Assessing the Effect of Incorporating Ethno-Mathematics Strategies on Students' Achievement in Functions.

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Abstract- The aim of this study was to assess the effect of incorporating Ethno-mathematics strategies on students' achievement in functions among the eleventh grade students. In addition, this study sought to examine gender differences on achievement and attitude. The respondents of this study comprised 122 conveniently selected eleventh grade students of Mpongwe Day Secondary school in Mpongwe District, Copperbelt Province, Zambia. A pre-test and post-test Quasi Experimental research design was used by randomly assigning treatment variables to the two classes which were used for the research. The experimental group (N=64) received instructions on functions using ethno-mathematics strategies while the observational group (N = 58) received instructions on functions using conventional teaching methods. The Questionnaire on Student Attitude towards functions (MAS) and Questionnaire on Teachers Approaches (MTAQ) were used to measure students' attitudes towards mathematics whereas achievement was measured using the Ethno-mathematics achievement test on functions (ETHNOMAT). The results showed that students taught functions using ethno-mathematics were associated with a significantly higher mean achievement than those taught using other conventional strategies ($t(120) = 5.669$, $p = 0$). However the research findings, revealed that gender was not associated with any statistically significant effect on achievement in ethno-mathematics ($t(60) = 1.651$, $p = 0.107$). Results from the study also revealed that there was a statistically significant difference in attitudes between the experimental and observational groups of students (F-value $=4.271, P<0.041$). The study revealed only a weak positive Pearson's Correlation Coefficient between MAS and MTAQ ($r = 0.369$, $p > 0.05$). The corresponding R2 value of 0.136 can be interpreted that the contribution of the teacher's approach on student's attitude towards functions is rather poor (13.6%).

Index Terms- Ethno-mathematics, Ivory Tower, Achievement, Contextualization, Functions

I. Introduction

Background

Lusaka times (2018/11/29) reports that Zambia has continued to rank as one of the lowest in mathematics and science in annual performance assessment reports in the Southern part of Africa. Deficiencies in teaching strategies and methodologies used by teachers were alluded to as the root cause of the pathetic condition. Additionally, Bekalevu (1998) links this problem of continuous low performance in mathematics of students from third world countries in general to lack of cultural consonance in the mathematics curriculum.

The scourge has had been a serious problem of local concern at Mpongwe Day Secondary School where the pass rates in Mathematics at School Certificate level have been oscillating below the targeted provincial pass rate of 70% since the opening of the school six years ago. At the named institution where the research was conducted, symptoms of poor orientation to mathematics learning in general included: inability for the 11th grade students to handle algebraic expressions, graphical representation of quantities and all other interrelated concepts pointing to lack of the background knowledge of functions. Eisenberg (1991) and Carlson, et al (2005) reiterate that it has been widely agreed that the concept of functions is difficult to learn. Eisenberg (1991) further observes that unwillingness to stress the visual aspects of functions by teachers is a serious impediment to students' learning Mathematics in general.

However Yerushalmy and Schwartz (1993) posited that the topic of functions remains to be one of the fundamental concepts of modem day Mathematics, virtually permeating all the areas of the subject. Martin (2003) advocates for good teaching to be supplemented by research by individual teachers in order to validate the effectiveness of their teaching strategies and establish what works well for them. Against this background, therefore, the study was conducted in order to to assess the effect of incorporating ethno-mathematics strategies on students' achievement in functions among the 11th grade students at Mpongwe Day secondary school.

The rationale for the study to incorporate ethno-mathematics in teaching the perceived difficult topic of functions is further championed by Zaslavsky (1991) who suggests that including the cultural aspects of students in the mathematics curriculum in general can deepen students understanding of mathematics, boost their recognition of mathematics as part of everyday life and enhance their ability to make meaningful connections between mathematics and cultural practices. Raussen and Skau (2010) further lament that agents of academic mathematics are usually so encaged in their ivory towers that they don't see the world well enough either. therefore they continue presenting mathematics in form a very cold austere, Rosa (2016) highlight that ethno-mathematics provide the exit way to go out, gather rich cultural heritage resources and create a perspective of teaching that will bring mathematics closer to reality. Additionally, Rosa (2016) opined that Ethno-mathematics is dynamic or evolutionary, holistic, transdisciplinary and transcultural rendering it more vital for teaching any form of academic mathematics. D'Ambrosio (1987) contends that even before that advent of ethno-mathematics, over three decades ago, there still has had been tendency to peep into culture for solutions. He hypothesizes that harnessing cultural values as a means of conveying mathematical content helps to emphasize the relevance of mathematics to the learners' lives, which in turn makes the lesson more interesting and enjoyable. Everyday applications of culture into mathematics trigger students' curiosity and motivation to learner.

