Declaration

This project is my original work and has not been presented for any award in any other university.

MUTANHO TENDAYI

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This project has been submitted for examination with my approval as the University supervisor.

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TITLE PROJECT

LEARNERS CHALLENGES IN THE LEARNING OF ‘O’LEVEL GEOMETRICAL TRANSFORMATION CONCEPTS

PROJECT WAS PRESENTED

YEAR GRANTED: 2018

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The undersigned certify that they have supervised, read and recommend to the Bindura University of Science Education for acceptance a research project entitled: LEARNERS CHALLENGES IN THE LEARNING OF ‘O’LEVEL GEOMETRICAL TRANSFORMATION CONCEPTS submitted by MUTANHO TENDAYI in partial fulfilment of the requirements for the Bachelor of Science Education Honours Degree in Mathematics.

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(Signature of the Chairperson)                                 Date

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(Signature of the Examiner(s))                                Date
Dedication

This work is dedicated to my mother Mrs Mutanho, my sisters, my brothers and my children.
Acknowledgements

I would like to express my gratitude to my project supervisor Mr Z Ndemo for guidance and assistance in making my research successful.

Secondly I am very grateful to my friends Samantha, Mavis and Alice for you unwavering support and encouragement throughout my study, you were a wonderful team with good team spirit.

I also thank the head and English teacher Mr Chinembiri and the learners for your co-operation I highly appreciated it.

Abstract
The purpose of the study is to analyse learner challenges in the learning of geometrical transformation concepts. The objectives of the study were (i) to identify challenges faced by learners in transformation (ii) to identify students’ conceptions of the nations of shear and stretch on transformation and to determine effective teaching methods that can be employed in the teaching of transformation. The statement of the problem; academics have gone along way in researches to identify the challenge of lack of understanding shear and stretch. Data collection methods included interviews and students tests, thus a mixed approach method was used to collect data. In depth explanations and quotations were also used to analyse data qualitatively. From the research work number of findings were discovered which included, the fact that most teachers had the view that learners confuses matrices of transformation and think that shear and stretch are the same because both of them use invariant line and matrices of transformation. This implies that there is need for practitioners to find effective methods and aids that assist in clearing learners misconceptions such as ICT tools and interactive learning methods. There is also need of team teaching and staff development sessions.
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Chapter One

1.0 Introduction

There have been a high rate of 'o' level Mathematics failure and subjects drop out. However, what is lacking is the availability of considerate literature in Zimbabwean secondary schools. Introduction to the study as well as this chapter is going an overview of a case study on learners’ challenges in the learning of geometrical transformations in Mathematics concepts. The statement of the problem, objectives, limitations, purpose of the study, delimitations, and definitions of terms will also be dealt with in this chapter.

1.1 Background of study

The teaching and learning process is inherently social act and as instructors we need to be mindful of the quality of the social emotional dynamics in our course because they impact on learning and teaching performance. There is a growing concern over low performance at 'O' level Mathematics in Zimbabwean secondary school yearly.

(Ministry of education, Sport and Culture, Mashonaland east Province in Herald.com.zw.4.feb 2018) indicates that, Mathematics had a national pass rate of 20.79% in 2016, 26.17% in 2015 ,11.15% in 2014 and 13.91% in 2013. This clearly indicates that the national pass rate is ranging from 11% to 30% which shows a cause of concern into Mathematical issues and topics. The National percentages are almost the same with the case schools pass rate which are as follows 14.5% in 2012, 12.6% in 2013, 8.5% in 2014, 10.3% in 2015, 10.3% in 2015 and 19% in 2017 (Ministry of Education Chikomba district). This is a serious concern that needs to be immensely looked at.

For quite some time Mathematics pass rate in Mashonaland East Province has always been lowest in summative ordinary level assessments compared to other subjects written in 2000 Mathematics pass rate was at the bottom with 17.9% and the highest pass rate was 80.7% in accounts. (Ministry of Education, Sports and Culture, Mash East Province). The trend was the same in 2008 and 2009 when statistics shows a very low pass rate in Mathematics as compared
to other subjects whose pass rate were very good. The pass rate of Mathematics in three high schools located rate of the two consecutive years 2008 and 2009 at 8.5% and 10.8% respectively. (Ministry of Education, Sport and Culture Mashonaland East Region, 2010).

Students are expected to compete effectively in the learning process so that results of performance are of high quality. The challenges being faced by both teachers and learners has hindered the school and National pass rate. The researcher’s teaching experience has noted that among the factors that influence students Mathematics achievement are teaching methodology, environment, and education background of parents. Among various mathematics topics at Ordinary Level, transformation has been noted as one of the topics that has for many years been neglected and seen as a difficult topic by both, teachers and learners so much that most educationists avoid the topic or just brush through it. It is an essential requirement by every field of intellectual endeavour and development to cope with the challenges of life; it is equally seen as the language used to describe the problem arising in technology. It relates other school subjects in area like number and numeration, variation, graphs, solution of equation, area and volumes.

Brief history of the teaching of mathematics in Nigeria started with arithmetic of components of mathematics at the primary and post primary schools. Feyerband (1999) asserts that arithmetic was compulsory for every primary school pupil and must be passed before a pupil could obtain the primary school leaving certificate, the same condition hold for the teacher training colleges either grade two or three. Mathematics still remains one of the core and compulsory subjects for the Nigerian students at both primary and post primary schools. Given the right to choose, many would out rightly avoid mathematics, this is because many of them have developed some element of fears about the subject may be as a result of long time negative information they get every year about the poor and low level performance in examination in mathematics or other factors this research work sets out to unravel. According to A Jagun (2000), the performance of students in junior secondary school today defined fear as a vital response to physical and emotional danger if we did not feel it, we could protect ourselves from legitimate threads.
The teaching of geometry (isometric) Transformation at secondary school level: What approach to use and why, Samuel Mashingaidze http://30/11/2012 dx.doi.org/10.5539/assp197 says transformations are somewhat a difficulty topic of the ordinary level mathematics syllabus. It usually comes barely towards the end of syllabus and as such it is either skipped or hurriedly done by most teachers of mathematics. Student and teachers, both, exhibit serious shortcomings in their understanding of transformation. During a workshop with mathematics teachers in Mberengwa district(2014) it emerged that transformation as a topic gives teachers the least pleasure, yet it is considered important in supporting students development of geometry and spatial thinking (Hollerbrands, 2008). In this workshop, teachers voiced mixed feelings about how they handle the teaching of transformation. Some of the teachers say they usually teach it when there is little time left. However studies revealed evidence that teaching geometric transformation is feasible and may have positive effects on students learning of mathematics. This clearly indicates that learners have challenges in Mathematics and transformation in particular of which it indicates much attention is needed to improve learning of transformation and mathematics.

