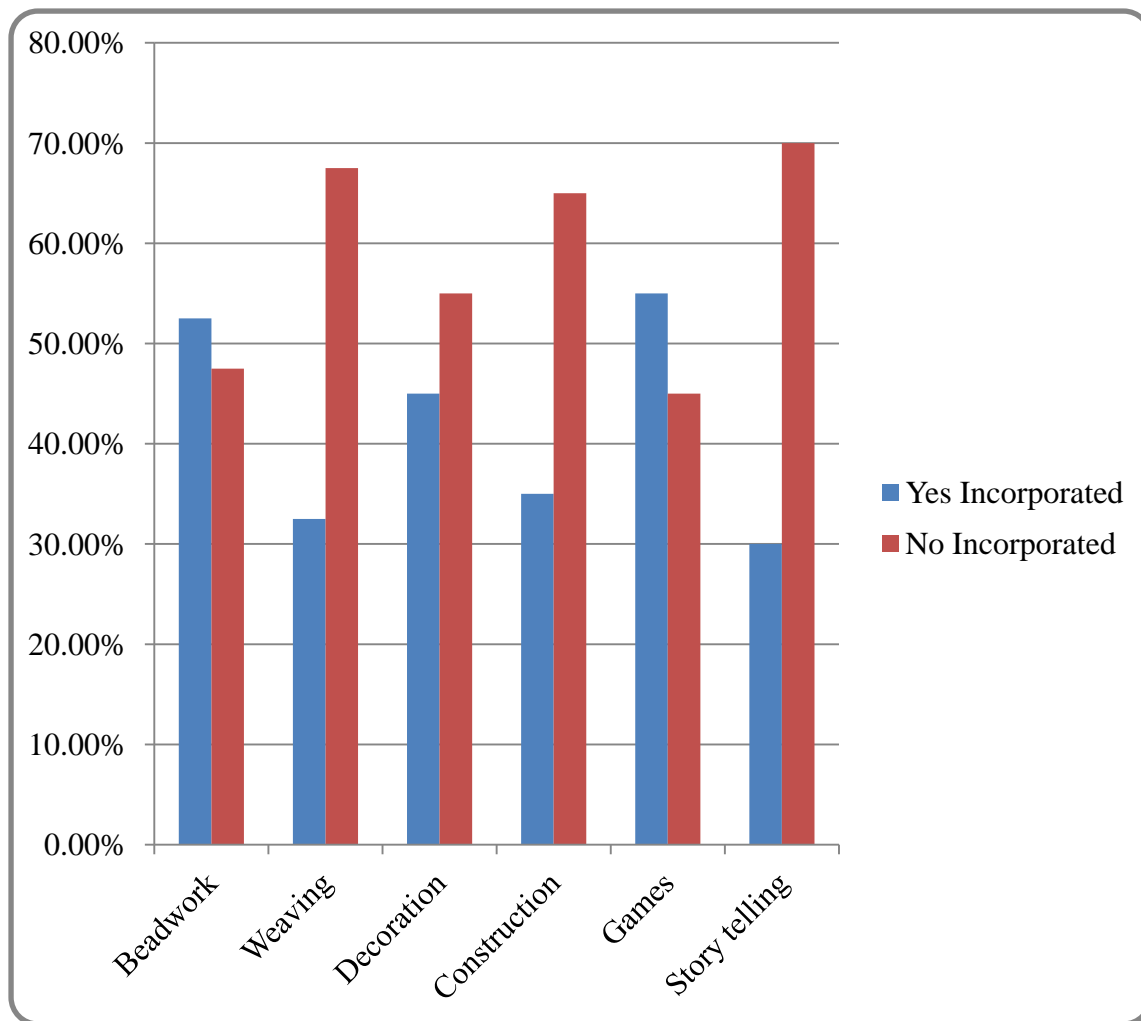
On the extent to which existing indigenous knowledge is incorporated in teaching of mathematical concepts figure 4.4 indicate that 2(5%) of the respondents said that it is always incorporated, 16(40%) of the respondents said that it is rarely incorporated, 14(35%) of the respondents said that IK is never incorporated and 8(20%) of the respondents said that they don't know if IK is incorporated in teaching of mathematical concepts.

It is evident from the findings that indigenous knowledge that exists in society has historically been ignored, from the colonial times to present regimes, where the school curricula are designed without including such knowledge. In his study, Kaino (2013) on the knowledge of traditional artifacts used by the Tchokwe tribe in Angola explored and then related to the mathematical content learned in the classroom. The activities show how the indigenous knowledge can be structured and get related to the mathematical knowledge taught in primary school but most teachers rarely or never incorporated the concepts in teaching.