II. Literature Review

Ethno-mathematics, coined by D'Ambrosio (1985), is rather a means than an end in itself. Orey (2000) defines Ethno-mathematics as the sum total of all mathematical concepts embedded in cultural practices that might be characterized as "a tool to act in the world". He maintains that all cultures and all people develop unique methods and sophisticated explications to understand and to transform their own realities. This natural tendency can be harnessed to teach academic mathematics. Barton (1996) described ethno-mathematics as a program that investigates the ways in which different cultural groups comprehend, articulate, and apply concepts and practices that can be identified as mathematical practices. Borba (1997) on the other hand terms ethno-mathematics as a way in which people from a particular culture use mathematical ideas and concepts for dealing with quantitative, relational, and spatial aspects of their lives. Dowling (1991), Rosa and Orey (2007) point out that this way of viewing mathematics validates and affirms all people's experience of mathematics because it demonstrates that mathematical thinking is inherent to their lives. From this perspective mathematics is identified in cultural activities in traditional and non-traditional societies. D'Ambrosio (2001) stated that ethno-mathematics has come to mean the study of how people within various cultural groups develop techniques to explain and understand their world in response to problems, struggles, and endeavours of human survival. This includes material needs as well as art and spirituality through the use of the development of cultural artefacts; objects created by members of a specific cultural group that inherently give cultural clues about the culture of its creator and users. Rosa and Orey (2008) stated that this perspective "provides an important opportunity for educators to link current events and the importance of these artefacts in the context of ethno-mathematics, history, and culture"

Perceived benefits of Ethno-mathematics mathematics education in general include curricular relevance as builds knowledge around the local interests, needs, cultural backgrounds, social interactions, the past and present experiences as well as the immediate environment of students, according to D'Ambrosio (1987, 2001), According to Adam et.al (2003), a culturally relevant mathematics curriculum based on an ethno-mathematical perspective infuses the students' cultural backgrounds in the learning environment in a holistic manner. Vitally, therefore, infusing ethno-mathematics in teaching academic mathematics in general is a practice that is pictured to satisfy the viewpoints of non-zero-some meaningful learning theories such as the Taxonomy of Significant Learning proposed by Finks (2003) which brings on board affective domain and humanising of teaching the academic mathematics. It can also be argued that some of the perceived beneficial attributes of ethno-mathematics posited by D'Ambrosio (1987, 2001) are engrained in the revised model for Bloom's taxonomy of learning done by Anderson and Krathwohl (2001).These attributes include (1) revitalizing the interest for active learner participation, (2) deepening understanding or comprehension of concepts, (3) enhancing learner's responsibility to construct their own new knowledge based on already existing forms of knowledge through contextualization of the lessons and (5) and orienting learners to problem solving skills .

The different researches conducted on ethno-mathematics of in the past three and a half decades have not only insufficiently answered all the questions on the vast and dynamically evolving subject matter but also creating further knowledge gaps as some researches have in produced disagreeing findings. For example Sochima (2013) in his research conducted on 156 Senior Secondary School students from Enugu State of Nigeria found that the ethno-mathematic was effective in enhancing students' achievement in mensuration. On the other hand Amita and Qouder (2016) conducted a research amongst native students from a native Bedouin tribe at a school in Australia but the findings showed that ethno-mathematics had no effect on achievement in tests and the results shocked the two researchers. The other exciting feature of the research findings of Sochima (2013) on ethno-mathematics were that there was a statistically significant difference in the achievement between males and females after exposure to ethno-mathematics materials; a claim which the research aims to either confirm or refute as the findings have serious implications of the choice of ethno-mathematics as a teaching strategy in a co-educational school like Mpongwe Day Secondary School.

There was therefore good motivation to conduct a parallel research in order to fill up the imaging knowledge gaps resulting from such research findings This study is important as it provides lenses to goggle into culture elements in order to pick subtle examples that can be used to improve the quality of teaching and learning of mathematics and in particular functions in classrooms.

Gerdes (2005) and Palares (2012) highlighted further motivational examples of how to translate into classroom applications the study of patterns and symmetry found in daily life items used in particular professional activities of people throughout Africa such as baskets and foremen, masons, or folk dancers.

The study therefore involved finding cultural connections needed for improvement and enrichment of pedagogical strategies meant to help learners face the challenging topic of functions and other related topics squarely.

From the above explanation, two research questions were formulated to guide the study. Firstly, what is the effect of using ethno-mathematics strategies on students' mean achievement in functions? Secondly, what is the effect of gender on the mean achievement among students taught functions using ethno-mathematics?

Attitudes towards Mathematics

Prior to the study, it was observed by the researcher that the general status quo of the students' attitude to learning Mathematics at the institution (Mpongwe Day secondary School) had fitted very well with that outlined by Nostrand (2008), "Many students have erroneous impressions about Mathematics and dislike Mathematical activities; many seem to fear, even hate Mathematics". Hart in Zan and Di Martino (2007) define student's attitudes towards mathematics as the emotional response either positive or negative associated to mathematics, confidence to succeed in studying mathematics, and strategies in coping with mathematical problems. Zan and Di Martino (2007) report that attitudes towards mathematics have an important role in determining learning achievement on mathematics and argue that students with positive attitudes towards mathematic will have higher scores in mathematics achievement.