In Lesotho the secondary school policy entails five years secondary school study .During this period students are required at the fifth and third year of study to sit for an external examination. At both phases of learning Mathematics is one of the examinable subjects and it is compulsory for all third year students, also known as the Lesotho Junior Certificate examination but optional at the senior school certificate examination except for student aspiring for a further study in the sciences. However, at both levels of study the Mathematics syllabus includes topics drawn from algebra, trigonometry and geometry. These topics are integrated and taught simultaneously every year (Lesotho Secondary School National curriculum 2010). However, indication emanating from the report compiled by the examination council in Lesotho, 2007, 2008 and 2009 revealed that students ‘performance in geometry and in particular transformation geometry of shear and stretch was very poor as compared to other areas of Mathematics. The average was below 20% in 2004(Examination council of Lesotho, 2004, 2009).This evidence leaves much to be desired. The report pointed to the fact that students may lack enough acquisition of geometric skills. Furthermore it was revealed that most students did not give the required solution for example
when finding stretch factor and shear factors using the given transformation to transform an object or image when given the coordinates (Examination council Lesotho, 2009). These difficulties experienced by students in an examination could be explained and understood better by reflecting on the research work done by van Hiele (1986). van Hiele research which had its roots in Piaget’s work focused primarily on five levels of geometric conceptualization. The five levels are visualisation, abstention, descriptive, formal education and rigor. van Hiele (1986) stated that there are two main reasons for existence of levels. 1. If students have not sequentially gone through the proposed five levels then they cannot function adequately at any given level. 2. If the instructor uses a language, a textbook, or a teaching method at a higher level that is different from that of student, a serious communication problem between the teacher and the students may occur and this may result in frustration and lack of understanding on the part of students. This clearly indicates that, researches about Mathematics failure have been made. However, a research gap on how shear and stretch transformations influence mathematics achievement and attainment was left and on what really presents a challenge on the topic transformation in Zimbabwe in Chikomba district schools.

1.2.0 **Statement of the problem**

Academics have gone a long way in researches and managed to identify the challenge of lack of understanding shear and stretch transformations. Learners find it difficult to use shear factor and stretch factor to transform shapes. It has been discovered that quite a number of ordinary level students drop Mathematics as a result of lack of understanding of some mathematics concepts.

1.3.0 **Objectives**

1.3.1 To identify challenges faced by learners in transformation.

1.3.2 To identify students’ conceptions of the notions of shear and stretch in transformation.

1.3.3 To determine effective teaching methods that can be employed in the teaching of transformation.

1.4.0 **Research sub questions**
1.4.1. State and explain challenges faced by learners in transformation.

1.4.2. Identify and explain learners' conceptions of the notions of shear and stretch in transformation.

1.4.3. How best can Mathematics teachers deliver transformation topic so it can be clear and easy to understand.

**Hypothesis**

**H0:** There is no significant difference between test conducted before and after use of electronic media, environment and pupils' involvement.

**H1:** There is significant difference between tests conducted before and after use of electronic, outside classroom environment and pupil participation.

1.5 **Significance of the study**

The study will **go a long way in benefiting the following:**

1.5.1 **Learners**

The first beneficiaries are the school pupils themselves. They need knowledge on how best they can understand mathematics problems.

1.5.2 **Teachers**

Second beneficiaries are teachers or practitioners and the ministry of primary and secondary schools together with its sister ministry of higher and tertiary educational benefit if supplied with didactically pedagogical principles that enhances the teaching and learning process of mathematics.

1.5.3 **Administrators**

Lastly this research is also important to the researcher in that it serves as a partial fulfilment to the requirements of BSC in mathematics.
1.6 Delimitations

1.6.1 Physical boundaries

The study is to be confined at a rural day school 30 kilometres from Chivhu town along Chivhu to Mutare road. The school has an enrolment of 920 learners with 450 girls and 470 boys from form one to form six.

1.6.2 Theoretical boundaries

The study will target Mathematics students of ordinary level. The school has four classes each stream. The research will examine 170 form four learners. The research is going to be governed by ordinary level syllabus. The research will also focus on shear and stretch transformations only. Learners are failing to multiply matrices to bring out the images in transformation. The research is also going to present an in depth study in the use of shear and stretch factors in transformation.

1.7.0 Limitations

1.7.1 Gathering information and collection of data can be expensive for the researcher. Time factor can pose a cause of concern in data collection and research work. The researcher could create time where free slots are available on the timetable. The research is time consuming as one is expected to have interviews thus time consuming as one has also other professional duties as a teacher. From the researcher's point of view, the other major limitation can be lack of expertise. The researcher can make use consultations from supervisor. The researcher can face challenges of multi-roles as a mother of children, wife, at workplace and lastly as a student. Therefore, to some extent the project can become strenuous and demanding. The researcher used possible time available to fulfil the demands of all duties.

1.8.0 Definitions of terms

The title of the study is learners' challenges in the learning of 'o' level geometrical transformation concepts. From these words the researcher defined the following terms: learning, challenge, geometry and transformation.
1.8.1 Learning

Haralambos and Holborn (2013) define learning as development that comes from an exercise and effort. Through learning children acquire competence in using their hereditary resources. Scheafer (2010) defines learning as, any response to stimuli that leads to a residual change in behaviour. Therefore, learning is only when a learner develops a new behaviour as a result of interacting with something.

1.8.2 Challenge

According to Girbison Blanford (2008) challenge is something that needs a lot of skills, energy and determination to deal with or achieve. Challenge can also be defined as an approach for conversation or solicitation, Mac Lead (1994)

1.8.3 Geometry

Https://www.mathsisfun.com defines geometry as the area of mathematics that deals with points, lines, shapes and space. It can also be defined as a branch of mathematics concerned with questions of shapes, size, relative position of figures and properties of space (https://www.sangakoo.com) This however indicates that geometry deals with questions of construction of lines, shapes, space, size, relative position of figures and understanding them. Freudenthal (1971) defines geometry as an activity of solving problems concerning shapes, vision and location. Geometry education concern itself with theories, principles and methodology in the teaching of geometry. This however, indicates that geometry is an educational branch of maths that focuses on the measurement and relationship of lines, angles, surfaces, solids and points.

1.8.4 Transformation

JB Channon and Chasakara (1985) define transformation as the name given to a change in position or dimensions (or both) of a shape. Kufakowadya and Nyamakura (2010) also define transformation as the process that involves the change of a figure in position, shape and/or size. Therefore, transformation is a term used to describe ways of manipulating the shape of a point,
line or shape, a process which changes the position of a shape. Thus, geometrical transformation is a branch of Mathematics concerned with questions of shape, size, relative position of figures and the properties of shapes.

1.9.0 Organisation of study

The study is organised in five chapters that are as follows: chapter one which is orientation and comprises of introduction, background of the study, focus of the problem, research questions, objectives, hypothesis, motivation of the study, delimitation, significance of the study, conceptual boundaries, limitations of study, definition of key terms, organisation of study and summary of the chapter. Chapter two has review of related literature followed by chapter three with introduction, research design, population of the study, sampling procedures, research instruments, pilot study and ethical considerations, data collection procedure, validity and reliability, data presentation and analysis procedure and summary of the chapter. Chapter four includes data analysis, presentation and discussions, chapter five with summary, conclusion and recommendation.