**Indigenous Knowledge/Artefacts Integrated in teaching Mathematics**

Question item Q3 provided respondents with various statement on the indigenous knowledge/artifacts. Respondents had to agree or disagree whether the indigenous knowledge/artifacts are incorporated in teaching mathematical concepts in the classroom. The statements included; (Beadwork: Used when pupils have to count the number of layers or turns to make before making a particular design in their beadwork. -counting) (Weaving: Used when pupils have to make repeated patterns of selected designs-circles, squares, triangles), (Decorations: Used when pupils have to visit mural decorations which create specific geometric patterns), (Construction: Used to apply to the concept of Symmetry when constructing traditional house, granaries), (Games: Used when pupils participate in recreation, competition, sportsmanship and many other similar and related notions) and (Story telling: Used to pass over knowledge onsets (algebra) through stories and riddles). The responses are summarized in figure 3 below.





**Figure 3: Indigenous Artefacts Integrated in teaching of Mathematics**

Findings in Figure 3, indicate that 21(52.5%), 13(32.5%), 18(45%), 14(35%), 22(55%), and 12(30%) agree that Beadwork, Weaving, Decorations, Construction, Games and Storytelling respectively are incorporated while teaching mathematical concepts in the classroom. On the other side the results shows that 19(47.5%), 27(67.5%), 22(55%), 26(65%), 18(45%) and 28(70%) of the respondents disagreed that Beadwork, Weaving, Decorations, Construction, Games and Storytelling respectively are not incorporated while teaching mathematical concepts in the classroom.

**Table 2: Use of Beadwork While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	21	52.5	52.5
Not Incorporated	19	47.5	100.0
Total	40	100.0	

Table 2, indicate that 21(52.5%) of the beadwork is used in the classroom while teaching mathematical concepts while 19(47.5%) of teachers don't integrate beadwork in

mathematical curriculum. From the observation made by the researcher, topics such as place value, measurement, geometry and algebra are integrated in beadwork during explanation and giving of examples in the classroom. The mathematical concepts that have been identified in the making of a grass container and the beadwork as shown in the pictures are: Counting; Estimation; Straightness of Lines; Shapes and Patterns; Angles; etc. Many other mathematical concepts may be found when an analysis of the various activities and processes is done. This calls upon the educators to play an important role of linking what happens at the cultural villages to various Mathematics curriculum requirements. As Graven, (2000) correctly points out, current curriculum change demand that teachers (educators) use a learner centred approach and understand Mathematics as a learning area which includes the following identity of Mathematics as a school subject. Teachers are appropriately placed due to their mathematical knowledge to create linkages between various activities embedded with mathematical concepts to ensure that learners' experiences are enriched through daily experiences of what they encounter outside the classroom.

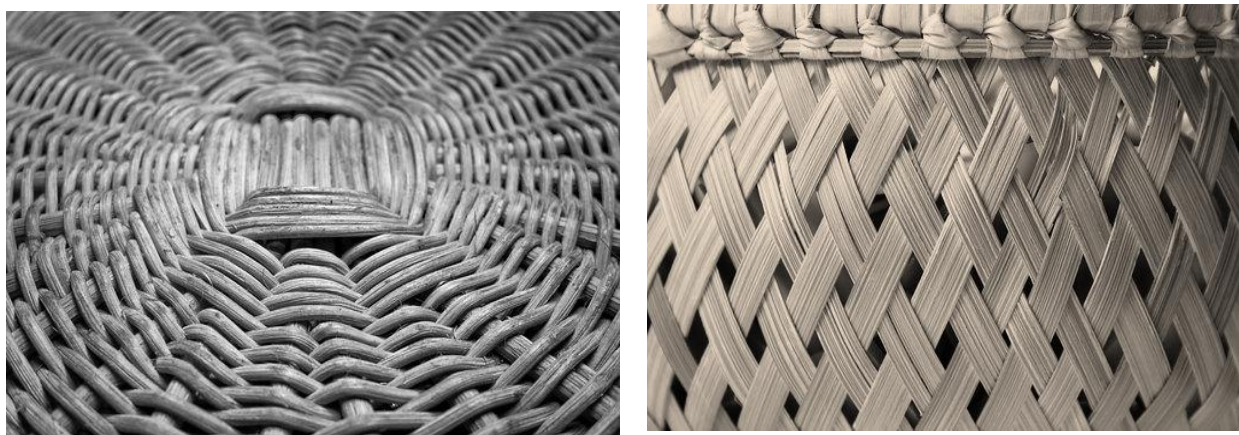


**Figure 4: Pictures of sampled beadwork**

**Table 3: Use of Weaving While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	13	32.5	32.5
Not Incorporated	27	67.5	100.0
Total	40	100.0	

Table 3, indicate that 13(32.5%) of the teachers use weaving is used in the classroom when teaching mathematical concepts while 27(67.5%) of teachers don't integrate weaving in teaching of Mathematics. From the class observation the researcher identified some materials on weaving however teachers did not incorporation weaving in the classroom teaching of Mathematics.