Contextualization and RME in Ethno-mathematics

Realistic Mathematics Education as an approach was first developed by the Freudenthal Institute in the Netherlands in 1971. The RME approach for mathematics is widely accepted as the best and most detailed approach, which was expanded from the problem-based approach for mathematics education. De Lange (1996) noted this theory has been adopted by a large number of countries all over the world such as England, Germany, Denmark, Spain, Portugal, South Africa, Brazil, USA, Japan, and Malaysia. RME is aimed at transforming mathematics learning into a fun and meaningful experience for students by introducing problems within contexts. The starting point in RME is choosing problems relevant to student experiences and knowledge. The teacher's role in this form of education is to act as a facilitator to help students solve contextual problems. This contextual problem-solving activity brings positive impact to the mathematical representation of students, which is related to their problem solving skills. The best way to teach mathematics is to provide students with meaningful experiences by solving the issues they face every day or by dealing with contextual problems. Realistic mathematics education enables the alteration of the mathematical material concept and its relationship. Realistic mathematics education changes the culture towards a dynamic one, but still in the corridor of the educational process.

Therefore, realistic mathematics education is an innovative learning approach that emphasizes mathematics as a human activity that must be associated with real life using real world context as the starting point of learning. Mathematics education motivates students to become critical and innovative and to cultivate sound reasoning in problem solving. Mathematics education is an active, dynamic and continuous process; activities in mathematics education help students develop their reasoning, to think logically, systematically, critically and thoroughly and to adopt an objective and open attitude when dealing with problems. Problem-solving skills enable students to think creatively and critically by using progressive and challenging thought processes; creative and critical thinking will help develop a nation and address its needs.

Adam (2002) maintains that the one particular approach to teaching mathematics that has been focused in researches over the past three decades which has been postulated to making the teaching of functions in mathematics more relevant, realistic, and meaningful to students and to promote the overall quality of education is incorporating of ethno-mathematics.

Research Questions

The focus of this paper is to answer the following questions Research Questions.

1. What is the effect of using ethno-mathematics strategies on students' mean achievement in functions?
2. What is the effect of gender on the mean achievement among students taught functions using ethno-mathematics?

Research Hypotheses

The following null hypotheses were formulated to guide the study.

H_01: There is no statistically significant difference between the mean achievement of students taught functions with ethno-mathematics strategies and those taught with conventional strategies.

H_02: There is no statistically significant difference between the mean achievement of male and female students taught functions using ethno-mathematics strategies.

III. Methods

Sampling procedure

A non-random-convenient sample was drawn out of a total population of 240 eleventh grade students at Mpongwe day secondary School. The Raosoft online sample size calculator was utilized to estimate the thresh-hold at 122. Accordingly, two natural classes were purposefully chosen and randomly assigned to the treatment variables. The Experimental Group, consisted of 64 students (34 boys and 28 girls), was taught functions incorporating ethno-mathematics into lessons. The Observation Group, consisting of 58 students (36 boys and 22 girls) was taught functions other conventional strategies.

Research Instruments

Quantitative data analysis research was used in the study. A proxy pre-test was given, and an ETHNOMAT post-test were given after the experimentation. The mean scores or achievement of the students were recorded. Additional information for the research was obtained from the questionnaires using an adaptation of the 5–point Likert–type scales called Mathematics Attitude Scale (MAS) and Mathematics Teachers' Approaches Questionnaire (MTAQ) which were originally developed by Alkan, Bukova Güzel and Elçi (2004). The MAS was used to determine the students' attitudes towards functions and the MTAQ was utilized for identifying mathematics teachers' approaches during class activities.

The MAS consisted of 21 subdivided into four broader sub-scales, namely: self-confidence in mathematics (6 items), perceived value of mathematics (5 items), mathematics enjoyment (5 items), and mathematics motivation (4 items).The Scores of attitudes towards mathematics is the total score of the four domains in MAS. The scores on self-confidence in mathematics described students' self-esteem and self-concept on their performance in mathematical tasks. The scores on perceived value of mathematics described students' beliefs on the usefulness, relevance and value of mathematics in the present life and the future. The scores on enjoyment of mathematics described the pleasure of students in learning mathematics in class. The scores on motivation to do mathematics described students' interest on mathematics and willingness to continue their study on mathematics. Prior to the administering of the instrument, a pilot test was carried out on 40 students using simple random selection on eleventh grade students from the Mpongwe day Secondary School. The overall validity of MAS was calculated at 0.517, and the Cronbach α reliability value was 0.798. The internal consistencies of the items ranged from 0.771 - 0.838 as shown in the table 1.

For the convenience of this study the corresponding MTAQ set of instrumentation was adapted to assess the effect of teacher's ethno-mathematics-wise orientation to teaching on the students' attitude towards functions. The internal consistencies of the items ranged from 0.762 - 0.825 and the Cronbach α reliability value was 0.809.

