

**APPLICATION OF ABAGUSII CULTURAL PRACTICES INTO TEACHING AND
LEARNING OF MATHEMATICS IN SECONDARY SCHOOLS IN MASABA
NORTH SUB-COUNTY, KENYA**

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E55/CE/24574/2012

**A RESEARCH THESIS SUBMITTED IN FULFILMENT OF THE
REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION IN THE
SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY**

MARCH, 2018

DECLARATION

I declare that this thesis is my original work and has not been presented to any other University for consideration. This research thesis has been complemented by referenced sources duly acknowledged. Where text, data, graphics, pictures or tables have been borrowed from other sources, including the internet, these are specifically accredited and references cited and in accordance in line with anti-plagiarism regulations.

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DEDICATION

I dedicate this thesis to my late father Andrew W. Bundi my mum Beatrice Bundi who has instilled a lot of discipline and culture of hard work in me. To my wife Nancy Nyatichi and my daughter Melab Nyamoita for their moral, financial support and encouragement through the entire period, to my brothers Dennis and Nehemiah and sisters Bilha, Edina, and Esther, for their moral support.

ACKNOWLEDGEMENT

I thank the Almighty God for his guidance and protection throughout the entire process of this study. I am greatly indebted to my supervisors Dr.Miheso,M.K O'Connor and Prof. Ondigi Samson for their guidance and support during the preparation of this thesis, as their wealth of knowledge and experience, contributed greatly to the success of the study.Thanks once again.

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ABBREVIATION AND ACRONYMS

KCSE	Kenya Certificate of Secondary Education
KNEC	Kenya National Examination Council
MOEST	Ministry of Education, Science, and Technology
MSQ	Mathematics Students' Questionnaire
MTQ	Mathematics Teachers' Questionnaire
NCTM	National Council of Teachers of Mathematics
SMASSE	Strengthening Mathematics and Science in Secondary School Education
SPSS	Statistical Package for Social Sciences
USA	United States of America

ABSTRACT

Every community has certain kind of mathematical knowledge which can be used in the formal mathematics curriculum. This study sought to investigate the application of Abagusii cultural practices into the teaching and learning of mathematics in secondary schools in Masaba North Sub-County, Kenya. The main objectives of the study were; to identify areas in Abagusii culture which use mathematical concepts, to find out whether both teachers and learners are aware of the applications of mathematical concepts in Abagusii culture, to establish the teachers' opinion on transfer of learning from Abagusii culture to mathematics to support learning and finally to establish how teachers can integrate Abagusii cultural practices into the teaching and learning of mathematics. The study was based on constructivist theory by Jean Piaget and John Dewey. The study adopted a descriptive survey design. Data was collected using Mathematics Teachers' Questionnaire (MTQ) for teachers and Mathematics students' Questionnaire (MSQ) for students. The target population included 86 teachers and 1741 form four students. Stratified random sampling was used to select six schools (19.35%) for the study. The strata were the divisions in the sub-county. From the six schools, purposive sampling was used to select 16 (19.36%) mathematics teachers and 274(15.72%) students. Piloting of instruments was done using split-half method followed by Spearman-Brown formula. The reliability of Mathematics Teachers' Questionnaires was (0.70),and Students' Mathematics Questionnaire (0.75). Reliability coefficient of 0.73 was obtained and considered to fulfill the required degree of consistency. Instrument validity was determined through appraisal by experts. Data collected was subjected to Statistical Package for Social Science (SPSS) for analysis. Statistical data was presented using frequency distribution tables and analysis used percentages. The study found out that Abagusii culture has mathematical concepts that can be used in teaching and learning of mathematics. Majority of the teachers and students are aware that Abagusii culture has mathematical concepts. Teachers also agreed to the integration of culture into the mathematics curriculum. The study recommended that curriculum developers and teachers should set up mathematical resource centers in every county. In these centers charts showing mathematical concepts can be illustrated. Equally, textbooks should use content from a culture based on students' background.

CHAPTER ONE

INTRODUCTION

1.0. Preamble

This chapter contains the background of the study and statement of the problem. It states research objectives, research questions that guided the study; assumptions of the study, scope and limitations of the study are stated; theoretical framework, on which the study was based, is also highlighted. The conceptual framework and operational terms that were used in the study are defined.

1.1 Background of the Study

Mathematics has a very important role in both the individual and society's well being because it has greatly facilitated the rise of living standards across the world. This means many societies have found it inevitable to include mathematics in their formal and informal curricula and other entrepreneurial endeavors, Bii, (2006). In understanding the role of mathematics, the Kenyan government made it one of those subjects one must study both in primary and secondary school levels, KNEC, (2005). This means the value of mathematics in this world cannot be over-stressed. It's an important tool for the understanding our daily activities. Figueiras (2014) says learning of mathematics is a continuous process and is not limited to the classroom experience only. In spite of the value attached to mathematics, secondary school students still have problems of low levels of achievement in mathematics.

But in countries like Brazil ,D'Ambrosio, (1985) and USA ,Wilson and Mosquera, (1991), educators have sought for recognition that mathematics is not only cultural

product, but also the cultural background of students can be used in powerful ways in learning of school mathematics.

Geders (1999) indicates that people from South Africa have a vibrant cultural mosaic, extremely rich in diversity. Among these mosaic artifacts there are many geometrical ideas that are shown in the work of wood and ivory carvers, potters, painters, and weavers. South Africa has set up a curriculum that supports all their learners to achieve their maximum potential, Revised National Curriculum Policy, (2002). This is normally done by checking the outcomes to be achieved at the end of the learning process. These outcomes are based on learner-centered and activity-oriented approach. The activities or practices that take place in various communities and the cultural artifacts that are found there is a true reflection of many communities. It is possible that these artifacts can be presented in the classroom and analyzed by the learners and teachers together to come up with the mathematical concepts found in them.

On the other hand, Zaslavsky (1999) notes that Africans have significantly contributed to the development of counting and numbers system. Therefore they deserve a place in studies dealing with the mathematics.

Anghilen (1995) asserted that school mathematics is normally carried out for its own sake, it is normally not related to any real or particular context and in most cases, and it involves recording using symbols. Bishop (1998) narrates that every community has a self-perpetuated form of mathematical knowledge-that is ways of counting, measuring, relating, classifying and inferring. Integrating culture into the learning and teaching of mathematics creates a link between the formal mathematics teaching, student's

background knowledge and learning the learner would experience while in school. Every community has a certain kind of mathematical knowledge, but unfortunately it is ignored in the formal mathematics curriculum.

A school set up that gives reinforcement to the students' home cultures, caters for prior knowledge and learning experiences of learners, then learning would take place for these students and if not learning would be drastically inhibited, D'Ambrosio (2001)

Teachers have a higher chance, Mosimege, (2000) due to their wide exposure to mathematical knowledge and this will assist to create linkages between various activities embedded with mathematical concepts to ensure learners' experiences are enriched through daily experiences of what they encounter outside the classroom. David (1990) found that the relationship between culture and mathematical activities can be emphasized together because the application of culturally sensitive mathematical activities can help students to see the relevance of mathematics in their culture and help teachers to use this connection to teach more mathematics.

The provision of meaningful and adequate education is fundamental to Kenya's overall development strategy, MOEST, (2004). This is done through imparting appropriate knowledge, skills and attitudes in the learners to enable their awareness, appreciation and preservation of their cultural heritage and also their creativity in modifying and even shaping this culture for their benefits and that of the society, Mercella, (2013). Further, the guidelines of the National Council of Teachers of Mathematics, NCTM, (1991) highlighted the importance of building connections between mathematics and students' personal lives and cultures.

1.2 Mathematical practices among Abagusii

Abagusii culture has many activities and practices that can be linked to mathematics. Counting reflects the addition method as it is done in schools. In counting, to move from one number to the next number they say add one to the previous number. The operations of multiplication and division are done as repeated addition and subtraction respectively. It is good to note that computation is not done with integers such as 0,1,2,3,4,5,6,7,8,9. Abagusii culture does not add four and three but they add four bananas to three bananas to get seven bananas. Similarly, they divide four bananas among two boys but not just four divide by two. However, no unique answers are to the division operation. For the same problem, several acceptable answers can be obtained depending on what to be divided.

Equally, Abagusii have a special way of making baskets which also show some mathematical concepts. Estimation is more prominent. Estimation on how much reeds, the grass is needed in each step in making baskets. The size of the basket is determined by what the container will be used for. It means the amount of grass used for different sizes are estimated. The dancing styles of Abagusii use constant sequence and patterns. Advanced styles can give periodic sequences where dancers will make a different number of steps forward, backward and sideways. Hence this study aims at analyzing the Abagusii cultural practices and how they can be integrated into the current secondary school mathematics curriculum to improve mastery of mathematics concepts hence improve performance.