1.10.0 Summary

This chapter has highlighted the introductory aspects of the study and background upon which this research stems as well as the statement of the problem. Research questions, significance of study, delimitations, limitations and hypothesis have also been identified and definition of terms which apply to this study. The next chapter discusses literature review.
Chapter Two

Introduction

This chapter serves to link theoretical concepts from other sources to the area of study. The researcher used primary and secondary sources, which deal with shear and stretch transformation topics at ordinary level mathematics. The literature review gives a direction of research on the area of study and the development of knowledge in the field. Newman (1997:28) says, the researcher will be able to identify contradictions in the existing body of knowledge that needs to be resolved, thus finding solutions to the stated problem.
2.0 Theoretical framework

Leon Feinstein Parental Support and Education

Leon Feinstein (2003) discussed more recent research that he conducted with others into the factors affecting success in Education. Feinstein used data from the National Child development study and the British Cohort Study. Feinstein claimed that the main factor influencing educational attainment was the degree of parental support account for class differences in educational attainment. Parental support was measured by teachers' assessments of how much interest parents showed in their children's education. Feinstein gives the following example to indicate the importance of parental support; in tests of maths attainment the improvement between 11 and 16 of children whose parents exhibited high interest in education was 15 percent points greater than those of children whose parents exhibited no interest. By comparison' the average advantage of having two parents who both stayed at school beyond the minimum leaving age and a father in a professional occupation was only 2 percent for maths. Feinstein (2003) suggest that positive effects of parental interest operate through motivation, discipline and support. This clearly indicates that sometimes failure to understand some mathematics concepts is strongly related to parental negative attitude towards the subject and lack of parental support and guidance in motivating learners into the subject. Rather some parents having failed mathematics do not encourage their children into developing positive attitude towards mathematical concepts.

Factors affecting student's attitude towards Maths: ABC theory and its reflection on practice.

2.2.2 Attitudes and Social Grades

Nicolaidai and Philippau showed that negative attitudes are the result of frequent and repeated failures or problems when dealing with mathematical tasks and these negative attitudes may become relatively permanent. As they progress their attitudes become less positive and frequently become negative at high school. There are a number of factors which can explain why attitudes towards mathematics become more negative with the school grade, such as the pressure to perform well over demanding tasks, uninteresting lessons and less than positive
attitudes. This also clearly shows that poor performers will sometimes make topic to appear difficult to learners thus leading to a negative attitude towards the subject.

2.1 Challenges faced by learners in transformation.

Skemp (1971) indicated, mathematics is hierarchical in nature, so learning of higher order concepts is successful only when related lower order concepts are fully grasped by the learners. Van de Walle (2004) posited that pupils need to make connections between new and old knowledge. They need to engage in reflective thinking, sitting through existing ideas to find those that seem most useful in giving meaning to new concepts being learnt. Furthermore, literature indicates that students often face challenges in mathematics content especially when trying to make sense of abstract concepts.

Edwards (2003) identified a particular misconception about rotations. She found that instead of seeing rotation as mapping all the points of the plane around a centre point, the student in her study expected the shape to slide to the given centre point and then turn around it showing that they had a hard time seeing rotation as occurring a distance from the object. (Edward 2003:7)

Transformations are somewhat difficulty topic of the ordinary level mathematics syllabus. It usually comes barely towards the end of the syllabus, and as such it is either skipped or hurriedly done by most teachers of mathematics. Students and teachers, both exhibit serious shortcomings in their understanding. During a workshop which the author conducted with mathematics teachers in Mberengwa district, it emerged that transformation as a topic gives teachers the least pleasure yet it is considered important in supporting mixed feelings about how they handle the teaching of transformations (Edwards, 1989)

It appears problems encountered by the students are as a result of lack of conceptual understanding and might also be a result of the teaching they experience in learning transformation. Nziramasanga commission (1999) lamented the poor state of mathematics instruction in Zimbabwe and discovered that the problems of quality of Mathematics instruction and learning are from different sources. The Mathematics teacher however, has fallen victim by being accused to be responsible for low quality student performance in secondary schools
(curriculum Team Research report, 2010). Foster (2007) highlights that if students are taught abstract ideas without meaning this might not develop their understanding. Teachers appear to have frequently becomes a barrier to student' understanding. The 'o' level textbooks also fail to present the content in such an elaborate way that could provide sufficient room for students to develop rational knowledge. (Nziramasangacomission, 1999)

Recently, Mathematics has become a determining factor to gaining admission into most Nigeria universities as it must be passed up to credit level before one gain admission into Nigeria university. Given the right to choose, many would out rightly avoid mathematics, this is because many of the students have developed some element of fears about the subject maybe as a result of long time negative information they get every year about the poor and low level performance in examinations in mathematics or other factors this research work sets out to unravel. Jagun(2000).

2.2 Impact of scarcity of resources in teaching and learning

School and teaching resources in Sub Saharan Africa analysis of the 2011 US Regional data collection on education reported that the quality of education is one of critical factors affecting the development and learning achievement of young people today. While the notion of education quality is often difficult to define, there are some basic features which are considered key educational outcomes. These include the quality of teaching workforce, the availability of adequate educational resources, supportive learning environment and suitable access to basic service in instructional setting. All of these are important for the promotion of learning and educational performance.

Overcrowding schools are in serious problem in many school systems particularly in the inner cities, where space for new construction is at a premium and fiction for such construction is limited as a result, students find themselves trying to learn white jammed into spaces never invented as classrooms such as libraries, museums, and lunchrooms. Schiller(2003) found out that overcrowding and heavy teacher workloads created stressful working conditions for teachers and led to higher teacher absenteeism and crowded classroom conditions not only.
Making it difficult for students to concentrate on their lessons, but notably limit the amount of time because teachers can spend on, in narrative teaching methods such as cooperative learning and group work. Marlowe (1999), learning by doing gives students opportunity to be active imaginative problem solvers. Bassey (1996), indicates that most children because of scarcity resources are at risk of academic failure thus, call for teachers intervention methods to scaffold pupils.

2.3 Student's conceptions of the notion of shear and stretch minimizing challenges faced by learners in transformation.

It was found that learners' reasoning was more based on their concept images than on formal definition. The most interesting were verbal concept images, some of which were very accurate, others incomplete and yet others exhibited misconceptions. There were a lot of misconceptions in the students, constructed definitions and incompetency in using graphical and symbolic representations of shear and stretch. For example some learners mislead stretch for enlargement both verbally and contextually.