Table 1: *Validity and Reliability of MAQ*

		items	Items no	Cronbach α
1	self-confidence in	4	2, 4, 8, 9, 13, 14	0.771 - 0.797
2	perceived value of	6	1, 5, 6, 10, 15,	0.777 - 0.836
3	mathematics enjoyment	5	3, 7, 20, 21	0.776 - 0833
4	mathematics motivation	5	11,12, 16, 17,	0.794 – 0.838

The response rate from the respondents was 95% and the data collected were analysed statistically using the Statistical Package for Social Science/SPSS version 16.0. Analysis of means differences on mathematics achievement between the experimental and observational groups of students was performed through Independent Samples t-test whilst analysis of variance (ANOVA) was used to establish the effect of gender on achievement. The analysis of correlation among Students' Attitudes and Teachers' Approach was executed through Pearson's Correlation Coefficient in order to predict the Students' Attitudes toward mathematics in relation the Teachers' Approach on mathematics. All results were considered statistically significant at confidence interval of $\alpha = 0.05\%$.

Historical Descriptions of the Interventions

Ethno-mathematics Lesson Plans for the Experimental Group.

To complete this research project, the teacher researcher had to complete certain tasks that included creating lesson plans and actually conducting some lessons as well as assessment of students through common monthly tests. For the Experimental Group, lesson plans were made on relations and functions and integrating ethno-mathematics by the researcher.

Lesson 1

Introduction: Types of Relations and Definition of Functions

Ethno-mathematics: Dramatization of family Role Plays (Ukubuta: In Bemba)

The students acknowledged role plays in childhood and they had to relive their memories. The teacher had students choose family roles to dramatize such as: the child, wife, husband, or grandfather grandmother of 10 selected individuals, so that the classroom was divided into about 10 extended families. The theory behind the use of role-play in science and mathematics teaching and learning revolves around 'active', 'experiential' or 'child-centred' learning. According to Taylor (1987). Role play encourages learners to be physically and intellectually involved in their lessons to allow them to both express themselves in a scientific context and develop an understanding of difficult concepts.

The results of play roles chosen were put in arrow diagrams which pictured various types of relations. Students had to use the results to identify the type of relation such as: one-to-many, many-to-many, many-to many and one-to-one. The students were then tasked to give examples of social relations which were typical examples of relations that were functions and to elaborate their responses in group work. Their findings were document and some of the cases which excited debate among the students have been sketched in figure 1, figure 2 and figure 3 respectively. (Letters and not the real real names of participants have been used for ethical reasons).

Using for example the ethnicity and cultural taboos or cultural norms of the students' backgrounds, students had to identify the familial relations which typically represented functions from the set of relations tabulated from role play drama. An example of a one-to-one relation which typifies a function used for the ethno-mathematics lesson on functions was: "is a child of (the named) mother" in figure 1.

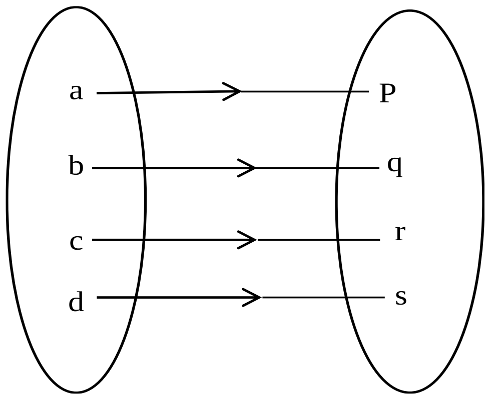

Figure 1 : The relation "is the child of ...mother " typifies a function

Every student was born from one mother. The local Bemba terms used commonly in the area, "bamayo mwaice" or "bamayo mukalamba", literally translated as " my younger mother" and "my older mother" are not real mothers but rather a mere traditional gracious ways of referring to "auntie" and this did not conflict the use of this example as one-to-one relation representing a typical function. One exciting example in this study which arose from the tabulated role play results and triggered debate was the relation depicted by figure 2.

To say decide whether a relation was a function or not involved looking at myths, taboos and society values. Student's responses indicated that barrenness was associated with curses of some kind and that this relation was considered to be "a taboo" in the cultural setting of the students. This relation was therefore used as a counter example of a function.

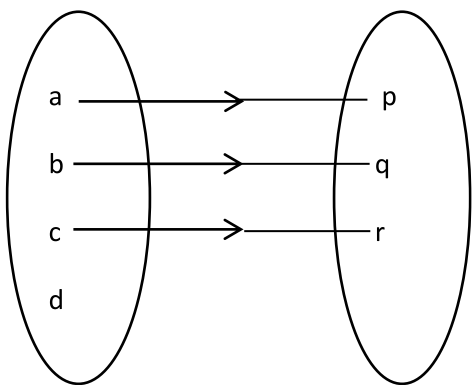

Figure 2: The relation "is the mother of " typifies a relation which is not a function

Student's responses indicated that it was very 'usual" for a woman to be married to one man although the man could be married to other wives. A function can be defined as a relation between two sets which associates to every element of a first set exactly one element of the second set. The contextualization of the definition and examples seemed to give the experimental group an added advantage to the observation group over language barriers in mastering the definition.