**Figure 5: Pictures of sampled weaved materials**

**Table 4: Use of Decoration While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	18	45.0	45.0
Not Incorporated	22	55.0	100.0
Total	40	100.0	

Table 4, indicate that 18(45.0%) of teachers use decoration in the classroom while teaching mathematical concepts when 27(55.0%) of teachers don't integrate decoration in teaching of Mathematics. From observation the researcher did not identified any decoration artifacts that could be incorporated in classroom teaching of Mathematics.

**Table 5: Use of Construction While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	14	35.0	35.0
Not Incorporated	26	65.0	100.0
Total	40	100.0	

Table 5, indicate that 14(35.0%) of the teachers used construction in the classroom while teaching mathematical concepts while 26(65.0%) of teachers don't integrate construction in teaching of Mathematics. However, from observation the researcher did not identified any artifacts that could be incorporated in classroom teaching of Mathematics.

**Table 6: Use of Games While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	22	55.0	55.0
Not Incorporated	18	45.0	100.0
Total	40	100.0	

Table 6, indicate that 22(55.0%) of teachers use games in the classroom while teaching mathematical concepts while 18(45.0%) of teachers don't integrate games in teaching of Mathematics. Among the existing indigenous knowledge integrated in teaching mathematical content games is mostly used in the classroom.

The word 'game' is usually associated with recreation, competition, sportsmanship, winning, losing, enjoyment, and many other similar and related notions. Nkopodi & Mogege, (2009), conducted a study entitled "preparation of using indigenous games in the classroom" specified activities necessary before indigenous games can be used in the Mathematics classroom which include: Identification of indigenous games according to the potential of their use in the curriculum; Analysis of games (applying mathematical concepts, principles and processes) of any game reveals the extent to which mathematical concepts are embedded in the game.

**Table 7: Use of Story Telling While Teaching Mathematics Concepts**

Description	Frequency	Percent	Cumulative Percent
Yes Incorporated	12	30.0	30.0
Not Incorporated	28	70.0	100.0
Total	40	100.0	

Table 7, indicate that 12(30.0%) of teachers use weaving is used stories, riddles and proverbs in the classroom when teaching mathematical concepts while 28(70.0%) of teachers disagreed

## **DISCUSSION OF THE FINDINGS**

The respondents were asked if there is existing indigenous knowledge in their community that could be incorporated in teaching of mathematical concepts and majority of the respondents agreed that there is existing indigenous knowledge in their community that could be incorporated in teaching of mathematical concepts. A cross tabulation on gender and existing indigenous knowledge indicated that more male teachers as compared to female teachers agreed that indigenous knowledge exists in Vihiga county.

On the extent to which existing indigenous knowledge is incorporated in teaching of mathematical concepts majority of the respondents said that indigenous knowledge is rarely incorporated followed by those who said indigenous knowledge is never incorporated at all and few said indigenous knowledge is always incorporated while the remaining few didn't know.

Concerning the indigenous knowledge/artefacts/tools, majority of the teachers did not incorporate weaving, decorations, constructions and storytelling in the mathematical concepts when teaching in the classroom. Atleast 50% and above of the teachers incorporated beadwork and games in the mathematical concepts when teaching.

## **CONCLUSIONS**

From the findings the researcher concludes that this study was viable since majority of the respondents agreed on the existence of indigenous knowledge that could be applied in teaching mathematical concepts. On the extent to which existing indigenous knowledge is incorporated in teaching of mathematical concepts, It is evident from the findings that indigenous knowledge that exists in society has historically been ignored since very few respondents admitted to incorporate indigenous knowledge in Mathematics curriculum. However, as much as there are plenty of indigenous knowledge/artifacts/tools such as weaving, decorations, constructions beadwork, games and storytelling, majority of the teachers don't incorporate them in the mathematical concepts when teaching.

## **RECOMMENDATIONS**

It is recommended that the exploration of the indigenous mathematical knowledge should be part of the curriculum design process and indigenous mathematical knowledge should be integrated into the school Mathematics curricula for clear understanding of concepts and for long-term retention of mathematical knowledge.

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