The previous researches recommend that teachers should use more than one method when teaching transformations. For example., practically oriented and process oriented instructions, with practical examples, to improve the images of the concepts that learners develop (http://www.pmena/OR/past conferences/2006/cd/ooook.pdf/25.06.2009).Within their methodologies, teachers should make effort to be aware of diversity ways in which their learners think of the actions and processes of shear and stretch, the terms they use to describe them and how they compare the original objects to image after transforming. There is also a need for accurate assessments of successes and shortcomings that learners displaying the quest to define and master mathematical concepts but taking cognizance of their limitations of language proficiency in English, which is not their first language. Teachers need to draw a clear line between the properties of stretch and enlargement and emphasize the need to include the invariant line in the definition of stretch. To remove confusion around effect of ",-" sign, more practice and spiral testing of this knowledge could be done to constantly remind learners of that property. Lastly, teachers should find out how to use smart phones, i-phones, i-pads and other
technological devices for teaching and learning and utilise them fully to their own and the learners advantage in learning these and other skills (Tall, 1997).

According to the constructivist theory, when learning a concept, learners reconstruct the knowledge about that concept to their level of understanding and the resultant knowledge structure is not always the exact replica of concept definition stated in the books but something related to it. The learner's cognitive system now uses that concept image to work out the cognitive tasks without consulting the original concept definition. An incorrect concept image could be expected to give rise to a desirable solution. It is necessary therefore that educators investigate what learners may have as concept (Borba and Confrey, 1996).

Tall (1977) says that problems in understanding develop during the process of instruction, but stops short of blaming teachers. Learners may not be able to identify their own problems, so a teacher has to use the art and science of teaching to identify learner’s individual difficulties and assist in removing possible conflicts, giving a clear exposition of the major mathematical ideas (Tall, 1997). Borba and Confrey (1996) examined student’s construction of transformations functions (translation, reflection and stretch) in what they call a multiple representational environment. They started with visualisation exercises. They conducted that visual reasoning that is seeing graphical transformation on the plane is a powerful form of cognition. Nyikahadzoyi (2006) assessed student’s knowledge and concept functions using open ended task based and reflective interviews in a case study of six final year Zimbabwean student teachers. The majority of students were found to have a process conception of a function and a few of them gave set theoretic definitions. From the above researches, it can be deduced that learners have various conceptions on transformation topics and problems. It has been also noted that teacher’s role is exceptional and necessary in problem identification of learners and taking them through necessary stages to bring understanding of lesson concepts.

Numerous studies have shown that spatial ability can be improved by training (Bishop, 1980). It would thus be of interest to educators to study how instructional programs can be designed to help students improve their spatial ability since there is much in common between spatial thinking and transformation geometry. The studies discussed clearly shows that a number of
learners conceptions of shear and stretch in transformation calls for teachers attention and an alarming rate so as to be able to iron out the problems.

2.4 Effective ways of minimising challenges in learning transformation.

With current South African curriculum (2011) School mathematics incorporates transformation geometry, which was introduced in the further Education and Training band in 2006. This strand allows learners to make connections across other geometrics within the space, shape and measurement learning outcome, as well as with algebra and trigonometry. These connections are intended to create a more integrated holistic knowledge. By studying the learners' visual strategies, they hope to develop an understanding of how learners, use of visualisation techniques could contribute to more effective problem solving. They hope that the study will inform teachers and curriculum developers about possible pedagogies approaches that could be used successfully when teaching this strand of mathematics. This however indicates that quite a number of strategies need to be considered so challenges in transformation can be minimised. This shows South African effort to discover ways in which the teaching and learning of transformation could be easy and enjoyable. According to Greer (1983:217) transformation describes the relation between a point and its image.

The need to use technology in the classroom is advocated by Bansilal (2015) stating that, rapid global technological developments have affected all facets of life, including the teaching and learning of mathematics. Technology can be used to facilitate learning by using dynamic software in the teaching and learning of mathematics (Cullen, Hertel and John, 2013). Merits of technology during interaction in mathematics embrace abrupt graphing and calculation. However, it is probably the case that the use of technology and other software have not been fully utilised in the classroom (Bu and Schoen, 2011).

There are two considerations for ensuring effective teaching when new approaches for teaching are used. Firstly, it is important that teachers need to be given proper training to give quality lesson presentations. Secondly, the new approaches or technologies ought to be utilised in a way to support the things that teachers already know. In other words the use of technology and new
approaches do not replace the content or knowledge possessed by both teachers and learners, but rather enhances learning in the classroom (Lu, 2005). Diagrams and pictures may be projected on the screen for better visualisation and understanding. This therefore implies that teachers as facilitators of learning need not use mathematical software without proper preparation and consultation, the user of software does not guarantee effective learning. According to classical learning theories it was found that in order for learners to do well, they have to progress from concrete experience to abstract generalisations, (Bleeker, 2011). The transition from concrete learning of geometrical concepts to abstract generalization is possible when teachers take into consideration the fact that concrete experience precede abstract work and that visualisation is powerful in the conceptualization of the abstract ideas. Therefore use of technology can enhance learning.

The effective teaching of transformation, just like any topic in mathematics, must include not only facts to be mastered but also an appropriate and logical system of cognitive activity. In other words, what is required is for the student to acquire relational understanding more than procedural understanding. Getting to know mathematics does involve much concrete experience and grounding in its central concept like number, shape and size comes through interaction with real objects and activities involving them. (Beatly and Malvern,1983). Learning mathematics is first and foremost learning how to do mathematics. The prime concern of mathematics is to enable pupils to develop skills and to use them.

Transformation problems can be solved by any of the two methods, that is, graphically and algebraically. And assessment of learning must include providing opportunities for students to choose how they solve a problem and observing how they do it as well as seeing if they get it right or wrong. For any successful teaching and learning it is also important to establish whether students possess the correct assumed knowledge base. (Beatly and Malvern,1983). Sunzuma GetaL,2013 argue for the inclusion of cultural geometry in formal school mathematics curriculum. In Zimbabwe members of the apostolic church apply geometrical concepts with meticulousness without the practitioners receiving school education. A descriptive ethno mathematics research that revealed how religious cultural geometry could enhance understanding of school
mathematics was employed in this study. Data was collected through observation and interviews. Twenty households which were conveniently sampled and three purposively sampled mathematics educators constituted the sample. This highlights how geometry is used in the apostolic sector and how it could be used to enhance student's geometry conceptual understanding in school mathematics as concept is widely believed to be difficult. The inclusion of religious mathematics could bridge the gap between school and the cultural mathematics since improving mathematics education was the original motivation for ethno mathematics in teacher education programmes that will enhance educators ‘content and pedagogical content knowledge. This shows that variety of ways and activities can be used in teaching transformation. Bringing social life experiences as teaching examples that will enhance teaching and learning. This shows that for concepts understanding learners need to be socialised in a friendly and known environment to them.