While 90% of the pupils experimental group were able to correctly identify a function only 80% of the students in the control group were all able to do so. To justify why for example students in the control group mistook figure 3 as not representing function was because r was not paired.

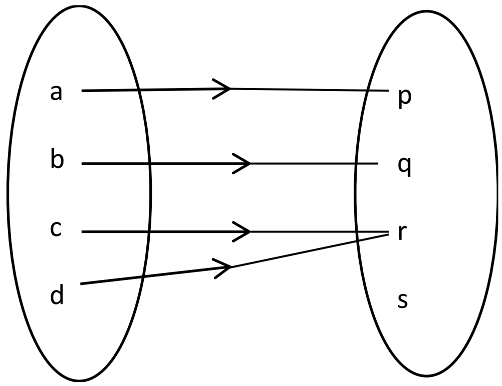

Figure 4.4.3: "is the wife of" typifies a relation which is a function for a group of married women only

To the effect that students were able to construct their own meaning of function composition, this amounted to a meaningful learning experience.

Lesson 2:
Subtopic: Function Evaluation and Function Composition

Ethno-mathematics Elements: Family Heritage or Family Trees

In this lesson genealogy was dramatized. One student had to volunteer to be the first ancestor (named as 1), 1 was allowed to choose his/her child (named as 2) 2 was also allowed to choose a child to beget and so on and until he chain was broken when a student chose to remain childless or when the list was long enough. The genealogy list was summarized as in a figure 4.4.4. (Actual names of the participants were withheld). A corresponding flow chart similar to figure 4.4.5 was used to develop the function notation, evaluation and composition.

Kafula (1)	**is the father of**	**James (2)**
James (2)	**is the father of**	**Mpasela (3)**
Mpasela (3)	**is the father of**	**Alick (4)**
Alick (4)	**is the father of**	**Kapilipili (5)**
Kapilipili (5)	**is the father of**	**Chiyombo (6)**
Chiyombo (6)	**is the father of**	**Dalitso (7)**

Figure 4.4.4: Sketch of data from Dramatization of a Genealogy

Students in the experimental group were asked to identify actual names of for example, the father to Mpasela, the father to Kapilipili, the grandfather to Alick, the father to the grandfather of Dalitso and so forth excitedly and easily.

The names of people in the ancestral tree were replaced by their generational position numbers and the results were put in the arrow diagrams in figure 4.4.4. The notation $f(x)$ was used to represent the expression "the father of the individual named$x$". Similarly, $g(x)$ was used to represent the expression is "the grandfather of the individual named$x$"

Accordingly, the students had to use the arrow diagram on figure 5 to evaluate functions. Names of students were replaced by numbers there by providing a passage way to enter in the formal language of function evaluation and composition within a relaxed environment.

ETHNO-MATHEMATICS EXERCISE

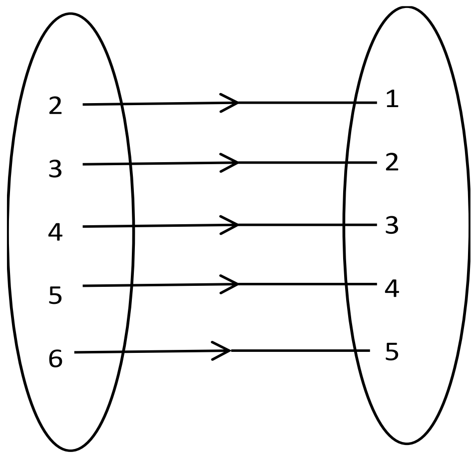

***Figure 4.4.5*: Arrow Diagram of Dramatized Genealogy**

Use figure 5 to evaluate the functions below.

(i) $f(2)$
(ii) $f(3)$
(iii) $f(7)$
(iv) $f(20)$
(v) $f(x)$
(vi) $g(4)$
(vii) $g(50)$
(viii) $g(x)$
(ix) $g(f(3))$
(x) $g(f(x))$

The students had to use the intuition from ethno-mathematics in genealogies to evaluate the functions and compositions of $f(x) = x - 1$ and $g(x) = x - 2$. Students had to construct their own methods two evaluate the functions.