1.3 Statement of the Problem

Culture has been documented as a resource in the teaching and learning process. According to studies done by D'Ambrosio (1990) mathematics is taught in schools as culturally free subject that involve learning supposedly universally accepted facts, concepts, and contents. This type of learning contributes to the poor performance of learners in the subject. He further argues that including cultural aspects in the curriculum has long-term benefits for mathematics learners.

He posits that, cultural aspects contribute to recognizing mathematics as part of daily life, enhancing the ability to make meaningful connections, and deepening the understanding of mathematics. Abagusii culture has been widely adopted in teaching subjects like English when teaching poetry, history when referring to migrations but not in teaching and learning mathematics. This Abagusii culture like other cultures is a rich reservoir for teaching mathematical concepts. Basket making for example can be used in teaching concepts related to estimation, numbers and operations, geometry and measurement concepts. By delivering mathematics in a format which does not relate to the learner's culture tend to make the subject lack relevance and limits learners' mastery of the concepts. While studies done in Kenya have also attempted to address on how best mathematics can be taught, they are yet to isolate and evaluate the application of cultural practices into the teaching and learning of mathematics at secondary school level. This study, therefore, seeks to investigate how the application of Abagusii cultural practices into the teaching and learning of mathematics in secondary schools in Masaba North Sub County Kisii County, Kenya can improve performance.

1.3.1 Purpose of the Study

The purpose of this study was to investigate the application of Abagusii cultural practices into the teaching and learning of mathematics in secondary schools in Masaba North Sub County.

1.3.2 Objectives of the Study

The main objectives of the study were:

- a) To identify areas in Abagusii culture which use or have mathematical concepts
- b) To investigate whether both teachers and learners are aware of the applications of mathematical concepts in Abagusii culture.
- c) To establish the teachers' opinion on the transfer of learning from Abagusii culture to mathematics to support learning.
- d) To establish how teachers can integrate Abagusii cultural practices into teaching and learning of mathematics.

1.3.3. Research Questions

To achieve the objectives above, the study was guided by the following research questions:

- a) Which mathematical concepts that are used in Abagusii cultural practices?
- b) Are teachers and students aware of the applications of mathematical concepts in Abagusii cultural practices?
- c) What are the teachers' attitudes to the integration of Abagusii culture in teaching and learning mathematics?

- d) How can teachers incorporate Abagusii cultural concepts in teaching mathematics?

1.4. Significance of the Study

The findings of this study will support the teaching approach of mathematics to that which is rich in student activities and one that is learner centered. It will also enable secondary school teachers to change the attitude towards mathematics. By showing the various activities in the Abagusii culture and how they use mathematics, learners could realize that mathematics is in culture and in everyday life thus giving it a practical approach. Lastly, the teachers and other stakeholders will be made aware of the Abagusii culture and practices that have mathematical concepts.

1.5 Limitation of the Study

This study was done in a sub county that is located in a rural setting and that only four students and not a cross-section of students from all classes was used, again the findings from this study may not be generalized to other geographical areas especially the urban areas but the study was to be replicated. This study was limited to a small sample

1.6 Assumption of the Study

The study was based on the assumption that integration of cultural practices in teaching improves students understanding in mathematics.

1.7 Theoretical and Conceptual frameworks

1.7.1 Theoretical framework

This study was guided by the constructivist learning theory and ecological system theory. Constructivism learning theory states that people develop their own knowledge and understanding of the world, through the interaction of things and reflecting on experiences. It further says that when learners experience something new, they harmonize it with their past experiences and ideas, this may lead to either changing what they believe or cast aside the new information as having no meaning. In this case, learners are active creators of their knowledge.

On the other hand, ecological system theory states that human development is influenced by different types of ecological systems. This theory holds that we encounter different environments throughout our lifespan that influence our behavior. This indicates that when we meet the right system before starting school it will impact on the teaching that you will receive later in school. This study will link the system learners meet first in life and that is the culture and see how it impacts in later learning of the learner.

1.7.2. Conceptual framework

There are many mathematical concepts represented in African cultural activities or practices. For example, making of clay, grass and raft containers, as well as the building of huts, reveal many mathematical concepts: counting, estimation, straightness of lines shapes patterns and angles. This clearly shows that mathematics underlies in many African cultures.

Mathematics will be practical and learners will realize its importance. When learners appreciate mathematics, they are motivated to learn and concepts are mastered therefore realizing improvement.

Teachers and learners should analyze the mathematical concepts embedded in the traditional activities and structures together. This will give them a learner centered approach and they will, in turn, appreciate the subject giving them improved performance.

This is summarized in figure 1.1 below:

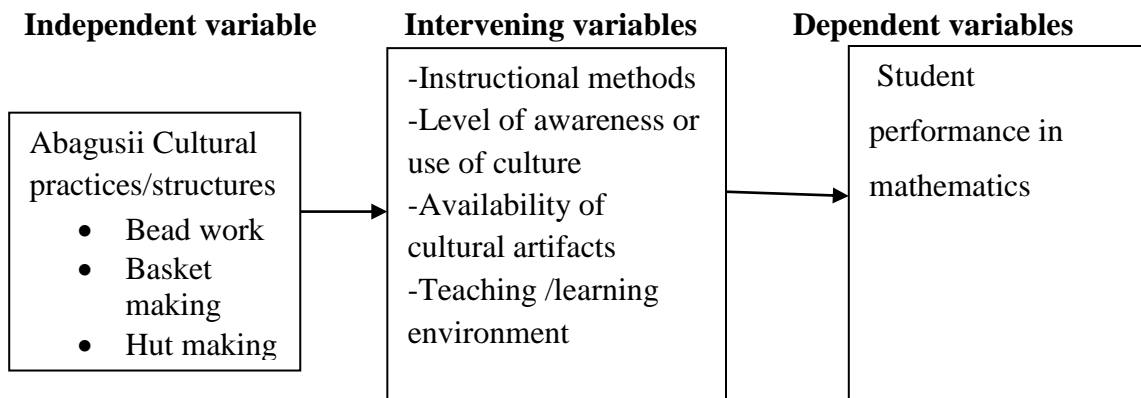


Figure 1.1: Conceptual framework

1.8. Operational Definition of terms

Abagusii Culture-	Abagusii culture is the body of learned beliefs, traditions, and guides for behavior that are shared among the members of the Abagusii society.
Application-	The relevance or value that something has, especially when it is used in specific field or area.
Ethnomathematics-	Ethnomathematics is the study of mathematical practices of identifiable cultural groups.
Informal mathematics-	Informal mathematics is mathematics that has traditionally been the common form of mathematics at most times and in most cultural communities.
Mathematical curriculum-	A Mathematical curriculum is the interaction of students with school content materials, resources, and processes for evaluating the achievement of educational objectives in mathematics.
Form four-	It is the fourth year in secondary school in Kenyan education system

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

This chapter deals with the scholarly work done by other researchers in reference to culture in mathematics. A literature review is cited both from within Kenya and studies done outside Kenya. In particular, issues discussed include how mathematics relates to culture, cases where culture has been used in a classroom situation and the geometrical concepts drawn from culture.

2.2 Mathematics and Culture

Mathematics for quite a while has been taken to be neutral and something which has no culture in it, Bishop, (1993), D'Amboise, (1990). It was ordinarily learned in schools as a subject that has no concepts obtained from culture. It was just viewed as a subject that exclusive required adapting all around acknowledged ideas, facts, and contents. Priest, Hart, Lerman and Nunes (1993), said that there is no reason for seeing mathematics learning as a subject that is unique and culture free. In this regard, if mathematics is viewed as cultural thing, then its a product of cultural development, Rios, 2000, Rosa and Orey, (2007)

Bishop (1988) gives six mathematical qualities common to every culture: measuring, counting, designing, locating, playing and explaining. For example, the skill of handling beads is normally handed on by grandmothers and mothers to their daughters.

In this way, it ensures that indigenous knowledge in our communities is not lost but is used correctly to create a link on what happens within mathematics classrooms and activities outside the classroom.

Graven (2000) points that the present educational curriculum change expects teachers to utilize an approach that is learner focused. Mathematics is an important subject for everyone; it is associated and it's connected to practical day life activities. Along these lines teachers ought to make a connection between culture and formal mathematics because of their exposure to mathematics ideas to ensure that learners encounter are improved through day by day experience inside and outside the classroom.