2.5 Summary

The rise in high failure rate in ordinary level Mathematics indicating also an attitude in transformation topic has posed a cause of concern in order to research on challenges faced by learners’ effective ways of minimising learners’ challenges and also in an effort to eradicate learners’ misconceptions and conceptions on the notions of shear and stretch. This chapter has also looked at theoretical frame work of the area under study. The next chapter will look at research methodologies.
Chapter Three

Methodology

3.1 Introduction

This chapter presents the methodology and steps taken in analyzing and describing the difficulties students experience in geometrical transformation with special focus on the concept of shear and stretch. Research methodology is an approach which underpins the research process (Blaxter et al, 2006). This implies that research methodology can be defined as a method or way to solve the research problem. The main thrust of this chapter is to describe the methods used in the research field to pursue the aims and objectives of the study. Thus this chapter covers the following areas: research design, study population, study sample, data collection and data analysis.

3.2 Research Design

A research design is a plan or structure for an investigation. It is a set of plans and procedures that reduce error and simultaneously help the researcher to obtain empirical evidence about isolated variables of interest. (Hepper, Kiviliggan and Wampold, 1992). The research design refers to the overall strategy that you choose to integrate the different components of the study in a coherent and logical way, thereby ensuring you will effectively address the research problem, it constitutes the blueprint for the collection, measurement and analysis of data (Labaree: 2009). The function of a research design is to ensure that the evidence obtained enables you to effectively address the research problem logically and as unambiguously as possible.

The study adopted a mixed research design that included qualitative and quantitative case study design. Both methods of investigation were used because they provided the wide ranging information. Mixed methods can help get the widest possible range of views or interpretations. Exposure to a broader range of perspectives and experiences can in turn assist with the information of explanation. (McEvoy and Richards, 2006) Mixed methods can help deepen the explanation of a phenomenon and to generate theory (Danermark, 2002; McEvoy and Richards,
The qualitative aspect of the research used the interview while the quantitative method was in form of written test to analyse students' performance. The written test was also used to show students' weaknesses and classify students according to their level of concepts comprehension. To maintain validity, triangulation was used to confirm and compare results from these two data sources. The written test response and other data such as interviews from student and tape recorder used during the interview were carefully analysed (Cohen and Manion, 1994)

### 3.3 Population and Sampling Procedures

Sekaran(2001) defines a population as the entire group of people, events or things of interest that the researcher wishes to investigate. Chiromo(2006) postulates that a population is a group of interest to the researcher, one of interest to the researcher. The group one would like to derive data from. The total population of the study consisted of three teachers thirty five learners as shown by the table below.

Table 3.1 the distribution of participants by gender.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Female</th>
<th>Male</th>
<th>Total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>learners</td>
<td>18</td>
<td>17</td>
<td>35</td>
</tr>
</tbody>
</table>

Livesey (2014) postulates that before data can be collected, the researcher needs to identify people or respondents who will be the subject of the research. This implies that from the total population the researcher is going to collect a sample to work with using stratified random sampling method.
3.31 Stratified random Sampling

This method involves the division of the sampling frame into groups in order to ensure that the sample is representative. The researcher identifies the important variables that need to be controlled and allocates the sampling units to different groups according to these variables (Haralambos and Holborn: 2013) Sampling is a strategy for selecting a smaller section of the population that accurately represents the characteristics of the target population at large. Sampling is important because it reduces resources required when gathering data as well as improving the quality of data by focusing on a smaller group. Breakwell, Sean and Fife-Schwz(2008) define a sample as a representative of the whole population. It is therefore a subset of a population that is used to represent the entire group as a whole. According to Flink (2009) stratified sample is a probability random sample that selects elements from relevant population subjects to be more representative of an entire population.

The researcher is going to group the population teachers, learners and administrators in their age groups accordingly. Then stratifying measure using age range will be used to pick the population to work with. For learners form three classes of average learners will be identified and then random sampling in that class will be then carried. The researcher stratified the population using age range, administrators who ranging from 30-45 and above 45. From form three classes out of 170 learners the researcher sampled two classes then randomly sampled 35 learners.

3.4 Research Instruments

Research instruments are measurement tools for example questionnaires or scales designed to obtain data on a topic of interest from research .(https://lib.dmu.edu>cinahl>instruments).The researcher used both qualitative and quantitative research instruments for the qualitative part the researcher used interviews and for quantitative data analysis the teacher used test.

3.4.1 Interviews
Matsa et al (2015) define an interview as a research instrument that involves a conversation between the interviewer and respondent for the purpose of both obtaining in depth and comprehensive information as well as gaining insights into people's experiences, perceptions, attitudes, opinions and feelings of reality.

Haralambos and Holborn (2013) state that, a structured interview is simply a questionnaire administered by an interviewer who is not allowed to deviate in any way from the provided questions. The interviewer simply reads out the questions to the respondent.

The interviews were administered at the school premises. During the interview each student was given a chance to respond to the questions being probed. The researcher set interview guide questions that focused on set research questions and administrators to be interviewed.

Interviews have been considered because they posed a number of merits which include the idea that issues can be explored in greater depth and the researcher does not limit the responses to fixed choices. Thus, there are more feasible than any other research method. However, interviews can have some shortcomings like lacking reliability as compared to the use of participants’ observation. A total 35 learners were interviewed from a population of 170 learners in form three.

3.4.2 Written Test

Mkanda(2014) views a test as a measurement to find out pupil's performance against set standard. It is therefore a measurement of knowledge, feelings, skills, intelligence and attitudes of pupils:- Assessment of objectives, familiarizing pupils with examination demands, developing examination skills and techniques.

The test was administered to form four learners with a total of 170 learners for both boys and girls. The purpose of the test was obtaining data from the written response and to help in formulating questions to be included in the interview discussions.

Written tests provided data about the students thought processes in transformation geometry problems solving situation. During the test sessions learners were expected to draw and show all
steps in arriving at answers. This enabled the provision of check due on the divergent thinking of learners. The learners were given a pre-test so that comparisons of results were carried. Some of the items included in the sample are (3) \( T \) is a translation \((2;8)\) and \( S \) is a stretch. Calculate the image of \( A \) \((3;2)\) under the following combined transformations: \( a) \ ST(A) \) \( b) \ TS(A) \) \( c) \ S^{-1}(A)\). One example on post test is on calculating image point given the matrix and object.

3.5 Data collection Procedures

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypothesis, and evaluate outcomes (Wahl, 1998). The researcher was issued with a letter by the university proving that the researcher is their bonafide student carrying out a research. The researcher went onto seek permission to carry out the study at school level from the school head and district school inspector. After being successful the researcher went on to select a sample to work with. The researcher made prior arrangements, two days before. A written test was given to students in the form of a worksheet. The test technique was chosen because it benefits. It enable learners to express themselves in writing and can help to provide information regarding the learners thought processes with regards to transformation geometry specifically with reference to shear and stretch. The written test considered of sub questions which will be drawn from van Hiele's level. The content of interviews was a follow up on question asked in the written test. Thus, was adopted as to compliment the written test and to address different set of questions which may have not been addressed fully when only the quantitative method of investigation is solely used (Cutiet, 2000). Data from the interview answered questions with regards to the extent to which students had difficulties relating to description, analysis and to deduce geometry.