(i) $f(2) = 2 – 1 = 1$
(ii) $f(3) = 3 – 1 = 2$
(iii) $f(7) = 7 – 1 = 6$
(iv) $f(20) = 20 – 1 = 19$
(v) $f(x) = x - 1$
(vi) $g(4) = 4 – 2 = 1$
(vii) $g(50) = 50 – 2$
(viii) $g(x) = x – 2$
(ix) $g(f(5)) = g(5 - 1) = (5 - 1) - 2 = 2$
(x) $g(f(x)) = g(x - 1) = (x - 1) – 2 = x – 3$

For example to explain $f(50)$, the students said the father to a 50th filial generation family member falls in filial generation number (50 – 1). Similarly the explanation for $g(f(x))$ was that the grandfather to the father of a family member x^{th} generation falls in the generation which is earlier by $(x - 1) - 2$ or simply $x - 3$ generations.

An ethno-mathematics related homework activity was given in which students had to estimate the total number of bricks on a traditionally baked kiln near the research site as shown on appendix E.

It was noted that the number of bricks on each layer was a dependent on the position of the layer from the top as indicated in figure 6.

Layer number From the top (N)	**Number of bricks on the layer**
1	12
2	16
3	28
4	36
.	.
.	.
.	.
N	$2N^2 + 10$

Figure 6: Ethinomathmatics activity to evaluate the function f(N) = 2$\mathbf{N}^2$ + 10

Students were able countercheck the number of bricks on each layer by comparing their findings with the formula f(N) = $2N^2 + 10$. Therefore the students easily accepted the change from dealing with concrete visual ethno-mathematics object (kiln of traditionally baked bricks) to use of a formal algebraic representation of functions.

Lesson 3:
Subtopic: Function Inverses

Ethno-mathematics Elements: The Academic Tour (visit) to Her Chieftainship Lesa's Palace

In this lesson a walk to Her Royal Chieftainship Lesa's palace was simulated by simple sketch of the route to the place using familiar land marks identified by students from the previous day's academic tour to the palace. Short phrases and antonyms to describe the forward and back or reverse journeys respectively were used. The resulting sketch map resembled figure 7 and corresponding brief descriptions of the journeys were compared for the forward journey and the corresponding return journey..

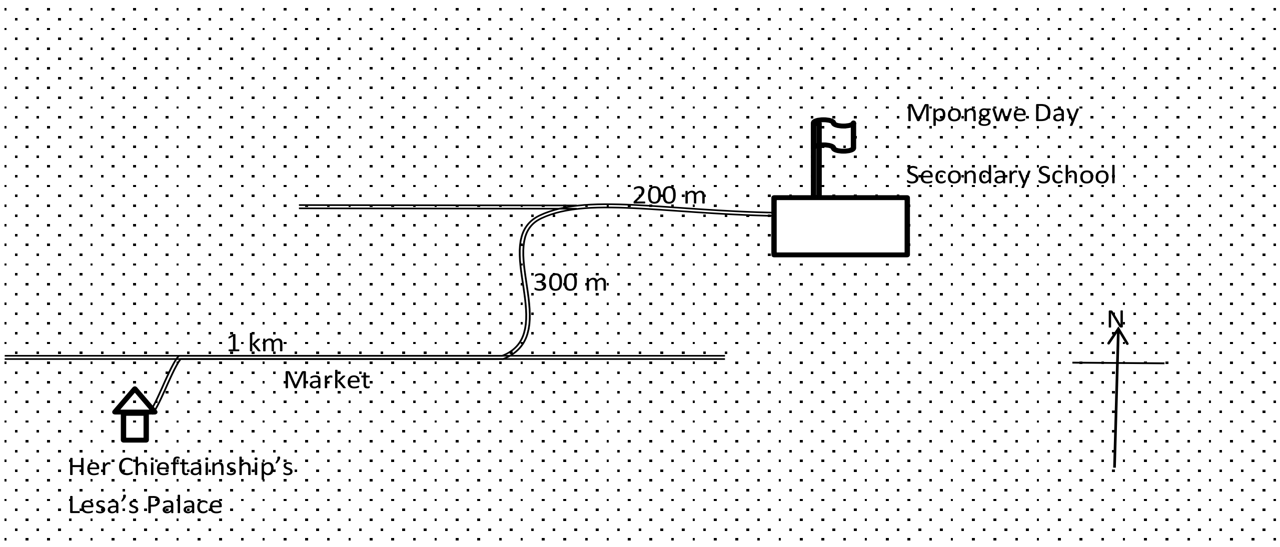

Figure 7: Sketch Map of the route to Her Royal Chieftainship's Traditional Home.

FORWARD JOURNEY

Starting from Mpongwe Day Secondary School, walk westwards 200m, turn left at path-junction, walk southwards 300m to tarmac junction, turn right, walk 1km westwards along tarmac, turn left at the palace junction and arrive Her chieftainship Lesa's Palace.

REVERSE JOURNEY

Depart from Her chieftainship Lesa's Palace walk right to the tarmac, walk 1km eastwards along tarmac Starting, turn right at path-junction walk and northwards 300m, turn right at another and walk eastwards 200m and arrive at Mpongwe Day Secondary School.

The approach was used to develop the concepts of inverses of functions such as

$f(x) = 2x + 1$.