Principles and standards for school mathematics, NCTM, (2000) proposes that children create geometric concepts and learning as they explore the world. They establish the basis for understanding not only their spatial world but also in the other topics in mathematics and sciences, and social studies, NCTM, (2000). D'Amboisio, (1985) states that many students fail mathematics because of the mechanics of schoolings that replaces these practices by other equivalent practices which have acquired the status of mathematics, which has been expropriated in their original structures and returned in a codified version.

2.3. Academic and informal mathematics

Carraher (1991) argued that mathematics concepts that are normally found out of school are shown by learners who make something new from the understanding of numbers before they even come to school. Bishop (1993) said that informal mathematics is an organized, systematic, mathematics education activity carried on outside frame work of the formal system.

Along these lines, there is a distinction between the mathematics knowledge obtained by going to class and the mathematical knowledge information obtained by culture. Then again, Nunes (1992) states that although some mathematical ideas can be gained minus schooling, schooling has an effective part in encouraging the learning of these ideas.

Carraher and Schliemann (1985) have hinted that some useful mathematical concepts are acquired outside the classroom without instructions because some of these concepts come up from an individual's social background based on everyday activities such as buying and selling of goods. Teachers should in this regard get challenges based on learners' reality that translate their way of understanding of daily life activities through the use of culturally applicable activities.

2.4 Incorporating Culture into School Mathematics

In South Africa, a colorful style of geometric wall decorations has been discovered by the Ndebele women, Gerdes, (1988). The Tonga women are known for constructing and decorating round huts using different geometrical shapes in Zimbabwe. Zaslavsky (1994) used the shapes of the Tonga houses to motivate learners to calculate the maximum area that will be occupied by a given perimeter. This way of calculating mathematics challenges gave the learners an opportunity to accept and appreciate mathematics as a cultural product.

In an alternate study, Mogari in South Africa did an investigation of young boys making toy cars out of steel wire. in the process, Mogari (2004) documented the closeness between shapes the young boys were making and the procedures they had developed, that are additionally developed in a school setting. The information about the development of

cars from wires is neither affected by the school mathematics nor the knowledge learned in schools. The knowledge is gained up by observation and association with the material during the action. In the event that this is done in a school setting the students will be persuaded that they can understand mathematics and they can learn school mathematics.

Rauff (1996) came up with geometrical ideas using the learning tradition of the Navago people at the reservation school near Arizona. On a similar study, Zaslavsky (1994) collected many customary materials from Mozambique that has a wide variety of mathematical concepts which he called “inner moment of geometrical thinking.” He showed that studying the mathematical concepts from geometrical shapes using Mozambican elements and Navago ethno geometry made the learners appreciate the need of their cultural heritage; as a result, they agreed that learners do not have to depend on rote learning of cognitive concepts that are alien.

Rosa and Orey (2009) looked through the symmetrical patterns that are found in quilts, and furthermore they came up with a connection between mathematics and the craft of quilting. Through the interpretation of various symmetrical patterns in quilts; Rosa and Orey thought of a method for instructing mathematical transformations. This teaching technique covers a considerable measure of work on interpretation, reflections, and rotations. These ideas are normally shown in lesson plans which can make teachers to come up classroom activities that will profit the learners to comprehend geometry, and most imperative on symmetry and patterns.

2.5 Geometrical Concepts found in Cultural Practices

Many communities such as Abagusii community show many geometrical concepts that are used with or without knowledge of the theoretical meaning. Men and women are known for making different household items such as pots, mats, and mud huts and carvings wooden cooking sticks. Women are good in clay pottery of different shapes and designs. Nearly all clay products are decorated with triangles and circles. Households' artifacts are cylindrical in shape and a variety of concepts are used in making these containers. They use concepts of circumference, radius, diameter and volume of cylindrical household containers.

This shows a combination of art and geometry but in a real sense, this can be used in classroom teaching of locus, curves, circumference, radius and volume. Equally weaving of baskets, mats, hats and hand bags show great geometry.

Various mats are produced for a variety of uses such as bedding, room dividers, floor covering, gifts and clothing different patterns. Some mats use rectangles. These mats carried geometry with measurement and other concepts in mathematics.

Baskets produced using reeds have an intriguing application of counting and design, applying a lot of mathematics particularly geometry and arithmetic calculations also. A few lines are straight others are curved. There are a lot of geometrical shapes of triangles, quadrilaterals, pentagons and hexagons. They convey a great deal of mathematics that could uncover proof of setting for classroom teaching and learning of mathematics.

The above information uncovered that connection between cultural and school mathematics are conceivable however there is no direction on the best way to structure learning encounters so cultural mathematics can be incorporated into the formal mathematics curriculum.

2.6 Culture and Curriculum

Mathematics is part of the school curriculum and should be able to emphasize and also give meaning the culture of learners rather than negating it completely. Teaching in classroom and learning using environments cannot be separated from communities in which they are found. Classrooms form part of our society with good defined cultural practices. In this regard, Borba (1993) stated that classrooms might be considered environments that facilitate pedagogical practices, which are developed by using ethno mathematical approach. When a learner attends school, they have some values attached to them, concepts and norms that they get in their socio- cultural environment.

According to Bishop (1993), some of these values, concepts and norms have mathematical concepts. However, the school mathematical concepts are taught in a manner that may not be relevant to learners' cultural backgrounds. Bakalevu (1998) and Rosa (2010) hypothesized that dismal achievement in mathematics is due to lack of cultural relevance in the curriculum. On the note, Eglash (1997) Rosa & Orey (2007) and Zaslavsky (1997) argued that incorporating cultural concepts in the curriculum will have tremendous benefits for mathematics students; this means that cultural artifacts and practices contribute to regarding mathematics as part of daily life activities, enhancing the ability to develop meaningful connections, and widening the understanding of mathematics.

Chieus (2004) said that the pedagogical work towards an ethno mathematics perspective allows for wider analysis of the school content in which pedagogical practices come up in the classroom environment because these practices enhance the socio cultural context of the students. Damazio (2004) accepted the argument by saying that pedagogical elements that are important to construct the mathematics curriculum are inherent in the school community and environment.

A curriculum that is culturally relevant ought to really provide for students' culturally mathematics skills and knowledge through the investigation of ethno mathematics. Rosa and Orey (2007) proposed that such mathematical curriculum must incorporate constructivist approach to deal with their places of learning. This can be accomplished via preparing teachers to teach in an environment that is grounded in real life activities, . This will help students in the social development of mathematical knowledge and skills. A curriculum that caters for culture achieves more extensive understanding of mathematics to pedagogical methods developed in the mathematics classroom situation, Borba, (1993).

According to Rosa and Orey (2006) one possibility is to understand how the relationship between academic mathematics and the real life are realized by both the students and teachers. This will involve the examples teachers use in their classroom teaching and the characteristics of informal and academic mathematics they like to explore in a classroom situation.

Mathematics curricula focus on the mastery of skills, accumulation of facts, rules and algorithms that are necessary for official examination. Since the curriculum is experienced as mathematical content, most students leave school thinking that

mathematics is something to be done only at school and that has no relevance to their lives.

2.7 Summary

This chapter has discussed mathematics and culture, how mathematics can be incorporated into teaching and learning of mathematics, and geometrical concepts found in culture. It can be observed that countries diverse like USA and Brazil have built a strong base of using culture and ethnicity of learners in teaching and learning of mathematics. Despite the notable progress in studies related to culture in Africa, there still exists a large gap between what Kenya has done and the rest of Africa. In Kenya no studies which have been done linking the mathematics found in culture and formal school mathematics. This study aimed at investigating the applications of cultural concepts in teaching and learning of mathematics. The Kenyan education system has not recognized the use of culture in mathematics however it advocates the use of education system that is learner centered and rich in activities. The gap that is existing is the one linking culture and mathematics that students meet later in school. This study is aimed at filling this gap by investigating the mathematics concepts found in Abagusii culture.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter discusses the research design, study locale, the procedure and modalities of data collection. It also covers determination and identification of the population sample size, sampling design, sampling procedures, the instruments of data collection, validity and reliability of the instruments, sources of data and methods of data analysis.

3.2 Research Design

This study applied descriptive survey research design. A descriptive survey was preferred because it involves fact-finding inquiries and describing the state of affairs as it exists at present. Among scientific disciplines, education, anthropology, public health make use of descriptive surveys to collect information relevant to interests and problems in their fields. Studies involving descriptive surveys account for a substantial proportion of the research done in the field of education, for example Lazars field and Sieber did a content analysis of educational research appearing in 40 journals and found that about one- third of them involved some descriptive survey methods, Borg and Gall,(1989). A wide range of educational problems can be investigated in survey research, Orodho, (2004).

3.2.1 Variables

The independent variable in this study was Abagusii cultural practices/ activities/ traditional artifacts. Abagusii activities have mathematical concepts the way they are being done while the artifacts have mathematical concepts the way they are made and the

way they appear. All these when used constructively in the classroom it will improve performance.

The dependent variable was student performance in mathematics. The intervening variables were instructional methods, student entry behavior and level of awareness or availability of cultural artifacts.

3.3 The Study Locale

The study was carried out in Masaba North Sub-county, Kenya. Masaba North is one of the five sub- counties that make Nyamira County. It has a population of 121,028 as per 2013 projections. The inhabitants of the sub-county are Abagusii, and are linguistically Bantu, who inhabit the southwestern part of Kenya in the African Continent. The choice of the sub-county is because it has been and is still performing poorly in KCSE and in mathematics in particular. Equally the sub-county keeps and practices Abagusii culture. This provided the opportunity to easily interact with the environment and the participants. The sub-county has 31 secondary schools of which one is a private school while the rest are public schools. The sub-county has no national school.

3.4 Target Population

The target population for this study consisted of 1827 participants (86 mathematics teachers 1741 form four students) from 31 secondary schools in Masaba North Sub County. Mathematics teachers were targeted in this study because of the important role they have in implementing of the mathematics curriculum. Form four students were targeted on the basis they have been exposed to a wider content in mathematics.

3.5 Sampling Techniques and Sampling Size

3.5.1 Sampling Technique

Sampling is a process of selecting a number of individuals or objects from a population, Orodho & Kombo, (2002) .The quality of any research study is influenced by the appropriateness of the methodology, instrumentation and suitability of the sampling strategy adopted, Manion et al, (2001). The research purposes associated with this study warranted the participants selected are those who provided a good opportunity to learn the applications of Abagusii practices in the secondary mathematics curriculum. Therefore stratified random sampling was used to select six schools. According to Gall (1996) stratified sampling ensures that satisfactory representation of the categories of population is included in the sample. In this study the strata included divisions in the sub county; Rigoma, Girango and Gachuba. The six schools were three from Rigoma two from Gesima and one from Gachuba as shown in the table below;

Table 3.1 Sampling grid

Division	Total schools	Sampled schools	Percentage
Rigoma	13	3	23.08
Girang'o	12	2	16.67
Gachuba	6	1	16.67

Source: Field

Simple random sampling technique was considered ideal for the selection of the schools from the stratum as it ensured an equal chance to all the schools in the stratum to be part of the research sample. Schools from each stratum were selected for the sample while ensuring the selection of each one school did not affect the selection of another school.

This was done by selecting one school at a time, with replacement as postulated by Koncar (1992) and Mugenda and Mugenda (2003). The rotary method was applied in the selection. Schools in each stratum were written on a small piece of paper of equal size which was then folded uniformly. The papers were then picked at a time with a school name recorded and immediately replaced before picking the next school. The picking continued until six schools had been selected for the sample.

Mathematics teachers were purposively selected from the sampled schools depending on whether they are teaching the selected class or not. The teachers who were selected are those that come from Kisii community.

From a list of all form four students in a class, 45 students per school were selected using the random numbers table technique, for the study sample.

3.5.2 Sample Size

Total samples of 280 (15.32%) participants were selected from the target population for the study. This sample was selected from 6 (19.35%) of the 31 secondary schools and it consisted of 16(19.36%) mathematics teachers and 274 (15.72%) students. The sample size was within the range stated by Kothari (2004) whereby he says that a representative sample for a descriptive survey study fulfills requirements of efficiency, reliability and flexibility, should be in the range of 10%-20%.

Table 3.2: Sample grid

	Target Population	Sample Size	Percentage
Teachers	86	16	18.60
Students	1741	274	15.74
Total	1827	280	15.15

Source: Field

3.6 Research Instruments

In this study, data was collected using questionnaires. According to Gray (2004), questionnaires facilitate faster collection of data from a large sample and ensure confidentiality on the same note, questionnaires were ideal for this study because they facilitate data collection from a large sample within limited time, ensure anonymity that give respondents freedom to respond without fear of victimization while allowing them to make suggestions. The validity, suitability and appropriateness of the items in the questionnaire were determined during the pilot study and the necessary corrections and modifications were made.

3.6.1. Mathematics Teachers' Questionnaire (MTQ)

This instrument was used to collect data from mathematics teachers. The MTQ had three sections consisting of open-ended and closed-ended items. The open-ended items gave the respondents a greater freedom of expression of ideas and opinions and closed items enabled the researcher to get specific responses. The questionnaire was used to collect information on mathematical concepts in Abagusii cultural practices.

Section A consisted of three items on demographic information; B had two parts, part I carried 10 items in a 4 point Likert scale nature and part II contains 15 items used to measure the mathematical concepts drawn from different traditional activity or structure and C contained two open- ended questions. Gray (2004) observes that the Likert rating scale facilitates responses about the degree of agreement with each statement on the questionnaire.

3.6.2 Mathematics Students' Questionnaire (MSQ)

The instrument was used to collect data from students. The student questionnaire had 2 sections, A had two items on demographic information; B two parts.

Part I contained 10 items in a 4 point Likert scale and part II will contain 12 items used to measure the structure/activity/practice from the Abagusii culture with the corresponding mathematical concepts.

3.7 Pilot Study

The pilot study was used mainly for the validation and testing the reliability of the research instruments that were used. According to Kombo and Tromp (2006), a questionnaire and other field procedures is the only way the researcher can find out if everything “works” particularly the research instruments. In this study piloting of the instruments was done in two randomly selected schools from the targeted population. Questionnaires were administered to mathematics teachers and form four students in the two schools. Pilot test assisted in reviewing the structure and to locate ambiguities inherent in the instrument, also to determine the level of understanding that will be shown

by the respondents and to modify the revealed flaws in questions and inadequacies in the coding system.

Pilot testing also provided the chance to be well conversant with the administration of research instruments. Pilot data was collected, analyzed and results were used to modify the questionnaire.

3.7.1 Validity

According to Mugenda and Mugenda (1999) validity refers to the accuracy and meaningfulness of inferences, which are based on the research results. It's the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. The degree to which MSQ and MTQ were to measure the application of Abagusii culture into teaching and learning mathematics was of great concern. Ascertaining the content validity, consultations with my research supervisors and experts in this area of study was done.

3.7.2 Reliability

Kasomo (2007) observes that reliability determines the strength and constancy of an instrument, where same results will be achieved and the same degree of consistency demonstrated whenever the same technique is repeated for a similar study. To ascertain the reliability of research instruments for this study, the split –half technique was used where the odd-numbered items of the instrument was placed in one subset and even numbered ones in the other. Responses from the two halves was analyzed and compared to determine the reliability of the instrument. The process was repeated for all research using Spearman-Brown formula,

$$\alpha = \frac{nr}{1+r}$$

Where α - reliability coefficient

r- split-half correlation (correlation between the two halves)

n-the number of times longer the full test is (for split-halves the instrument is twice

as long as each of the halves, so the value of n is 2)

r-will be calculated using the Pearson product moment formula

$$r = \frac{\sum XY}{\sqrt{(\sum X^2)(\sum Y^2)}} \quad \text{Where}$$

$$X = x - \bar{x}$$

$$Y = y - \bar{y}$$

X - Scores from the first half of the pilot sample

Y - Scores from the second half

\bar{y} and \bar{x} will be their respective means

A reliability coefficient for each of the instruments was obtained: Mathematics Teachers' Questionnaires (0.70), Students' Mathematics Questionnaire (0.75). A reliability coefficient of 0.73 was obtained and considered to fulfill the required degree of consistency.

3.8 Data Collection Techniques

Data was collected from the sampled schools. The schools were first visited to familiarize with the school's authority and to explain the purpose of the study. During the visit

identification of one teacher in each school was done, preferably HOD Mathematics who served as a coordinator. The teacher assisted in administering the questionnaire to students and teachers in the school. After the questionnaires were completed, the coordinator collected them and handed them over to the researcher.

3.9 Data Analysis

This identifies the tools that were used in analyzing data. Data was analyzed as per the objectives of the study. Both qualitative and quantitative methods were used in the analysis. Qualitative data was obtained from open-ended items in both the students and teachers questionnaire.

The qualitative analysis involved the presentation of statistical data in the form of frequency distribution tables and percentages were used to analyze qualitative data whose explanations were descriptive. Statistical Package for Social Sciences (SPSS) was used in drawing the frequency tables and in the calculation of percentages.