3.6 Reliability and Validity

The reliability of a test or instrument refers to the extent to which it consistently measures what it is supposed to measure (Cresswell, 2010). A test is reliable to the degree that it measures accurately and consistently, yielding comparable results when administered a number of times
(Agwubike and Momoh, 1995). To ensure reliability of the data collected in the study, the contents of the written test and interview will pass through a verification stage. However, the responses given may not be accurate and may not reflect real behaviour. They may be also handicapped by forgetfulness or ignorance. On the other hand validity refers to the extent to which inferences made on the basis of numerical scores are appropriate, meaningful and useful to the sample. (MacMillan and Schumacher, 2001). Validity also checks whether the instruments provides an adequate sample of items that represent that concept (De Oos et. al, 2003).

In this study, both construct and content validity was used in this study to check if the test and interview questions really measured intended concepts. The selection of questions from textbooks was based on the questions ability to solicit learners' to visualise, identify and describe geometry.

3.7 Data Analysis procedures

Tukey (1961) defines data analysis as procedures for analyzing data, techniques for use surname of author in citation interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all machinery and results of statistics which apply to analyzing data. Data analysis is the process of systematically searching and arranging collected data, direct quotes from learners, test results and other materials gathered by the researcher for in-depth comprehension which enable the researcher to provide adequate information. McMillan and Schumacher (2001) defined data analysis as an ongoing of qualitative research.

3.7.1 Qualitative Data analysis

Interview

The pen and paper, verbatim quotes from the learners and researchers' notes used during the interview were also assessed. The researcher used multiple data analysis from test results and identified learners ‘challenges. Learner’s expressions and responses were also used to analyse learners’ difficulties in geometry.
3.7.2 Quantitative Data Analysis

Test (pen and paper test)

In order to determine the difficulties learners have in transformation. A table for determining learners' achievement and challenges to be used according to van Hiele's level adopted from Soon (1992). Showing various levels at which learners results from the response from the written test has shown.

3.8 Ethical Considerations

There are ethical considerations which all researchers must consider before engaging in a research study. Ethics can be referred to as the accepted code of moral principles required to be exercised when carrying out a research (Kamyalide, 2000).

Chiromo (2006) postulates that the participants need to know before agreeing to take part after ethical considerations. Confidentiality is important, Pfukwa (2011) avers that confidentiality has to do with people who will have access to the data. The participants will not be required to disclose their identity except with informed consent. Pfukwa (2011) defines confidentiality as the process of protecting an individual's privacy. The researcher must respect the participants' rights to privacy (Chiromo, 2006).

All stake holders which include the school head, parents, teachers, the teaching service department and learners were informed before embarking on the research work. Letters seeking permission was written to the school head and the District Schools Inspector and was requested to sign to indicate permission granted. Respondents were assured of confidentiality to be exercised with collected data.

3.9 Summary

This chapter described the research methodology of the investigation that was conducted at Madzivire High School, Chivhu, Chikomba district. Ethical considerations, detailed description of the study samples, instruments used and the validity and reliability of these instruments were discussed. The chapter further described the sampling, how the pilot study was conducted, data
collection methods and analysis. The next chapter presents the analysis of data collected from the written tests and interview.

Chapter Four

Data presentation and discussion of findings

4.1 Introduction
The previous chapter outlined a description of methodology, the research design and the instruments used in the research. In this chapter results from data analysis from interviews and tests are to be presented and discussed. Quotations are used extensively to provide qualitative data and feel of responses. The findings of the research are given as follows: firstly the sample population and this chapter respond to research sub-questions raised in paragraph 1-5 in chapter one.

4.2 Quantitative perspective state the research question

Table 4.1

Summary of the sample.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Population</th>
<th>Sample</th>
<th>Sex</th>
<th>Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Teachers</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Form four learners</td>
<td>170</td>
<td>35</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>176</td>
<td>38</td>
<td>19</td>
<td>19</td>
</tr>
</tbody>
</table>

Results for qualitative part

Student t-test

Ho null hypothesis

There is no significant difference between test conducted before and after use of electronic media, environment and pupil’ involvement.
H1 There is significant difference between tests conducted before and after the use of electronic, outside classroom environment and pupil participation. Hypotheses formulation to improve

Significance level - 5% (.05)

Rejection criteria

If t-calculated is greater than t-critical reject the null hypothesis. If t-calculated is less than t-critical accept the null hypothesis, fail to reject.

Degrees of freedom

Boys

Df=n-1=17-1=16

Girls

df=n-1=18-1 =17

Students’t-test results for transformation pre and post test for form four boys.

Table 4.2

<table>
<thead>
<tr>
<th>Participant</th>
<th>X</th>
<th>Y</th>
<th>(X-Y)d</th>
<th>(X-Y)^2d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>00</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>05</td>
<td>05</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>35</td>
<td>55</td>
<td>-20</td>
<td>400</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>8</td>
<td>05</td>
<td>20</td>
<td>-15</td>
<td>225</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>55</td>
<td>-45</td>
<td>2025</td>
</tr>
<tr>
<td>11</td>
<td>15</td>
<td>60</td>
<td>-45</td>
<td>2025</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>30</td>
<td>-20</td>
<td>400</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>30</td>
<td>-20</td>
<td>400</td>
</tr>
<tr>
<td>14</td>
<td>00</td>
<td>05</td>
<td>-5</td>
<td>25</td>
</tr>
<tr>
<td>15</td>
<td>00</td>
<td>05</td>
<td>-5</td>
<td>25</td>
</tr>
<tr>
<td>16</td>
<td>00</td>
<td>10</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>17</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>50</td>
<td>-35</td>
<td>1225</td>
</tr>
<tr>
<td>5</td>
<td>05</td>
<td>15</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>Sum</td>
<td>170</td>
<td>410</td>
<td>-250</td>
<td>7350</td>
</tr>
</tbody>
</table>

Mean----X=10 and Y= 24.1

t=\[\frac{\sum d^2-(\sum d)^2}{n}/(n-1)\]

= \[\frac{(7350- (250)^2/17)}{17-1}\]

= \[\frac{(7350-62500/17)}{17-1}\]

= \[\frac{(7350-3676.5)}{16}\]

=3673.5/16
T- Calculated = 22.9

T- Critical = 2.91

T calculated of 22.9 is greater than t-critical of 2.91 therefore, I reject the null hypothesis. Thus, there is significant difference between tests conducted before and after use of electronic media, outside classroom environment and high pupil participation.