Function: $f(x) = 2x + 1$

Start with a number: x , *multiply* x by 2 and *add* 1

The corresponding inverse function or reverse function is can found using the antonyms for multiply and add respectively and starting from the end of the sentence going backwards.

Start with a number , *subtract* 1 and *divide* x by 2

Therefore the Inverse or reverse process for $f(x) = 2x + 1$ was found as $f^{-1}(x) = \frac{x-1}{2}$

This way of presenting the inverse was more rigorous than the step-by-step method proposed by Chiyaka et al (2013).

To find the inverse for the function $f(x) = 2x - 1$, Chiyaka et al (2013) has proposed for a step-by-step detailed outline of the solution a follows:

STEP1: Let $y = 2x + 1$

STEP1: Interchanging$y$ $i$and ix, we obtain $x = 2y + 1$

STEP1: Making y the subject of the formula, we obtain $y = \frac{x-1}{2}$.

Therefore the inverse of $f(x)$ is $f^{-1}(x) = \frac{x-1}{2}$

This method is of course more practical and can be used to work out inverses for rational functions which are less tractable for descriptive method of ethno-mathematics.

However, this is not surprising. In this regard, "ethno-mathematics can been characterized as a tool to act in the world" according to Orey (2000). It has merely been used to provide insights into the social role of academic mathematics. Ethno-mathematics has been used here to present the mathematical concepts of functions in a way in which these concepts are related to the cultural backgrounds of students. D'Ambrosio (2001) maintains that this approach enhances their ability to make meaningful connections and deepens their understanding of mathematics.

IV. FINDINGS

Demographic Characteristics of the Respondents by Gender

Table 2 shows the genders of the respondents who participate in this study. The data is in form of frequencies and percentages. There were a total of 122 participants with 70 males representing 58.3% and 70 females representing 41.7%. The data show that this study group was male dominated.

The Experimental Group exposed to teaching functions using ethno-mathematics was associated with post-test mean M = 70.4 (S.D = 17.79, N = 64). By making comparisons using the data from table 3 respectively, we can see that the observational group was associated with a numerically smaller post-test mean achievement M = 55.6. (S.D = 17.17, N = 58).

Table 2 : ***Demographic Characteristics of the Respondents by Gender, N=122***

Description	Frequency	Percentages
Male Students	70	58.3%
Female Students	50	41.7%
Totals	120	100%

Table 3: Groups Statistics associated with post-test mean scores, N=122

	N	Mean	S.D	Skewness	Kurtosis
Experimental Group	64	70.4	17.79	0.11	-0.14
Observational Group	58	55.6	17.19	0.57	-0.55

To test the null hypothesis that the observed differences in the post-test means was not statistically significant, an independent samples t-test had to be performed. Preliminaries required conducting the Kolmogorov-Smirnov test for normality as illustrated in table 4. The test, D (122) = .063, p = .200, shows that study sample test scores were significantly normal at $\alpha = 0.5$ for the purpose of conducting the parametric *t*-test.

Table 4: Kolmogorov-Smirnov's test for normality of study groups, N=122

	Kolmogorov-Smirnov		
Variable	Statistic	df	Sig.
Pre-Test Scores	.063	122	.200*
Post-Test Scores	.037	122	.200*

The independent samples t-test conducted was associated with a statistically significant effect of $t\,(120) = 5.669$, $p = 0$ as shown in table 4. Thus students taught functions using ethno-mathematics were associated with a significantly higher test mean than those taught using other conventional strategies.

Table 5: T-Test for post-test means from the two study groups, N=122

Variable	N	Mean	S,D	Df	T-value	*p*-value
Experimental	64	70.4	17.79	120	5.669	0.000
Control	58	55.6	17.19			

Cohen's *d* value was estimated at 0.79 by using the online effect size calculator and this shows a large effect size going by Cohen's (1988) guidelines.

Furthermore, Table 6 shows the results of another t-test which was conducted to compare the effect of ethno-mathematics across gender.

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Table 6: T-Test for post-test means across Gender, N= 62.

Variable	N	Mean	S.D	df	T-value	*p*-value
Experimental	38	69.3	15.63	120	1.651	.107
Control	24	72.4	15.88			

The male students exposed to teaching functions using ethno-mathematics were associated with a post-test mean achievement M = 69.3 (S.D = 15.63, N = 62). This mean value is lower than the observed post-test mean M = 72.4 (S.D = 15.88, N = 24) for the female counterparts as shown in table 6. However the T-test t (60) = 1.651, p = 0.107, associates gender with no statistically significant effect on ethno-mathematics teaching strategies.

In the study, a correlation was made to determine the relationship between the attitude of pupil in class and the teachers' approach for teaching using the Pearson Correlation Analysis. Table 7 shows that there was a weak positive relation between the students' attitudes towards functions and the teaching strategy used by the teacher.

Table 7: The Pearson correlation analysis between students' MAQ points and MTAQ .

	MTAQ
MAQ	0.369

The study also showed that there was no statistically significant difference in attitudes of students towards mathematics between the genders. (F- Value=0.018, P=0.894), as shown in Table 8.

Table 8: Group ANOVA of Attitudes towards functions, N = 122

Variable	N	Mean ± SD	t- value	P value	Interpretation
Experimental	64	2.89 ± .875	4.271	< 0.041	Significant
Observational	58	2.57 ± .840			
Total	112	2.74 ±..870			

Based on the analysis of data as presented in this study, the following major findings were made.

1. The mean achievement of students taught with ethno-mathematics teaching strategies was significantly higher than that for students taught with conventional approach.
2. There was no significant difference in mean achievement scores of male students taught using ethno-mathematics strategies and the mean achievement of females taught using the same strategy.
3. There was significant difference in attitudes of students taught using ethno-mathematics strategies and attitudes of students taught using conventional methods.
4. There was a weak positive correlation between the way students viewed the teaching strategies, methods or classroom activities used by their teacher and there attitude towards the topic of functions.

V. DISCUSSIONS

Introduction

This chapter presents discussions of the results from chapter five above in line with the research questions. The questions on the research included:

1. What is the effect of using ethno-mathematics strategies on students' achievement in functions?
2. What is the effect gender on the mean achievement scores of students taught functions using ethno-mathematics teaching strategies?

What effect has ethno-mathematics on students' achievement in functions?

The independent samples t-test conducted was associated with a statistically significant effect t (120) = 5.669, p = 0 as shown in table 5.3.5. Thus students taught functions using ethno-mathematics were associated with a significantly higher test mean than those taught using other conventional strategies. These results correlate with the study conducted by Sochima (2013) in Nigeria meant to ascertain the effect of ethno-mathematics teaching materials on students' achievement in mensuration. The sample for that study was 156 Senior Secondary Schools two (SSS 2) students, who were randomly selected from 16 Senior Secondary Schools in Igbo-Etiti Local Government Area of Enugu State through multi-stage sampling technique. The mean was used to answer the research questions posed, while the ANCOVA statistic was employed in testing the null hypothesis at 0.05 significant levels. Findings of the study showed that the ethno-mathematic

was effective in enhancing students' achievement in mensuration with particular reference to volumes of cylinder and hemisphere.
However, the findings from this study contradict those done by Sochima (2013) on issues of gender. In this study, the male students exposed to teaching functions using ethno-mathematics were associated with post-test mean M = 69.3 (S.D = 15.63, n = 62). This mean value is lower than the observed post-test mean M = 72.4 (S.D = 15.88, N = 24) for the female counterparts as shown in *table* 5.3.6. However the T-test t (60) = 1.651, p = 0.107, associated gender with no statistically significant effect on ethno-mathematics teaching strategies contrary to the findings of Sochima(2013) associating gender with a significant effect on achievement.

The findings in this study also contradict to the research findings by Amita and Qouder (2016) on native students from a native Bedouin tribe in Australia. Their findings had shown that that ethno-mathematics had no effect on achievement in tests.

The findings of this research conform to the argument by Davison (1988) that the interaction of native culture and mathematics ideas can be mutually reinforcing. In other words, application of native culture situations to the mathematics classroom could help native students see relevance of mathematics in their culture, and to use this connection as a means of learning formal mathematics according to Aichele & Dawning (1985). Application of ethno-mathematics strategies seemed to motivate students to participate freely without the phobia of strict formalism in teaching mathematics.

Magallanes (2003) also supports the findings from this study. He had also found statistically significant effect that after using ethno-mathematics software in combination with traditional teaching practices there was increase in the students' achievement in coordinate planes and associated concepts.

This finding also confirm NCTM (2013) hypothesis that cultural experience and practices of the individual learners, the communities, and the society at large can be used effectively as vehicles to not only make mathematics learning more meaningful, but provide learners with the insights of mathematical knowledge as embedded in their social and cultural environment.

Conflicts of Interest

The authors declare no conflicts of interest.

VI. Recommendations

Based on the findings from this study, it's recommended that more rigorous studies of ethno-mathematics should be carried out on other topics and sites so that ethno-mathematics can supplement to the mathematics curriculum. More or ethno-mathematics should be used as a springboard for teaching the formal or academic The other recommendation is to regularly make learning settings become more ethno-mathematics friendly as that it is only through the lens of formal, academic mathematics sensitive to cultural differences that the real value of the mathematics inherent in certain cultures and societies be understood and appreciated.

VII. Conclusion

The main purpose of the research was to assess the effect of using ethno-mathematics strategies on students' achievement in functions. The results of this study have shown that the use of ethno-mathematics teaching materials does not only enhance the students' achievement in functions but it also has a positive effect on the attitude of learners. The lesson plans used in the study to enhance achievements in functions are rudimentary and therefore need further research, improvement and possible adaptation for use in other related topics in mathematics education.

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