3.10 Logical and Ethical Considerations

The researcher followed all the ethical issues expected in carrying out this research study. According to Mugenda and Mugenda (2003), respondents were well informed the purpose of the study and their consent was sought before their participation.

The researcher also sought permit from the relevant authority and also ensured that adequate measures were in place to protect the confidentiality of respondents. The identity of the respondents was protected by either using numbers or third parties. Ethics was also upheld in the design and analysis of the data.

CHAPTER FOUR

PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

In this chapter, statistical analysis and interpretation of data collected using research questionnaires is discussed in various sections following the research questions. The findings are presented, analyzed and interpreted sequentially as per the research questions with meanings and inferences drawn from the findings of data analysis as compared with the concepts in the literature review.

In this research, a total of 286 questionnaires were retrieved out of the 290 issued. It was 98.62% response rate. The data is presented in frequency tables and percentages beginning with the demographic information and then followed by the specific research information, which addresses the study objectives.

The data collected was classified into meaningful categories called codes. This was necessary so as to carry out the subsequent operations of tabulating and analyzing data. This can reduce large numbers of heterogeneous responses into sequential classes or groups. The responses from open-ended questions in the last part of the questionnaire for teachers were not coded but analysed, and used to qualitatively make meaning of the numbers of the non-specific responses.

4.2 Demographic data

The demographic information was sought to assess who was surveyed and how to break down overall survey response data into meaningful groups of respondents. The demographic information of the respondents was categorized into gender, professional

qualifications and working experience for the teachers and gender, favorite subjects for the students. Percentages and frequency of each demographic variable of teachers were computed and results summarized in the table 4.2.1 below:

4.2.1 Teachers' Demographic data

The teachers' demographic information was broken down into gender, teaching experience and professional qualifications. Percentages and frequency of each demographic variable were computed, and the results summarized in the table 4.2.1 below:

Table 4.2.1: Teachers' Demographic Finding (N=15)

Variable	Frequency	Percentage
1. Gender		
Male	9	60
Female	6	40
2. Teaching experience		
1-5 years	3	20
6-10 years	3	20
>10 years	9	60
3. Professional qualification		
Graduate teacher	11	73.3
Diploma	4	26.7
Untrained teacher	0	0
Others	0	0

Table 4.2.1 above indicates that majority 9 (60%) of the investigated teachers were male meaning that the schools that were selected in the study had a higher number of male teachers teaching mathematics compared to their counterparts 6 (40%).

In terms of education level, the majority of the teachers had a first degree 11 (73.3%) compared to those who had a diploma 4 (26.7%). On the other hand more than half of the teachers 9 (60%) had a teaching experience of more than ten years, compared to those with a teaching experience of between 1-5 years 3 (20%) and those with 6-10 years 3 (20%). Teachers with long teaching experience might exercise a great chance of applying cultural concepts in teaching and learning of mathematics because of long exposure to mathematical content.

4.2.2 Students' demographic data

The student's demographic information was broken down into gender and favorite subject for the students. Percentages and frequency of each demographic variable were computed, and the results summarized in the table 4.2.2 below:

Table 4.2.2: Students' Demographic Findings (N=271)

Variable		Frequency	Percentage
Gender	Male	147	54.2
	Female	124	45.8
Favorite subject	Mathematics	137	50.6
	Other subjects	134	49.4

All the students used in the study were from four because they have been exposed to more mathematical concepts. Gender of the respondents was also analysed because it is the influencing factor in mathematics performance. The table 4.2.2 indicates that the sample used in the study had 147 (54.2%) male and 124 (45.8 %) female students.

The number of boys and girls was almost equal because most schools in the study were mixed day school which draws students from different social background regardless of the gender.

The favorite subjects of the respondents were sought because those students who liked mathematics were more likely to apply cultural concepts in mathematics. Those who perform well in mathematics are likely to apply the knowledge in other day-to-day activities. It was established that 137 (50.6%) of the students had mathematics as their favorite subject while 134 (49.4%) had other subjects.

Students with a positive attitude towards mathematics are likely to use the knowledge learned in culture to perform well in mathematics, and this will enhance mastery of content.

4.3 Abagusii cultural dimensions that have mathematical concepts

Both teachers and learners were asked to state the mathematical concepts that can be drawn from different Abagusii cultural artifacts /activities/ practices while the learners were asked to state the Abagusii cultural activities /artifacts /practices that have mathematical concepts. The intention of the question was to establish areas in Abagusii culture that have mathematical concepts that can be used constructively in class.

Table 4.3 shows the responses given by the teachers and the number of teachers who gave a particular response.

Table 4.3: Responses of teachers (N=15) on Mathematical concepts represented in some cultural heritage

Cultural practice/structure/activity	Mathematical concept	No. of teachers	Percentage
Building a traditional hut	Geometry	8	53.3
	Circles	2	13.3
	Measurement	4	26.7
	Area	1	6.7
Making baskets	Volume	7	46.7
	Reflection	3	20
	Frustum	3	20
	Common solids	2	13.3
Making patterns on walls	Reflection	11	73.3
	Geometry	4	26.7
Weaving a mat	Estimation	6	40
	Area	7	46.7
	Counting	2	13.3
Making ornaments	Sequence/ series	8	53.3
	Approximation	7	46.7
Playing children Games	Probability	15	100
Abagusii dance	Sequence	15	100
Making clay works	Volume	10	66.7
	Common solids	5	33.3
Bow and arrow	Speed/ distance	15	100
Traditional counting	Addition	6	40
	Integers	9	60
Bonfire	Temperature	15	100
Harp	Counting	7	46.7
	Common solids	8	53.3
Beadwork (necklace)	Counting	5	33.3
	Approximation	6	40
Counting technique	Addition	15	100

From Table 4.3 geometry and sequence and series were the concepts given by the highest number of teachers 8 (53.3 %) which is used in constructing a traditional hut, 4(26.7%) gave measurement, while 1(6.7%) gave area. This agrees with Zaslavsky (1994) who used shapes of the Tonga houses to challenge students on how to find the largest area that

will be enclosed by a given perimeter. In making baskets, volume was mentioned by the seven (46.7%) teachers while reflection and frustum had equal numbers 3 (20%).

In making patterns on a traditional wall, majority of the teachers, 11 (73.3%) gave reflection while 4(26.7%) gave geometry as the concepts that can be drawn from it. This agrees with Gerdes (1988) who found out that in South Africa a colorful style of geometric wall decorations has been developed by the Ndebele women and it was used in learning mathematics. In making mats, 7 teachers (46.7%) stated area, estimation 6 (40%) while the minority stated counting 2 (13.3%).

This observation means that the students' daily activities, their environment, events in the community can be utilized in class to make lessons more real, relevant and hence more meaningful to the students. Teachers should recognize that patterns and symmetry are commonly reflected in the culture and can easily be linked with the mathematics that they teach.

4.4 Learners and mathematical concepts applied in Abagusii culture

Students were asked to state the structure /activity or practice which has certain mathematical concepts in the Abagusii culture.

Table 4.4 shows the responses given by the students and the number of students who gave a particular response:

Table4.4: Responses by students (N=271) on Abagusii cultural heritage in which some mathematical concepts are represented

Mathematical concept	Abagusii cultural practice/structure/Activity	No. of students	Percentage
Ratios/proportion	Cooking food	135	49.8
	Harvesting	71	26.2
	Property division	65	24.0
Symmetry and reflection	Basket making	85	31.4
	Making patterns on walls	90	33.2
	Making mats	96	35.4
Geometry	Constructing huts	57	21
	Painting walls	69	25.5
	Making patterns on walls	88	32.5
	Playing games	57	21
Measurements	Making baskets	131	48.3
	Constructing huts	140	51.7
Area and perimeter	Constructing huts	171	63.1
	Making mats	100	36.9
Mass weight and volume	Buying and selling	70	25.8
	Harvesting	75	27.7
	Pot making	75	27.7
	Basket making	51	18.8
Angles and shapes	Games	74	27.3
	Pots	80	29.5
	Calabash	81	29.9
	Ornaments	36	13.3
	Season Determination	53	19.6
Probability	Playing games	52	19.2
	Dancing	60	22.1
Pattern, sequence and series	Beadwork e g necklace	132	48.7
	Making of anklets	79	29.2
	Harvesting	70	25.8

From Table 4.4 most of the students are aware of the many areas in Abagusii culture that have mathematical concepts. They listed basket making, making patterns on traditional walls, making mats to have symmetry and reflection. It's also important to note that measurement as a concept in mathematics is used in making traditional baskets and

constructing traditional houses. Geometry was listed by most students that it is used in constructing huts, painting walls and making patterns and playing games.

4.5 Teachers awareness of mathematical concepts in cultural dimensions

The study sought to establish if the teachers are aware that Abagusii culture has concepts that can be used in mathematics teaching. By being aware that culture has mathematical concepts they are likely to embrace culture in classroom activities.

Table 4.5: Mathematics teaching and culture.

Mathematics teaching and culture	SD	D	A	SA
	%	%	%	%
1. Mathematics identified in traditional cultural activities should be taught in schools	0	0	46.7	53.3
2. Teachers should show how mathematics is used in cultural contexts	6.7	0	66.7	26.7
3. Teachers should teach only the mathematics that is prescribed in the syllabus and textbooks	46.7	40	0	13.3
4. Teachers should take into account students' prior knowledge learnt out of school when teaching.	0	0	60	40
5. Mathematics identified in cultural activities should be included in the secondary mathematics.	0	0	66.7	33.3

From Table 4.5 most of the teachers (53.3 %) strongly agreed that mathematics identified in traditional activities should be taught in schools while (66.7%) agreed that some of this should be included in the secondary mathematics curriculum.

When asked if teachers should show how mathematics is used in cultural contexts (66.7%) agreed while (26.7%) strongly agreed that they should do so. On the average (46.7%) of teachers strongly disagreed that teachers should not only teach the

mathematics prescribed in the syllabus and text books and 60% and 40% agreed and strongly agreed that teachers should take into account student’s prior knowledge learned out of school.

These findings agree with Bishop, Hart, Lerman, and Nunes (1993), who said that there is no sense in regarding mathematics learning as abstract and culture free because the learning process cannot be abstract and context free, that is, learning cannot be free of societal influence.

4.6 Where mathematics learning takes place

The study sought to establish an opinion of teachers about where mathematics learning takes place. The question was intended to establish whether teachers are aware that learning can be found in culture and outside classroom. The following options were available for the respondents

Table 4.6: Where mathematics Learning takes place

	SD	D	A	SA
Where mathematics Learning takes place	%	%	%	%
1.Mathematics can be taught through in traditional cultural activities	0	0	53.3	46.7
2.Students can learn mathematics only taught to them by teachers in school	46.7	53.3	0	0
3.Traditional practices such as counting, measure, structures also have mathematics	0	0	60	40
4.Students only go to school to learn school mathematics and not cultural mathematics	0	60	33.3	6.7
5.Culture has a lot of mathematics	0	0	80	20

Statements about mathematics learning sought to establish whether teachers believed that mathematics could be learned outside of the official systems of mathematics learning, particularly in a traditional cultural context.

From Table 4.6 more than half of the teachers (53.3 %) said mathematics can be learnt by participating in cultural activities while (46.6 %) strongly agreed and another 80% agreed that mathematics is found in culture, with an average of 53.3% disagree that mathematics is learnt in schools only or that it is found in mathematics textbooks. Most teachers believed mathematics could be learned in a cultural context, for example, by taking part in traditional cultural activities, dancing or building traditional huts. The likely explanation for these findings is related to the home backgrounds of the teachers in the sample. Most of the teachers live in rural areas where traditional practices and activities are the norms, and they would have experienced this lifestyle. Research elsewhere on children's mathematical knowledge shows that mathematics is acquired outside of the structured systems of mathematics learning, for example, in everyday activities out of school, at work, in the street or informally (Nunes, (1992)).

Most teachers (60%) agreed that traditional practices have mathematics such as counting, measurements; structures also have mathematics while (40%) strongly agreed. Again when they were asked if students go to school to learn school mathematics and not cultural mathematics majority (60%) disagreed while the minority (6.7%) strongly agreed. Majority (80%) of the teachers agreed that culture has a lot of mathematics while (20%) strongly agreed.

4.7. Students awareness of the application of mathematical concepts in culture

The study sought to establish if the students are aware that Abagusii culture has mathematical concepts that can be used in mathematics teaching.

Table 4.7 Student’s awareness of the application of mathematical concepts in culture

Student awareness of mathematical concepts in culture	SD	D	A	SA
	%	%	%	%
1.I like mathematics	1.8	9.2	55.4	33.6
2.If mathematics was not compulsory I would drop it when registering for examination	46.5	42.1	7.7	3.7
3.Mathematics should remain compulsory in secondary schools	1.1	5.9	49.4	43.5
4.People who have not been in school know mathematics of some kind	0.4	6.6	48.7	44.3
5.People who have not been in school use mathematics	0	5.9	55.0	39.1
6.We use mathematics in daily lives	1.1	5.5	53.1	40.2
7.Not all people need mathematics in their daily lives	52.4	41.7	5.2	0.7
8.There is a lot of mathematics in Abagusii practices	0.4	7.4	45.4	46.9
9.We need some mathematics knowledge in some cultural structures or practices	0.7	3.7	51.7	43.9
10.Knowledge of mathematics in our culture can make me a good mathematician	1.8	10.3	50.9	36.9

One hundred and eighteen students (43.5%) strongly agreed that mathematics should remain compulsory in secondary schools, 134 students (49.4%) agreed, 16 students (5.9%) disagreed while 3 students (1.1%) strongly disagreed. One hundred and twenty- six (46.5%) strongly disagreed that they would not drop mathematics during registration of KCSE, 114(42.1) disagreed, 21(7.7%) agreed and 10(3.7%). One hundred and six (39.1%) students strongly agreed that people who had not been in school use mathematics in their lives, 149 (55%) agreed while 16(5.9%) disagreed.

One hundred and nine students (40.2 %) strongly agreed that we used mathematics daily, 144(53.1%) agreed 15 (5.5%) disagreed while 3(1.1%) strongly disagreed.

One hundred and twenty- seven (46.9 %) strongly agreed that Abagusii culture has a lot of mathematics 123 (45.4%) agreed while 20(7.4%) disagreed. When asked if we need some mathematics knowledge in some cultural structures or practices, majority 119 (43.9 %) strongly agreed, 140 (51.7 %) agreed while a minority 10(3.7%) and 2(0.7 %) disagreed and strongly disagreed respectively.

The knowledge of mathematics in our culture can make the students good mathematician was also sought from the students, majority 100(36.9 %) of the students strongly agreed while, 28 (10.3%). D'Ambrosio (2006) argued that in an ethno mathematical perspective, mathematical thinking is developed in different cultures in accordance with common problems that are encountered within a cultural context.

4.8. Integration of Abagusii culture into teaching and learning mathematics

The opinion of the teachers was sought on the ways incorporation of the Abagusii culture into teaching and learning mathematics can be achieved. This is because teachers are appropriately placed ,(Mosimege, (2000)), due to their mathematical knowledge to create linkages between various activities embedded with mathematical concepts to ensure that learners' experiences are enriched by daily experiences of what they encounter outside the classroom. They were required to respond using Yes or No and give reasons for their response. The frequencies and percentages of their responses are shown in Table 4.5.0 below;

Table 4.8: Responses by teachers on integration of culture and mathematics

(N=15)

Responses	Number	Percentages
Yes	13	86.7
No	2	13.3
Total	15	100

13 teachers (86.7%) agreed to the integration of culture and mathematics. They said that it was necessary because mathematics was abstract to many students and approaching it from prior knowledge and learning experiences then mathematics learning will be highly facilitated. They argued that showing the areas where mathematical concepts have been used in cultural activities or structures will allow students to identify the usefulness of culture in mathematics. This will enable them to develop a new understanding of the subject, create interest and make learning more enjoyable and memorable. Graven (2000) agrees that the current curriculum change demand that teachers to use a learner centered approach.

2 (6.7 %) of the teachers said No to the integration of mathematics and culture citing simple concepts that exist in culture. They said that mathematics teachers may not have the time to come up with artifacts/ structures or activities which have mathematical concepts. They may require a lot of time to visit villages and also to get resource people.

4.9 Ways of integrating Abagusii culture into teaching and learning of mathematics

The opinion on how culture can be integrated into mathematics teaching and learning was sought from teachers. They were required to suggest ways in which culture can be used in teaching and learning of mathematics and the result is summarized in table 4.9 below:

	Frequency	Percent
1. Bring them to class	9	60.0
2. Involve them in making them	3	20.0
3. Taking students outside the classroom to discover the artifacts	3	20.0
Total	15	100.0

The findings show that teachers support the incorporation of culture into mathematics. From table 4.9 Majority of the teachers (60%) suggested that it is possible the traditional artifacts to be brought to the classroom and analyzed by the teachers and learners together to reveal mathematical concepts found in them. Others (20%) suggested visiting communities or taking them outside the class and involving them to make the structures. The activities or practices that take place at villages and the artifacts that are found in communities have a lot of mathematics, so visiting them will make students interact. Teachers should recognize that patterns and symmetry are commonly reflected in the

culture and can easily be linked with the mathematics that they teach. These findings agree with Eglash (1997) Rosa and Orey (2007) and Zaslavsky (1997) who argued that including cultural aspects in the curriculum will have long –term benefits for mathematics learners. Elsewhere Zeichner (1996) agrees with the findings by asserting that in order for teachers to implement the principle of cultural congruence, they should have knowledge of and respect for the various cultural traditions and languages of students in their classrooms.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This study investigated the applications of Abagusii cultural practices into teaching and learning of mathematics in secondary schools in Masaba North Sub County, Nyamira County, Kenya. A survey was done to find the mathematical concepts found in Abagusii culture, teachers and students awareness of these concepts and the opinion of teachers on the integration of culture to support teaching and learning of mathematics.

This chapter makes a summary of the key findings, draws conclusions and makes recommendations on the same. The summary is based on the research questions of the study.

5.1 Summary of Finding

This section summarizes key findings of the study, based on research questions.

5.1.1 Areas in Abagusii culture which use or have mathematical concepts

Both teachers and students were asked to state mathematical concepts that are found in Abagusii culture. This intended to show if they are aware if culture has mathematical concepts. Geometry was the concept given by the highest number of teachers (53.3 %) which is used in constructing a traditional hut, (26.7%) gave measurement, while (6.7%) gave area. Exploring these geometric designs requires an understanding of the ways that shapes are made or the way they appear. Twenty percent of the teachers stated reflection, patterns and symmetry are found in pottery and basketry. Most students (90%) stated

symmetry and reflection is found in making patterns on traditional walls while (57%) of the students said constructing houses has a lot of geometry.

5.1.2 Awareness of Teachers and students of the mathematical concepts in Abagusii culture

Both teachers and students are aware of mathematical concepts found in Abagusii culture. Most of the teachers (53.3 %) strongly agreed that mathematics identified in traditional activities should be taught in schools while (66.7%) agreed that some of this should be included in the secondary mathematics curriculum. The teachers stated different mathematical concepts applied in different Abagusii cultural practices/structures, for example they stated geometry, circles, measurements and area can be learned from building a traditional hut. Volume, reflection, concept on frustum and common solids can be learned from making traditional baskets. Making traditional pattern has a lot of geometry and reflection.

Majority of the students (56.9 %) strongly agreed that Abagusii culture has a lot of mathematics while (45.4%) agreed. This indicates students are also aware of the Abagusii structures/practices that have mathematical concepts that can be used in mathematics learning. They were also given the concept in mathematics and were required to state the structure activity or practice in Abagusii culture that has that concept, for example they stated cooking food, harvesting, property division have a lot of ratios and proportion. Making baskets, making patterns on traditional walls, making mats have concepts of symmetry and reflection.

5.1.3 Where mathematics learning takes place

Majority of the teachers (53.3 %) said mathematics can be learned by participating in cultural activities and another 80% agreed that mathematics is found in culture, with a majority 53.3% disagreed that mathematics is learnt in only schools or that it is found in mathematics textbooks only. Most teachers believed mathematics could be learned in a cultural context. On average most students (46.9 %) strongly agreed that Abagusii culture has a lot of mathematics. On average (43.9 %) agreed that we need cultural mathematics.

5.1.4 Mathematics teaching and culture

Half of the teachers (53.3 %) strongly agreed that mathematics identified in traditional activities should be taught in schools while (66.7%) agreed that some of this should be included in the secondary mathematics curriculum. Equally (66.7%) agreed that teachers should show how mathematics is used in cultural contexts.

On average (46.7%) teachers strongly disagreed that teachers should not only teach the mathematics prescribed in the syllabus and text books and (60%) agreed that teachers should take into account student's prior knowledge learned out of school.

5.1.5 Integration of Abagusii culture into teaching and learning mathematics

As a teacher prepares to integrate culturally relevant teaching into a mathematics classroom, it is important for the teacher to recognize the student's prior knowledge and incorporate their backgrounds into the lesson and classroom environment. Borba, (1993) opines that a culturally responsive teacher uses differentiated instruction to tailor learning to every aspect of a student's culture. From the study, majority (86.7%) of the fifteen teachers agreed to integration of culture and mathematics. They said that it was necessary

because mathematics was abstract to many students and approaching it from prior knowledge and learning experiences then mathematics learning will be highly facilitated.

Two of the teachers (6.7%) said No to the integration of mathematics and culture citing simple concepts that exist in culture. They said that mathematics teachers may not have the time to come up with artifacts/ structures or activities which have mathematical concepts.

5.1.6 Ways of integrating Abagusii culture into teaching and learning of mathematics

Majority of the teachers (60%) suggested that it is possible the traditional artifacts to be brought to classroom and analyzed by the teachers and learners together to reveal mathematical concepts found in them. Others (20%) suggested visiting communities or taking them outside class and involving them to make the structures. The activities or practices that take place at cultural villages and the artifacts that are found in communities have a lot of mathematics, so visiting them will make students interact.

5.2 Conclusions

From the findings of the study, it can be concluded that;

- i) Abagusii culture has a lot of mathematical concepts. The areas that have the mathematical concepts include construction of houses (huts), making of baskets and bead work. The concepts that can be found in culture include: geometry, estimation, sequence and series, areas and volume concepts.

- ii) Through the study, it is evident that both teachers and students are aware of the application of mathematical concepts in culture. For example, when constructing huts measurement, area and geometry are applied
- iii) The teachers' opinion on the transfer of cultural concepts to instruction is encouraged. By using culture explicitly in the classroom will help break down barriers, dispel cultural myths, and encourage curiosity amongst learners.
- iv) Most teachers support the idea of integrating culture in mathematics citing that it will give mathematics a practical approach, improve curiosity and make it more interesting when learning it.

5.3 Recommendations

The research findings from this study are, in the researcher's view relevant to the Ministry of Education and bodies that are entrusted with the task to oversee all aspects related to quality education in Kenya in terms of positive attainment of required knowledge, skills and results in national examinations. Based on this view, the researcher makes the following recommendations:

- i) Teacher training institutions should emphasize the need to consider the child's prior knowledge, their culture during training. The rationale of each topic in mathematics syllabus for the learners should be well stated such that learners will realize its importance in everyday life.
- ii) Educational managers should consider setting up mathematical resource centers in every county. In these centers charts showing mathematical concepts that can be found in every cultural activity, structure or practice are displayed. Traditional

images and cultural practices should be well documented in resource centers for easy access for learning purposes.

- iii) Textbooks should use examples that are drawn from student culture, for example using traditional baskets when teaching approximation and errors, frustum, common solids.

5.4 Suggestion for Further study

Further research is recommended in the following areas:

- i) The study was carried out in one Sub-County using only one community. Similar studies could be carried out in other parts of the country to gather adequate information on the subject to be able to generalize.
- ii) From the teachers' responses, it was suggested that integration will make mathematics more practical and interesting. A research should be done on how to make mathematics more practical and interesting at secondary school level. Also, a study on the implications and effects of teaching using culture should be done.

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APPENDICES

APPENDIX I: INTRODUCTORY LETTER

Dear respondent,

I am a student at Kenyatta University pursuing a Masters of Education degree in Mathematics Education and carrying out a research on Application of Abagusii culture into teaching and learning mathematics in secondary schools in Masaba North, Nyamira County.

I am requesting for assistance by filling in the questionnaire provided. The information will help me accomplish the research objectives and will be treated with total confidentiality.

Thanks in advance

SECTION B

PART 1: AWARENESS OF MATHEMATICS IN CULTURE

What is your opinion about the following statements?

Key: SA-Strongly Agree, A-Agreed D-Disagree, SD-Strongly Disagree

Statement	SD	D	A	SA
1.I like mathematics				
2.If mathematics was not compulsory I would drop it when registering for examination				
3.Mathematics should remain compulsory in secondary schools				
4.People who have not been in school know mathematics of some kind				
5.People who have not been in school use mathematics				
6.We use mathematics in daily lives				
7.Not all people need mathematics in their daily lives				
8.There is a lot of mathematics in Abagusii practices				
9.We need some mathematics knowledge in some cultural structures or practices				
10.Knowledge of mathematics in our culture can make me a good mathematician				

PART II: APPLICATION OF MATHEMATICAL CONCEPTS IN ABAGUSII CULTURE

From the following listed mathematical concepts, list any structure/activity/practice from the Abagusii culture which can be learned from

Mathematical Concept/s	Structure/activity/practice from Abagusii culture
1.Ratios and proportion	
2.Symmetry,reflection	
3.Geometry e.g. circles, rectangles, square, Triangles, polygons	
4.Estimation/measurement of length and width	
5.Areas and perimeter	
6.Mass ,weight and volume measurements	
7.Angles and shapes	
8.Probability	
9.Patterns, sequence and series	
10.Fractions, decimals, percentages	
11.Speed and distance	
12.Circumference ,radius and diameter	

APPENDIX III: MATHEMATICS TEACHERS' QUESTIONNAIRE

Introduction

The main aim of this questionnaire is to find out the application of Abagusii cultural practices in teaching and learning of Mathematics in secondary schools in Masaba North District.

INSTRUCTIONS

- i) There are no correct and wrong answers
- ii) The information you give concerning your view about mathematics and Abagusii culture will be confidential
- iii) Respond to all questions by putting a tick in brackets corresponding to your answer or filling in the blank spaces.
- iv) Don't write your name anywhere in this questionnaire

SECTION A: General information about the respondent

1. Your sex: Female Male

2. Teaching experience
1-5yrs () 6-10yrs () 10yrs+ ()

3. Professional qualification Graduate teacher ()
 Diploma ()
 Untrained Teacher ()
 Others 1.
 2.

SECTION B

PART 1: CULTURE AND MATHEMATICS

What is your opinion about the following statements?

Key: SA-Strongly Agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly Disagree

Statement	SD	D	A	SA
Mathematics teaching and culture				
1.Mathematics identified in traditional cultural activities should be taught in schools				
2.Teachers should show how mathematics is used in cultural contexts				
3.In schools, teachers should teach only the mathematics that is prescribed in the syllabus and textbooks				
4.When teaching mathematics teachers should take into account students' prior knowledge learned out of school				
5.Some mathematics identified in cultural activities should be included in the secondary mathematics curriculum				
Where mathematics Learning takes place				
6.Mathematics can also be found in traditional cultural activities				
7.The only mathematics students learn are those taught to them by teachers in school				
8.Traditional practices e.g. counting, measure, structures also have mathematics				
9.Students come to school to learn school mathematics and not cultural mathematics				
10.Culture has a lot of mathematics				

PART II: APPLICATION OF MATHEMATICAL CONCEPTS IN ABAGUSII CULTURE

From the following listed Abagusii structures and practices list down any mathematical Concept that can be leaned/drawn from them

Structure/practice/activity	Mathematical Concept(s)
1.Carpenter building traditional hut (enyomba)	
2.Making of baskets (egekabu/ekiondo, ekee)	
3.Making patterns on traditional wall	
4.Women weaving a mat	
5.Making of ornaments (ebitinge, amatete)	
6.Playing children games (obiti)	
7.Abagusii Dance (ogotenga/entaburuta)	
8.Making clay works (enyongo)	
9.Bow and arrow (obota na ritimo)	
10.Method of counting (kobara)	
11.Bonfire (ekebute) /forest fire	
12.Harp (obokano)	
13.Population (omobaro)	
14.Beadwork e.g. necklace (amatete)	
15.Counting technique (kobara)	

SECTION C: INTEGRATION OF CULTURE IN MATHEMATICS LEARNING

1. In your opinion do you think it is necessary to integrate Abagusii culture to support teaching and learning of mathematics

- (i) Yes (ii) No

Give your reasons for the answer above

- (i)

(ii)

2. In your own opinion ,how can Abagusii culture be integrated into teaching and learning of mathematics?

(i)

(ii)

APPENDIX IV: WORK PLAN

		Jan – May 2014	August 2014	September 2014	December 2014	Jan- April 2015	May 2015
1	Proposal Writing						
2	Proposal Defense						
3	Pilot testing						
4	Data Collection						
5	Data Analysis						
6	Thesis Writing						
7	Thesis Defense						

APPENDIX V: BUDGET

	PARTICULARS	UNITS	QUANTITY	UNIT COST (KES)	AMOUNT (KES)
1.	Accommodation- Nairobi	Day & Night	15 Days	5000	75,000
2.	Travel- Kisii to Nairobi to and fro	To & fro	7 Times	2000	14,000
3.	Meals – Breakfast	Local	10 Days	250	2,500
	- Lunch	Local	10 Days	600	6,000
	- Dinner	Local	10 Days	600	6,000
4.	Print –Research Proposal	Sheets	4 Copies*48 pages	10	1,920
	-Research Thesis	Sheets	6 Copies*90 pages	10	5400
5.	Photocopies	Sheets	500 sheets	10	5,000
6.	binding	Pages	6 Copies	500	3,000
7.	Miscellaneous				50,000
	TOTAL				168,820

APPENDIX VI: RESEARCH PERMIT



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

25th September, 2015

NACOSTI/P/15/3060/7363

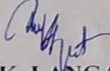
Daniel Momanyi Bundi
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on "*Application of Abagusii cultural practices into the teaching and learning of mathematics in secondary schools in Masaba North Sub County, Kenya*," I am pleased to inform you that you have been authorized to undertake research in **Nyamira County** for a period ending **23rd September, 2016**.

You are advised to report to **the County Commissioner and the County Director of Education, Nyamira County** before embarking on the research project.

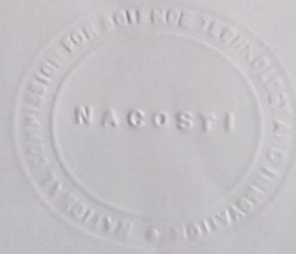
On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.


DR. S. K. LANGAT, OGW
FOR: DIRECTOR GENERAL/CEO

Copy to:

The County Commissioner
Nyamira County.

The County Director of Education
Nyamira County.



APPENDIX VII: LETTER FROM COUNTY COMMISSION

REPUBLIC OF KENYA



THE PRESIDENCY

Ministry of Interior and Coordination of National Government

Telephone: 020-2012491
Fax: 058-6144446
Email: cenvamira@yahoo.com.
cenvamira2012@gmail.com.

COUNTY COMMISSIONER
NYAMIRA COUNTY
P.O. BOX 2 - 40500
NYAMIRA

When replying please quote our

REF: NYRC/ED.2/VOL.I/113

DATE: 10th November, 2015


✓ The Deputy County Commissioners
MASABA NORTH

RE: DANIEL MOMANYI BUNDI
RESEARCH AUTHORIZATION

Reference is made to letter Ref. No. NACOSTI/P/15/3060/7363 dated 25th September, 2015 from the Secretary/CEO, National Commission for Science, Technology and Innovation, Nairobi authorizing *Daniel Momanyi Bundi* to carry out research on "*Application of Abagusii Cultural practices into the teaching and learning of mathematics in Secondary Schools in Masaba North Sub-County*"

This office has no objection to the planned research to be conducted in Nyamira County for a period ending 23rd September, 2016.

Kindly accord him the necessary assistance.


JOSEPHINE A.A. ONUNGA
COUNTY COMMISSIONER
NYAMIRA

Copy to:

National Commission for Science, Technology
& Innovation,
P.O. Box 30623
NAIROBI

County Director of Education
P.O. Box 4
NYAMIRA

APPENDIX VIII: LETTER FROM DIRECTOR OF EDUCATION

MINISTRY OF EDUCATION



Telegram: "EDUCATION", Nyamira
Telephone: (058) 6144224

COUNTY DIRECTOR OF EDUCATION
NYAMIRA COUNTY
P.O.BOX 745
NYAMIRA

When replying please quote

NCEO/1/25/232

10TH NOV, 2015

REF.....

DATE:

TO WHOM IT MAY CONCERN

RE: AUTHORITY TO CONDUCT RESEARCH BY DANIEL MOMANYI BUNDI

The above named person is a student at **KENYATTA UNIVERSITY**. He has been given authority by the National Commission for Science, Technology and innovation to conduct Research on "**Application of Abagusii Cultural Practices Into the Teaching and Learning of Mathematics in Secondary Schools in Masaba Sub County Nyamira County,**"

The research will commence immediately and end on **23rd September, 2016.**

Please accord him your assistance.

DR. SAMSON ARODI
FOR: COUNTY DIRECTOR OF EDUCATION
NYAMIRA COUNTY.

APPENDIX IX: ABAGUSII CULTURAL ITEMS



Chirumba (necklace)



Ebitinge (anklet)



Ebibekerero ao ao/Items



Ekee/plate