**Student t-test results for transformation pre and post test for girls**

Table 4.3

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>(X-Y)d</th>
<th>(x-y)^2d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>30</td>
<td>-20</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>35</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>55</td>
<td>-40</td>
<td>1600</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>50</td>
<td>-35</td>
<td>1225</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>55</td>
<td>-40</td>
<td>1600</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td>35</td>
<td>-25</td>
<td>625</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>35</td>
<td>-25</td>
<td>625</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>25</td>
<td>-15</td>
<td>225</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>35</td>
<td>-25</td>
<td>625</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>05</td>
<td>20</td>
<td>-15</td>
<td>225</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td>20</td>
<td>-10</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>45</td>
<td>-30</td>
<td>900</td>
</tr>
<tr>
<td>16</td>
<td>20</td>
<td>35</td>
<td>-15</td>
<td>225</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>40</td>
<td>-25</td>
<td>625</td>
</tr>
<tr>
<td>18</td>
<td>15</td>
<td>45</td>
<td>-30</td>
<td>900</td>
</tr>
<tr>
<td>Sum(total)</td>
<td>250</td>
<td>620</td>
<td>-370</td>
<td>10300</td>
</tr>
<tr>
<td>Mean</td>
<td>13.9</td>
<td>34.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ T = (Ed^2 - ([Ed]^2)/n)(n-1) \]

\[ = (10300 - [(-370^2)/62])/18 - 1 \]

\[ = [10300 - 136900]/18 \]

\[ = [10300 - 7605.6]/17 \]

\[ = 2694.4/17 \]

\[ = 158.5 \]

T critical = 2.898

T Calculated = 15.9

T calculated is greater than T critical therefore, I regret the null hypothesis.
t- calculated of 15.9 is greater than t critical of 2.898 therefore, I reject the null hypothesis. Thus, there is significant difference in between tests conducted before and after use of electronic, media, outside classroom environment and pupil centred learning.

Boys mean pre-test

\[ \text{Mean} = \frac{\sum x}{n} \]

\[ = \frac{250}{18} = 13.8 \]

Post –test

\[ \text{Mean} = \frac{\sum x}{n} \]

\[ = \frac{620}{18} = 34.4 \]

Mean mark for boys pre-test are lower than mean mark for post test on transformation. This indicated that learners did well in post test show cased that they had understood the lesson well. This however indicated that the test which was written before simulations and use of media was employed overalls indicated worse results. This is a clear indication that learners level of concept understanding improved with the improved learning environment through the use of electronic media. Jenkins cited in Harallambos and Holborn(2013) postulates that the internet provides the main means through which people can interact with each other in a participatory learning culture and build collective intelligence.

For girls mean for pre-test

\[ \text{Mean} = \frac{\sum x}{n} \]

\[ = \frac{170}{17} = 10 \]
Mean for post test

Mean=$\sum \times \frac{1}{n}$

=415\17

=21.5

The mean test for girls indicated 10 for pre-test and 21.5 for post test this shows that the test results greatly improved on post test thus, indicating the lesson delivered before post test made the concepts much easier that made learners to improve.

4.3 Qualitative results: Interviews for teachers.

4.3.1 Challenges faced by learners in transformation

When asked about challenging areas faced by learners one of the teachers says,’’……most learners have problems in describing transformations, multiplying image point by matrix using shear and stretch factors and distinguishing between translation and reflection when describing transformation.’’ This clearly indicates that learners have areas that they face difficulties in learning transformation. Another mathematics teacher asked also highlighted that most learners that she has identified have problems in identifying a translation as a transformation, identifying matrices and also states that learners tend to memorizematrix operators of transformation instead of identifying them through mappings and non mappings. The third teacher asked also stated that learners have difficulties in finding matrix of transformation and using it and also failing to state invariant lines of shear and stretch.

The above responses indicates that, although teachers explain to learners on transformation concepts yearly they noticed that learners often pose such challenges in transformation. Sometimes they develop their conceptions which might not lead them to proper concepts of transformation. Barba and Confrey(1996) state that, when learning a concept learners reconstruct the knowledge about that concept to their level of understanding and the resultant knowledge structure is not always the exact replica of concept definition stated in the books.
but something related to it. An incorrect image could be expected to give rise to a desirable solution.

4.3.2 Areas in transformation many learners face challenges

When asked about topics most learners face challenges 50% of them aired out that most learners are challenged by shear concepts, 25% of them by rotation and 16.7% by stretch and 8.3% enlargement.

4.1 Pie chart

Types of transformation

![Pie Chart](image)

Fig 4.3. Learners’ conceptions of the notion of shear and stretch transformation

When asked about learners conceptions of the notion of shear and stretch transformation 66.7% of the teachers interviewed state that, most learners confused matrices of transformation and that some think that shear and stretch are the same because both of them use invariant line and almost the same matrices of transformation. 33.4% of the teachers indicated that learners cannot differentiate on the concept of invariant line. Edwards (2003)
identified a particular misconceptions about rotations she found that instead of seeing rotation as mapping all points of the plane around a centre point, the student in her study expected the shape to slide to the given centre point and then turn around it showing that they had a hard time seeing rotation as occurring a distance from the object. This clearly indicates that some students develop misconceptions that misdirect them.

4.4.1 Ways of correcting students’ misconceptions.

Table 4.4

<table>
<thead>
<tr>
<th>Measures</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning aids</td>
<td>40%</td>
</tr>
<tr>
<td>ICT tools</td>
<td>30%</td>
</tr>
<tr>
<td>Environment use</td>
<td>30%</td>
</tr>
</tbody>
</table>

When asked on how misconceptions are corrected 66.6% of the teachers asked stressed on the need for the teacher explanation to be vividly aided by a variety of learning aids and use of I.C.T tools. Foster (2007) postulates that if learners are taught abstract ideas without meaning this might not develop their understanding. Nziramasanga commission (1999) also states that, teachers appear to have frequently become barrier to student’s understanding. The ‘o’ level textbooks also fail to present the content in such an elaborate way that could provide sufficient room for students to develop rational knowledge. This however shows that a lot of effort should come from an industrious teacher to make learning live and concepts clear.
33.3% of teachers interviewed stressed on the need to effectively use environment outside the classroom together with demonstration methods. Thus diverting from boring and strenuous environment of learning and the classroom.

4.4.2. Effective teaching methods on transformation topic.

**Table 4.5**

<table>
<thead>
<tr>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher exposition</td>
<td>Demonstrations</td>
<td>Discovery learning</td>
</tr>
<tr>
<td>Question and answer</td>
<td>Group/class discussions using square board</td>
<td>Individual presentations</td>
</tr>
<tr>
<td>Demonstrations</td>
<td>Discovery method</td>
<td>Group and class discussions</td>
</tr>
</tbody>
</table>

When asked about methods they used when delivering mathematics lessons on transformation a range of teaching strategies and methods were given. The methods range from rote learning up to high learner involvement types of methods. However, teacher A indicated the use of teacher centred methods citing on challenges of transformation of which different opinions were presented by other practitioners. On the need to incorporate learners as much possible so by doing one remembers most. Lu (2005) states that use of technology and new approaches do not replace the content or knowledge possessed by both teachers and learners, but rather enhances learning in the classroom. Thus, if practitioners make a wide selection of teaching approaches they enhance learning activities.

**4.5 When asked about addressing learners challenges following responses were given:**

**Table 4.6**

<table>
<thead>
<tr>
<th>Need of lesson evaluation</th>
<th>35%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remediation</td>
<td>30%</td>
</tr>
<tr>
<td>Staff development</td>
<td>20%</td>
</tr>
</tbody>
</table>
Of the responses given more emphasis was put on the need of lesson evaluation and preplanning of the lesson followed by remediation identifying those in need and work with them. Staff development sessions were also mentioned however, they stated that not frequently instead they prepared team teaching.

**4.6 Responses for learners’ interviews.**

**4.6.1 Challenges faced by learners in transformation.**

When asked about topics in transformation that were a challenge the following responses were produced:

| Table 4.6 |
|---------------|---------------|---------------|---------------|
| Enlargement   | Shear         | Rotation      | Reflection    |
| 5             | 10            | 6             | 4             |
| 14.7%         | 29.4%         | 17.6%         | 11.7%         |

29.4% of the learners indicated that they had a challenge in understanding shear thus, shear seemed to be more challenging to learners. Rotation had 17.6% which was equal to the percentage of those who find the concept of stretch transformation to be a challenge to them. Enlargement becomes the fourth with 14.7% followed by reflection with 11.7%. Translation seemed to be better to learners as compared to other topics in transformation.

When asked about the problems they were facing as learners in an effort to grasp concepts, following responses were made: 16.6% learners had some feelings that marking points, finding coordinates of image point given the matrix made their life difficult in transformation. 60% of learners highlighted that they face challenges in finding matrix of shear and stretch factor and
to understand what is invariant line or the concept of invariant line. 23.4% also postulated that they are challenged by how to find stretch factor and matrices for both shear and stretch. This clearly indicates that for sure transformation as a topic poses many challenges to learners.

4.6.2 Teaching methods employed in transformation

Methods used

4.7

<table>
<thead>
<tr>
<th>Teacher exposition</th>
<th>Learner Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>57.1%</td>
<td>42.9%</td>
</tr>
</tbody>
</table>

Most of the learners indicated that a number of lessons are delivered mostly with teacher centred approach. However, learners had a feeling that more should be done to involve them at most so that they learn by doing and also through corrections. 42.9% raised the idea that a number of instances they are involved however, there is need for teachers’ guidance handicap them, thus fail to grasp intended concepts. Nziramasanga commission (1999) states that it appears problems encountered by students are as a result of lack of conceptual understanding and might also be as a result of the teaching they experience in learning transformation.

When asked about what they think should be done to assist them understand better the following responses were made: Some learners highlighted on the need for maths teachers to commit extra time for them and accommodate different learner abilities. Other learners had a feeling of increased time allocated for mathematics on the time table to create time for remediation and extra work. Others had a feeling that teachers should stick to their business when teaching and wholly commit themselves to individual needs of every learner.

4.7 Summary
This chapter presented and discussed results from the analysis and interpretation of data collected in the research. From the analysis and presentation of findings it can be concluded that a need to be considered when delivering transformation topic in mathematics. Teachers need to consider differential learners ability and comprehension span so as to cater for individual differences, staff development for teachers is also a necessity to iron out their weaknesses.
Chapter five

Summary, Conclusions and Recommendations

5.1 Introduction

This chapter serves to present a summary of findings, conclusions and recommendations of the study. In an effort to analyze the learner’s challenges in the learning of ‘o’ level geometrical transformation concepts thus, fulfilling the purpose of identifying and summarizing the major areas of study chapter one to four.

5.2 Summary of research design.

This study is the investigation of learners’ challenges in learning transformation concepts. The objectives were:

a) To identify challenges faced by learners in transformation

b) To identify student’s conceptions of the notions of shear and stretch in transformation.

C) To determine effective teaching methods and aids that can be employed in the teaching and learning of transformation.

The research study used mixed method of research whereby qualitative and quantitative research designs were used because data intended and involved the need to extract deep opinion in individuals as regarded to the challenges faced by learners in transformation. Under the qualitative aspect interview was employed. While quantitative design the researcher administered pre-test and post-test, where aspects of descriptive statistics were employed giving the research dimension and not strictly rendering it a qualitative design. The research design found to be the best because it allows the researcher to interact with participants and it
permits the use of interviews to collect detailed information. The study sample comprised of teachers and learners with a target population of 170 form four learners and 6 teachers.

5.3 Discussions of major findings

Teachers have indicated that learners are challenged with transformation other than other mathematics topics. Practitioners pointed out that most learners face challenges in describing transformation, multiplying object by a given matrix. Using shear and stretch factors and distinguishing between translation and reflection.

Most teachers highlighted that most learners confuse matrices of transformation and that some think that shear and stretch are the same because both of them use invariant line and matrices of transformation.

Edwards (2003) identified a particular misconception about rotations and she found that instead of seeing rotation as mapping all points of the plane around a centre point, the students in her study expected the shape to slide to the given centre point and then turn around it showing that they had a hard time seeing rotation as occurring a distance from the object. The teacher also highlighted that; misconceptions can be corrected through on the need for the teacher explanation to be vividly aided by a variety of learning aids and use of ICT tools. Foster (2007) postulates that learners are taught abstract ideas without meaning this might develop their understanding. Results showed that Mathematics teachers should try and commit extra time for them and accommodate different learners’ abilities other learners had a feeling of increased time allocated for mathematics on the time table to create remediation and extra work.

Student t-test revealed that the t-calculated of 12.91 hence null hypotheses was rejected. Results from interviews made indicated that a lot need to be done to improve concepts comprehension of transformation topic. Mean mark results for pre- test are lower than mean mark for post test on transformation for boys. This indicated that learners did well in post test showing that they had understood the lesson well. This indicates that a variety of activities should be used to make concepts much clear.
5.4 Recommendations for this study

The following recommendations can therefore be made as a result of the study. Teachers are encouraged to identify learners challenging areas so as to know how to remedy them. Teachers are also encouraged to staff develop one another in order to keep check braised with the new techniques and concepts. Teachers are encouraged to use variety of learning methods and aids in an effort to make lessons and concepts easy and understandable. They must also identify learners’ misconceptions on topic under study and be able to iron out them. Learners must be given a chance to air out their grievances on topics so that teachers will be able to evaluate and use suitable teaching methods. Practitioners are encouraged to engage on team teaching and assist each other in areas they are not strong at and also to research and read widely so that they empower themselves with necessary concepts and knowledge.

5.5 Conclusion

Basing on the study objectives, sub questions and the view of findings drawn on the challenges of learners in transformation topic, the study concluded that scarcity of resource and the use of old textbook caused high failure in transformation topic. It can also be concluded that some practitioners are challenged by transformation therefore, the need for staff development and team teaching. It has been observed that the use of outside classroom environment and a variety of learning aids improve learners’ concept comprehension. One can concluded that, remediation and extra work is essential for lesson concepts comprehension especially for slow learners.
References


Corley, L. (1990) Student’s levels of thinking as related to achievement in geometry. New Jersey:


