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DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

FACULTY OF SCIENCE EDUCATION

THE IMPORTANCES OF USING MATHEMATICAL INSTRUMENTS IN THE TEACHING AND LEARNING OF 'CONSTRUCTION' IN MATHEMATICS. A CASE OF A RURAL SECONDARY SCHOOL IN MASHONALAND CENTRAL PROVINCE IN BINDURA DISTRICT

A DISSERTATION REPORT BY

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The undersigned certify that they have read and recommend to Bindura University of Science Education for acceptance, a dissertation entitled; “The importances of using mathematical instruments in the teaching and learning of ‘construction’ in Mathematics . A case of a rural secondary school in Mashonaland Central in Bindura District," submitted by KARISE SAVIE (B226449A) in partial fulfilment of the requirements for Bachelor of Science Education Honors Degree in Mathematics.

STUDENT	DATE
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DEDICATION

This project is dedicated to my Husband Evans Mtandwa, my brother Innocent Karise and my lovely mother Kuzvindiwana Annatoria for the love and support towards my goal.

ABSTRACT

The study investigates the importances of mathematical instruments in the teaching and learning ‘construction’ in Mathematics in rural areas. The study employed a qualitative research approach which utilized a case study research design. The sample of the study included four administrators, two Mathematics teachers and thirty-eight students. Questionnaires and interviews research instruments were used to collect the required information. The collected data were analysed by employing descriptive statistics. The findings revealed that the use of mathematical instruments is very important in the learning and teaching of ‘construction’ especially in rural areas where there are low income schools. Also, basing on the findings the students and staff were aware of problems which affects the learning of mathematics in general and construction in particular. From this research it is evident that providing mathematical instruments as a school is very helpful in educating the low income society , offering incentives to teachers and increasing the number of mathematics teachers can go a long way in improving the learning and teaching of construction in Mathematics in rural areas.

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I thank the Lord Almighty for his grace and mercy that have allowed me to successfully complete this study. It is also my great honour to give thanks to my supervisor who have been very patient and providing his skills and knowledge in guiding me through this dissertation. I would also want to extend my gratitude to all the respondents at Mazunga Secondary School who provided all the required information necessary in conducting the study. Above all I would like to thank my family for their untiring support during the course of the study.

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DEDICATION

This project is dedicated to my family for all the support, guidance, and encouragement throughout my life. Without you, my academic success would not be possible. Especially to my mother who made sure that I received the best education possible and for raising me in the best environment a daughter could ever ask for. To my father, who always stood by me when I needed him the most, and to my big brothers for their encouragement. I am forever in debt to you.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter highlights the background of the study, problem statement, objectives, research questions, justification, delimitation and limitations on the benefits of Mathematical instruments (Mathematical set) in the teaching and learning of 'construction' in Mathematics in rural areas. A case study of Mazunga Secondary School in Bindura District.

1.1 Background of the study

STEM (Science, Technology, Engineering and Mathematics) is currently a buzzword in school education in many countries worldwide (H. Chitate 2016). In Africa STEM is seen as the panacea for economic challenges facing the African countries. In Zimbabwe Some senior educationists within the Ministry of Primary and Secondary Education has decidedly convinced that STEM provides the optimum environment for the development of invaluable competencies such as problem solving, critical thinking, creativity, team work, communication skills and conflict resolution (Ministry of Higher and Tertiary Education, Science and Technology Development, 2016). These skills are deemed to be very important for socio-economic transformation of the country, hence should be developed among all students.

The slogan, "IF WE STEMITISE, WE INDUSTRIALISE", by the Zimbabwe Manpower Development Fund (ZIMDEF) testify that the study of STEM subjects will result in the industrialisation of the economy and will also create employment (Mberi and Phambili,

2016). The STEM project has been positively accepted by many parents and students. Against this background, there are a lot of challenges likely to impede the implementation of this innovative project, particularly in Mathematics which is one of the component of the STEM (Ncube, 2016).

There has been a challenge in the teaching and learning of Construction in Mathematics in Zimbabwe, particularly in rural areas. Most rural schools in Zimbabwe do not have enough Mathematical instruments (Wanjala Aurah, & Symon, 2015). Worst still some don't even have qualified teachers to teach Mathematics subject (Hattie 2013). The world has been evidenced with promotion of science subjects under the umbrella of STEM (science, technology, engineering and mathematics). Most schools, particularly those in rural areas have for years experienced serious challenges in the learning of this topic of construction as they do not have enough mathematical instruments. There is shortage of instruments which made Mathematics learning difficult for the pupils as they could not grasp the concepts (Donnelly, 2018). Mathematical instruments make the subject easy to comprehend by having practical experience. The situation is even worse for some schools which also do not have Mathematics teachers. (Smith & Robinson, 2020).

In 2015, with the support of UNICEF, most rural schools were supported with some Mathematical instruments like Meter rulers, big protractors, big compasses and set squares. The motive was to help the disadvantaged rural learners to solve mathematical problems practically Especially the topic of construction. The initiative by UNICEF to support the low income schools has seen an improvement in the learning of Mathematics in rural areas. This initiative has gone a long way in supporting government policy to promote the STEM program. It is therefore, apparent to establish the impact of mathematical instruments found in Mathematical set in the teaching and learning of Construction in Mathematics in rural areas.

1.2 Statement of the problem

The introduction of new curriculum in October 2014 dubbed 'Zimbabwe Curriculum Blueprint' spanning from 2015 – 2022 has been earmarked on the development of Stem Subject in Zimbabwe. However, the implementation of the STEM program has been affected by lack of qualified teachers and inadequate equipment and facilities among others. Especially the needy learners in remote areas who does not afford to buy personal Mathematical sets. It becomes very important to establish the effect of mathematical

instruments like those found in the mathematical set (set square, ruler, protractor, divider and compass on the teaching and learning of construction in Mathematics in rural schools.

1.3 Objectives of the study

The main purpose of the study is to discover the importances of using Mathematical instruments (mathematical set) in the learning and teaching of 'Construction' in Mathematics in rural schools. Precisely, the study sought to:

a) Find out the problems faced by pupils in learning Mathematics in rural area specifically the topic of construction.

b) Identify the benefits of mathematical instruments in the teaching and learning of Construction in Mathematics in rural area.

1.4 Research questions

The following research questions guided this research:

1. What are the problems faced by pupils in learning Mathematics?
2. What are the benefits of these mathematical instruments in the teaching and learning of 'construction' in Mathematics?

1.5 Significance of the study

Studying the impact of mathematical instruments in the learning and teaching of the topic of Construction in Mathematics in rural areas, is important for several reasons. Mathematics teachers will benefit from understanding the results of this study. The study will prompt school authorities and all the stakeholders to do all things possible to invest in the provision of Mathematical equipment and facilities to better the learning and teaching of Mathematics in all the schools in the districts. Lastly, the findings of the study would contribute to academic knowledge and would be of great benefit to those who have the zeal to further research on Mathematics facilities and their effects extending and strengthening the evidence base for decision.

1.6 Assumptions of the study

The study assumes that;

- All the students do Mathematics.

- All the students can read and write.

1.7 Delimitations of the study

The research will be a case study of Mazunga Secondary School in Mashonaland Central province. The focus of the study is on the importances of the Mathematical instruments (mathematical set) in the learning and teaching of construction in Mathematics in rural areas, and it is going to make use of data obtained from this research to conclude and establish whether the use of mathematical instruments beneficial in the learning and teaching of Mathematics in rural areas in Zimbabwe. The main target populations of the study are both learners and teachers and administrators at Mazunga Secondary School in Bindura District.

1.8 Limitations of the study

For the fact that this study is restricted to Bindura District, it is not certain if the same results would be obtained if the survey is done on a different area for the fact that the questionnaires as well as the survey design used as the instrument and research design respectively will be different. It will be not certain if other kind of instruments as well as research design will yield the same results.

Other limitations arise from the uncooperative attitude of some respondents as well as their non-challan attitude. This will affect the validity of their response. As such incoming students as well as individuals who may wish to conduct a further research should take this into consideration.

1.9 Definition of key terms

Mathematics – it is the science that deals with the logic of numbers, shapes, pattern, quantity and arrangement. It is a field of study that discovers and organizes methods, theories and theorems that are developed and proven for the needs of empirical sciences and Mathematics itself. (Engzell et al 2021).

Mathematical instruments – these are tools or devices used in the study or practice of Mathematics. (Mainali, B. 2021).

Mathematical model – Oxford secondary school dictionary (2010) defines a mathematical model as an abstract description which refers to authentic objects from real life that one uses

in the classroom to teach a specific concept. It can be both physical and virtual, as long as it is something used in the real world.

1.10 Summary

This chapter has highlighted the background of the study, problem statement, objectives, research questions, justification, delimitation and limitations. The next chapter reviews literature related to the benefits of mathematical instruments in the teaching and learning of construction in Mathematics in rural areas.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter critically analyses literature relevant to benefits of mathematical instruments and models in the teaching and learning of Mathematics in rural areas. It will examine different issues such as theoretical framework, conceptual framework, empirical studies and research gap on the benefits of mathematical instruments and models in the teaching and learning Mathematics in rural areas.

2.1 Theoretical Framework

Yadav (2017) define Mathematics as a way of knowing or a method that involves disciplined inquiry in the creation of knew knowledge. One of the most critical issues in mathematics education is what determines quality teaching and learning. UNESCO (2013) identifies quality teaching as one of the mast important elements in the improvement of education. Effective successful teaching of mathematics can be measured by what the teacher does, by what students become after teaching and by the interaction between the teacher and student (Lessani, Yunus, and Abu Bakar (2017). It is important to note that mathematics requires active learning techniques such as group problem solving, problem based learning and the use of case studies. These active and innovative teaching methods or techniques provide a much more effective environment in which students can learn; hence mathematics teachers should have some novelty skills in planning and organising lessons.

2.2 Problems faced by pupils in learning 'Construction' in mathematics

Mathematics inhabit a dominant position in the growth and progress of the nation. It helps in developing progress that leads to the advancement and success of a country. Despite the positive feedback of studying mathematics education, it has been observed that learners are fearful of studying the subject (Das 2019). This implies the negative attitude and poor performance of learners in learning mathematics.

In a study on the challenges encountered in the teaching and learning of mathematics in rural schools in South Africa, Mtsi and Maphosa (2016) identified lack of resources for mathematics teaching, learners' background, language of instruction, and lack of parental support among the factors affecting mathematics learning.

Mathematics educators in the early 21st century are facing a myriad of issues. Indeed, students in Africa still lag behind students in other nations in mathematics achievement, particularly European and Asian countries (National Center for Education Statistics, 2017). Some of the complex issues in the field of mathematics education include the availability of appropriate textbooks and classroom resources; the preparation and training of mathematics teachers (including both pre-service training and in-service professional development); political and religious opposition to cutting-edge mathematics instruction; the need to meet standards and to prepare students for standardized examinations; and the dramatically increasing use of the internet as a source of information. (Hessan et al, 2016)

Hattie (2013) echoed that, the teacher is the single most important source of variation in the quality of learning. The supply, development, and retention of good mathematics teachers is therefore of paramount importance. Research on teacher supply has tended to focus on how to attract potential applicants, and thus on their intentions and judgments. Undergraduates have been the main target, perhaps because potential mature entrants are more difficult to reach (Ghavifekr and Rosdy, 2015). Studies show that the proportion of undergraduates willing to consider teaching seriously has broadly declined over the last decade. Despite this decline, potential teachers' judgments on the character of the job are comparatively stable. Students are often central to the attraction of becoming a teacher. The possibility of 'making a difference', of enthusing students and of working with people, rather than with money or things, are important motivations to teach. Undergraduates often cite the influence of their own teachers on them as students. This shows that there is a large pool of goodwill available.

But potential teachers are often concerned about their ability to control classes, and that they will be unsupported in doing so.

It is quite often that in classrooms the student's voice is silent, except in giving rote answers to questions from their teacher. Teachers spend most of their time teaching knowledge-based mathematics in a learning environment that ignores their students' experiences and provides few opportunities for conceptual development. Students do not fully engage mentally in classroom because teaching and learning do not fit into their range of experience and because their voices might often be unheard. Students are viewed as knowledge consumers. When students are viewed only as consumers, their voices are often reduced to responses to the questions of teachers who know the "right" answers in advance and what is expected of them, silencing student critical thinking and creativity (Alghamdi, 2017)

Smithers and Robinson (2010) argued that teacher training targets in the sciences have been missed regularly, but since figures are not differentiated across the disciplines, and published figures on vacancies are somewhat uninformative, the impact is difficult to trace. The story on supply clearly varies between schools, regions and disciplines. Schools in challenging circumstances often have greater difficulty in recruiting and retaining specialist teachers. The impact of this differentiation on teaching quality is likely to be negative. Polarisation is particularly visible in physics, the major 'shortage' subject, but extends more broadly.

Idiaghe (2014) states that accessibility with the resources and academic efficiency among students are strictly connected. The inadequacy of resources could lead to unproductivity among learners. Students in institutions with scarce instruction and learning amenities performed lower, unlike their counterparts in schools with enough facilities.

Anderman and Sinatra (2012) stated that some of the challenges in the field of mathematics education include the unavailability of classroom resources, appropriate textbooks and the preparation and training of mathematics teachers, religious and political opposition to cutting-edge mathematics instruction, the requirement to meet standard and to formulate students for standardized examinations, and the dramatically increasing information using the internet as a source. Given these and other problems, it is tremendously important to understand, recognize, and build upon the abilities of adolescent learners, while at the same time tailoring instruction to address the exclusive challenges faced by this age group.

According to the study of Tomaro (2018), the quick advancement in mathematics, newly recognized societal and cultural norms and values, and changes in the climate and

environment, as well as the depletion of natural resources all significantly impact the lives of children and youths, and hence their ways of learning, viewing the world, experiencing phenomena around them and interacting with others. These changes challenge mathematics educators to rethink the epistemology and pedagogy in mathematics classrooms today as the practice of maths education needs to be proactive and relevant to students and prepare them for life in the present and in the future.

Science and Mathematics education in all levels of schooling is consistently seen as abstract and irrelevant to real-life situation. Students in biology and chemistry are burdened with memorization of truths, and students in physics and mathematics feel that their discipline contents are abstract and cannot relate these materials to the real world. Students in all-purpose fail to see that science is in nature all around them and the scientific method is widely appropriate in different aspects of their lives (Zengele and Alemavehu, 2016).

Unal (2017) further stressed that mathematics is an important subject at upper primary level and understanding of basic mathematics concepts increases the content knowledge of the teachers and students. But for some time teachers faced the difficulties to understand some mathematics concepts. Also they had occurred difficulties to teaching some mathematics concepts. If these concepts which are difficult to understand for the teachers, it will be transferring towards students incorrectly and it will create many alternative conceptions. In order to teach today's mathematics concepts, teachers need to understand subject matter deeply and flexibly so they can help students create useful cognitive maps, relate one idea to another, and address alternative conception (Basargekar and Singhavi (2017). Teachers need to see how ideas connect across fields and to everyday life. This kind of understanding may provide a foundation for pedagogical content knowledge that enables teachers to make ideas accessible to others, to be aware of the conceptual problems of the teachers (Smithers and Robinson, 2014).

2.3 Relevance of using mathematical instruments in the teaching and learning of Mathematics.

A mathematical instrument is a tool or a device used to visualize mathematical concepts, explore mathematical relationships, measure and calculate mathematical quantities and

demonstrate mathematical principles. There are several types of mathematical instruments like Geoboards which explore geometry and patterns, pattern locks which helps in understanding symmetry and tessellations, protractors used to measure angles, compasses which helps in drawing circles and arcs, rulers which are used in measuring and making lines , set squares for drawing angles and shapes, calculators for performing calculations and also graph papers for plotting coordinates.

The use of mathematical instruments enhances understanding in various forms like visual aids. Models and instruments help students visualise complex concepts. It also enhances understanding in the form of hands-on-experience. Students learn by manipulating instruments, fostering deeper understanding. Moreover, on the concept of enhancing understanding, there is also the aspect of Concrete –representational-abstract (CRA) approach. It implies that instruments bridge gap between concrete and abstract math concepts.(Alemu, 2015)

The use of mathematical instruments improves engagement through interactive learning, real world connection as well as collaborative learning. It also develops problem solving skills because of experimental learning, critical thinking as well as spatial reasoning. Mathematical instruments help learners to overcome resource constraints because of cost effective concepts since simple locally-made instruments can replace expensive ones (Spencer-Smith and Hardman ,2014). Accessibility as they can be shared among learners and also contextual relevance as locally-relevant models and instruments connect math to students' daily lives.

The use of mathematical instruments helps to build confidence, this is due to tangible results that can be obtained by learners, there is also sense of accomplishment. Students develop pride in their work. It also reduces math anxiety because hands-on-experience alleviates fear and anxiety. Mathematical instruments and models are also relevant in the process of teaching and learning because it prepares for assessments. This is due to familiarity with instruments as students become comfortable using instruments for exams. Also the practical application helps students to apply theoretical knowledge and also improves performance which lead to better exam results.

The idea of making use of what is freely available using human and natural resources is not new. Rousseau (2019) argues for education based on experiences and the senses, rather than based on textbooks and academic imparting of knowledge. George (2017) notes that in the reconstruction period after World War II teachers in Central European schools were forced

through circumstances to draw on their experience to construct appropriate teaching aids from locally available materials. Nevertheless, mathematical instrument is worth being used in Physics practical work to improve the learner's achievement. Apart from teaching method/ strategy used by the teachers in teaching the students; school type may be implicated in students' acquisition of mathematics process skills.

2.4 Ways to improve the teaching and learning of 'Construction' in Mathematics in rural area

According to Adeniyi (2012) the possibility of internships in which students are afforded opportunities to engage in real scientific practices under the supervision of professional scientists provides a unique opportunity for adolescents. Research from evaluations of undergraduate research experiences (UREs) has demonstrated their effectiveness in building student's appreciation for both the content and process of Mathematics. Apprenticeship learning has been shown to be effective with adolescents as young as middle scholars when properly structured to support "doing authentic science 'at the elbows' of real scientists (Rabiu, & Saidu,2018).

According to Omuna et al. (2016), improving Mathematics education by emphasizing scientific inquiry, the education and mathematics communities are challenged to transform students' experiences into mathematics classrooms. New approaches to mathematics teaching feature inquiry as essential for student learning. These approaches assume that students need to find solutions to real problems by asking and refining questions; designing and conducting investigations; gathering and analysing information and data; making interpretations, creating explanations, and drawing conclusions; and reporting findings. Throughout improving the practices of mathematics teaching, students learning is expected to be more active and relevant that will improve their achievement. However, poor performance on national and international tests, high dropout rates, lack of preparedness, and other pressing educational problems are still evident as an existing problem in massive efforts to realign approaches to excellence and equity (Njenga, 2014).

According to Alexander's Model of Domain Learning (Alexander, Jetton, & Kulikowich, 2015), students need to move toward the proficiency stage of knowledge development before

they have sufficient knowledge with which to reason critically. Therefore, teachers must determine the level of their students' background knowledge, as well as identify misconceptions and alternative conceptions before each new topic is broached. A host of knowledge building techniques can assist teachers in their efforts to shore up students' requisite background knowledge. Collaborative environments such as Knowledge Forum (Scardamalia & Bereiter, 2013) capitalize on the preference of adolescents to work in socially engaging environments. The goal is for classroom structures to promote a knowledge-centred environment designed to develop understanding and facilitate knowledge transfer.

NRC (2000) postulated that secondary teachers are trained in mathematics as a discipline. They tend to have undergraduate degrees in discipline specific domains such as chemistry, biology, and physics. Their content knowledge allows them to model thinking and acting like a scientist in their discipline and affords an opportunity for supporting students in domain-specific inquiry.

The depth and breadth of the content in secondary mathematics classrooms enhances mathematics teachers' opportunities to build on previous topics touched on in earlier learning progressions. In particular, higher order thinking and conceptual change will be promoted in adolescent mathematics classrooms if teachers do not treat each mathematics course as a mutually exclusive, discrete class; rather, teachers must work more collaboratively so that information learned in one mathematics class is reviewed and reinforced in subsequent classes (Scardamalia & Bereiter, 2013).

Schunk and Ertmer (2017) put forward that mathematics educators can support the development of self-regulation in their students in several ways. First and foremost, students must be allowed to have some control over how they learn or process mathematical instruments. Self-regulation is by definition a "self" controlled process; when maths curricula are tightly regulated and prescribed by the teacher (offering students little flexibility) students are unlikely to engage in self-regulatory behaviours (Pintrich, 2014). Second, educators must encourage students to evaluate their work as they progress (Paul 2015). If students do not stop and reflect on whether they are reaching their goals, then they often will not attain their goals, particularly if they do not adjust their strategies when necessary.

Inquiry-based mathematics teaching should put emphasis on student voices as a central place in the learning process. This occurs in learning when students pose questions, gather and analyse evidence and construct arguments based on it, and communicate their findings to

others (Mamman and Isa, 2018). Furthermore, science learning need to be connected with existing student's life so that students feel that mathematics is practical, familiar with the beliefs and practices of their lives.

Engaging students in learning via a need learning environment may ensure that student could develop their personal involvement in fulfilling their needs. However, researchers and reformers recognize that what is missing in reform strategies is the creation of a personalized environment that promoting students' engagement and caring student–teacher relationships (Awoloja, 2016). Moreover, students' interest in learning mathematics has to come from their own "concerns, interests, and experiences". Otherwise students will feel that learning mathematics is not a priority unless mathematics learning is an extension of their community activity. It has also been discovered that currently, mathematics learning in schools does not serve the needs of students so that students' lack of interest occur and mathematics is often perceived as a difficult subject.

2.5 Role of Practical work in the teaching and Learning of 'Construction) in Mathematics

Analysts differ in their opinions about the purpose of practical work because of their different views about learning theory. Ameyaw (2019) argue that practical work experiences help students establish the accuracy of their beliefs as well as providing them with direct experience with concepts. Anaduaka et al (2018) suggests that practical activity does not fulfil the various functions expected of it, except perhaps for the development of manipulative skill. But better manipulative skill hardly seems a sufficient return for the resources committed to practicals. Practical work in the teaching and learning of Mathematics enhancing understanding, engagement and retention. Some of the roles include,

cognitive roles - such as Conceptual understanding, Practical work help students grasp abstract math concepts. Under cognitive roles there is also Problem solving, hands-on experience develops critical thinking and analytical skills. there is also Visualisation, practical work aids in visualising mathematical relationships and patterns.

Affective roles, such as Motivation – practical work sparks interest and enthusiasm for Mathematics. Also Confidence – Hands-on success builds students' self –assurance in math abilities. There is Reduced anxiety – practical experience alleviates math anxiety.

Psychomotor roles, such as Fine motor skills – manipulating materials develops hand-eye coordination and also Spatial awareness – practical work enhances spatial reasoning and visualisation.

Social roles such as, collaboration. group work fosters communication, team work and social skills. Also there is discussion which encourage peer to peer discussion and explanation. Apart from social roles, there is **Assessment roles** such as formative assessment which informs teachers about student's understanding and also summative assessment which evaluates student's mastery of math concepts.

A study on Philipines carried out by Lockheed et al (1989) showed small positive benefits of practical work, but other strategies such as small group teaching and frequent testing had a larger effect. Apondi (2015) asserts that mathematical practical work is an accepted part of science instruction. Given its important place in the education of youth, it is surprising that we know so little about its functioning and effects. Rosenshine (2012) points out that practical mathematics in schools is often perfunctory and follows a recipe approach. A great deal of practical w o r k is in reality aimed at proving or verifying facts already taught in theory work.

2.6 Empirical studies

Sherman and MacDonald (2008) carried out a study on the role of practical work in the teaching and learning of mathematics at school level. This study shows that practical work is an essential component of mathematics teaching and learning, both for the aim of developing students' mathematical and scientific knowledge and that of developing students' knowledge about mathematics. Practical work of a more open-ended, investigative kind can develop students' tacit knowledge of math enquiry. It is, however, hard to argue that this kind of knowledge is needed for 'mathematics and scientific literacy', though it is clearly of value to students who wish to follow more advanced courses in mathematics. Attempts to include investigative practical work in the mainstream curriculum often result in practice that is disappointingly different from that intended, especially when students' performance of investigative tasks forms part of the course assessment.

In their study, Gudyanga et al (2013) seeks to expose what innovative teaching there is in the Zimbabwean mathematics teaching context, as well as what opportunities and what challenges there are. Science and Mathematics is the mother of all technology hence no

sustainable development can take place in any country without talking about mathematics and science.

2.7 Gap analysis

Most researchers have looked into investigated issues related to the benefits of mathematical instruments in the teaching and learning of Mathematics in rural areas. Most of these researches where done in schools operating in towns and developed countries. However, this study is different from other research studies because it analysis the benefits of mathematical instruments in the teaching and learning of mathematics in rural areas. This study is also being carried out in Zimbabwe at a rural school.

2.8 Summary

This chapter has highlighted literature relevant to this study. It examines different issues such as theoretical framework, conceptual framework, empirical evidence and gap analysis. The next chapter will look at research methodology.

CHAPTER 3

3.1 INTRODUCTION

This chapter focuses on explaining procedures that the researcher used in gathering and analyzing data on the importances of using mathematical instruments in the learning of 'construction' at form three level. The elements covered in this chapter are the research design, target population , sampling methods and techniques , sample size , data collection methods and data collection procedures , validity and reliability as well. Justification of the selected methods of questionnaires and interviews techniques will also be provided.

3.2 Research approach

In this study the researcher adopted both qualitative and quantitative research approach. In this mixed methodology, the quantitative and qualitative parts fit to complement or enable the attainment of the overall programmatic research goals (Ameyaw, 2019). According to Gichochi (2014), the researcher is able to collect the two types of data simultaneously. It provides a study with the advantages of both quantitative and qualitative data. By using the two methods a researcher can gain perspectives from the different methodologies. Mischo and Maab (2013) adds that, in qualitative research the questions often ask not only for information and opinions but also allow the interviewer to probe the richness of emotions and motivations related to the topic. The same author adds that researchers often use qualitative data to help clarify hypotheses, beliefs, opinions, attitudes and motivations... qualitative work is often a first step because it enables a researcher to fine-tune the language that will be used in quantitative tools (Mischo and Maab (2013). Shields and Singhavi (2017) say qualitative

methods were used when a question needed to be described and investigated in some depth. Qualitative research was however, sometimes subjective in nature and calls for examining reactions and perceptions in order to gain understanding of social and human activities (Drijvers, 2013). According to Tomaro (2018) qualitative methods are an in-depth investigation into an individual or group or institution aimed at determining the varieties and relationship among variables influencing a current behaviour or status of the subject to be studied.

3.3 Research design

According to Mamma & Isa (2018) a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, a research design is the plan for the collection and analysis of data (Burns and Grove, 2017). As such research design includes an outline of what the researcher will do from formulating the research question, its operational implications to the final analysis of data (Mamman & Isa, 2018). This study adopted the descriptive survey research design. Anaduaka et al, 2018) points outs that descriptive studies are primarily concerned with finding out "what is." Put differently, this study adopted a descriptive survey research design as it involved gathering data to assess the importances of using mathematical instruments in the teaching and learning of construction at form three level.

3.4 Population

Collis and Hussey (2015) observe that when conducting research, the first step is to define the population to be studied in terms of its geographical, demographic and other boundaries to decide whether it should be fully or partially covered. A study population or target population, therefore, refers to the group about which the researcher wants to gain information and draw conclusions‖ (Vans, 2014). According to (Stewart ,2014), a population is a group of units or objects considered potentially useful in the dissemination of required information for the research understudy. In other words, a population is the entire pool of possible subjects that have some common characteristics that are of interest to the researcher (Levis, 2016). In this study, the target population comprised of 2 Mathematics teachers and

38 form 3 mathematics learners at Mazunga Secondary School. The class is going to be divided into 2 groups, the first group is going to be taught the topic of construction using mathematical sets , while the other group , the teacher is going to use the traditional method of just teaching without the mathematical instruments.

3.5 Sample size

A sample size is the number of respondents who are required to participate in the survey in order to ensure statistically valid conclusions (Stewart, 2014). Animum (2014) say the ideal sample should be large enough to serve as an adequate representation of the population about which the researcher wishes to generalize and small enough to be selected economically in terms of subject availability and expense in both time and money. The researcher determined the sample size for pupils based on 10% minimum threshold as suggested by Mugenda & Mugenda (2013). A sample size of 2 teachers and 38 learners were administered with the questionnaires. Both teachers were interviewed as depicted.

3.6 Sampling

Sampling is the act or process of selecting a suitable representative part of a population for the purpose of determining the characteristics of the whole population (Perves, 2017). Put differently, it is a finite part of a statistical population whose properties are studied to gain information about the whole population (Salaria, 2019). In this study it was not possible to collect or analyse all the data available in the population due to restrictions of time, money and often access (Chiromo, 2016). For this reason, a small group of participants was chosen from the population and this formed the sample. Tuckman (2021) argues that it is legitimate to generalize conclusions derived from responses obtained during field experiments provided the sample reflects the subject from the target population and for whom results were to be generalized in the wider population. The crucial question Tuckman (2021) argues is whether a sample respondents 'particular characteristics differ from those of other people but rather whether such differences matter.

To select participants in the learners 'category, the researcher used purposive or judgmental sampling to identify the learners that responded to questionnaires. According to Mberi, N and Phambili (2016) in purposive sampling, the researcher uses his or her own judgment about which respondents to choose, and picks those who best meets the purposes of the study. According to Alvi (2016) non-probability sampling is also known as judgement or non - random sampling where every unit of population does not get an equal chance of

participation in the investigation. Kombo and Mtsi, and Maphosa (2016) note that judgmental sampling is based on the assumption that the investigator wants to discover, understand and gain insight and therefore has to select a sampling technique that best addresses what s/he wants to discover. The study sought to use this method because it was able to capture the required information without being rigid in approach (Vans, 2014).

The justification of purposive sampling was that the researcher knew the school and its setups. She was aware of the people who could possibly provide the needed information. According to Wosenga (2020), purposive or judgmental sampling occurs when one selects the sample on the basis of one's knowledge of the target group and the nature of the research aims.

3.7 Data gathering instruments

According to Leedy and Ormrod (2014:52) a data gathering tool is a device used by the researcher to collect data, to answer the research questions as well as an instrument designated to measure knowledge, attitude and skills of a study population. The instruments can be questionnaires, interviews, observations, document analysis, desk research or field research (Abawi 2013). In this study of investigating the importances of using mathematical instruments in the teaching and learning of construction, the data gathering tools that were used were questionnaires and face to face interviews.

3.7.1 Questionnaires

A questionnaire is a research instrument consisting of a list of questions that a number of people are asked so that information can be collected about something (Leedy and Ormond (2014:36). Abawi (2013) defined a questionnaire as a data collection instrument consistent of a series of questions and other prompts for the purpose of gathering information from respondents. Most often, this method of data collection is used to gain statistical data that can serve as the basis for scientific research (Adler, 2024). Woolfolk (2014) notes that a questionnaire is a method of obtaining specific information about a defined problem so that after analysis and interpretation, it results in a better appreciation of the problem. The questionnaire was used in this study as it provided varied amounts of appropriate and easily comparable data at a low cost per respondent (Leedy and Ormond, 2014). Secondly, the questionnaire provided a reliable, practical and effective way of collecting data from a large sample size, that was easily managed by the researcher (Adler,2017). Considering that the teachers and learners at Mazunga Secondary were busy with the teaching and learning

process, questionnaires were easy in that they could be dropped off and collected later. Thirdly, the questionnaires made it easy for the respondents to have the freedom of private response to more personal questions as they were provided with enough time to answer the given questions (King, 2016)

Questionnaires work best with standardized questions that would be interpreted the same way by all respondents (Leedy and Ormond, 2014). Among some notable disadvantages of using questionnaires were that some respondents could not be found in their respective schools when questionnaires were administered (O'Leary, 2012). Another disadvantage is that questionnaires may be misplaced, torn or lost in some cases (Gurbuz and Sahin, 2014). These issues reduced the likelihood of having a 100% on questionnaire returns. As such the researcher had to put measures in place such as using colleagues to monitor the questionnaire respondents who were learners in this case. Some learners could have simply rushed to fill in the questionnaires without fully understanding the meaning of the questions. It was, therefore, difficult to fully know the conditions in which questions were answered but the researcher could only hope that all ethical procedures were followed.

3.7.2 Interviews

Participants within the teacher category were interviewed. Pahi (2017), defined interviewing as a way of uncovering and exploring the meanings that underpin peoples' lives, routines, behaviours and feelings. O' Leary (2022) says face to face interviewing is a type of qualitative research that combines immersive observation and directed one-on-one discussions. Interviews were done in an informal setting or whatever settings were comfortable with the teachers, provided all research ethics were followed (Awoloja, 2016). Through interviews the teachers' views, opinions and experiences were noted.

The advantages of interviews were that it was possible to probe more deeply and make follow ups on questions (Salaria, 2022). According to Boyce and Neale (2016) the primary advantage of in-depth interviews was that they provided much more detailed information than what is available through other data collection methods, such as questionnaires. They also provide a more relaxed atmosphere in which to collect information (Babbie and Mouton, 2021). The teachers felt comfortable having a conversation with the researcher about their programs and teaching as opposed to filling out questionnaires.

Just like any other data collection instruments in-depth interviews have drawbacks. Interviews are prone to bias, they are time intensive in the collection and transcribing and

analysis of the collected data. Interviews need a skilled interviewer to get good results and the results from interviews are not generalizable to the whole population (George, 2017). To mitigate these drawbacks of interviews the researcher limited the interviews to the five teachers so as to reduce on the time to be expended on transcribing. The interview guide was used to avoid some instances where some respondents strayed from the subject matter. Furthermore, the researcher triangulated data collection methods to offset some of the noted cons of interviews (Inyang, 2017).

3.8 PROCEDURES OF COLLECTING DATA

Data collection is the physical process of collecting data from participants in a given sample. The study employed the structured questionnaire and interviews guide as the measurement instruments.

3.8.1 Questionnaire

The data collection method chosen for this study was the survey method, in which a structured self-administered questionnaire was applied to gather data from a sample of the whole population. The questionnaires were distributed to the students for completion during lunch time to ensure no academic learning time was lost or disrupted. The questionnaires were physically distributed to the students at Mazunga Secondary School and students have given time to complete and submit back. The respondents will indicate their views on the questions asked by ticking the appropriate answer or write in the space provided. A cover letter attached to the questionnaire explained the nature and purpose of the study and provided instructions on how the questionnaire was to be completed.

3.8.2 Interview Guide

Interviews was done only with the administrators and teachers in science department to capture the views concerning the importances of using Mathematical instruments in the teaching and learning of ‘Construction’ in rural areas. The date of the interview was set in advance before setting an appointment with the respondent.

3.8.3 Primary source

Primary source of data refers to all data collected by the researcher originally without taking it from any written records, Ameyaw ,2019). The researcher used primary source because it enables the researcher to have control of the data collection methods enabling them to focus

on specific aspects of their research this means that the researchers will only set out to find more information about specific issues that matters to them Also, (Wiid and Diggines, 2009), elaborates that primary data is highly likely to be suitable to the purpose of research because it is obtained directly from the source. However, collecting primary data is time consuming and the researcher is likely to collect large volumes of data which some may not be necessary for the research. Lupton and Bowey (2005).

3.8.4 Secondary Sources

Secondary data is the data that have been already collected by and readily available from other sources. Secondary sources may serve as complementary to primary sources while it may also stand to measure consistence and objectivity from primary responses (Lupton and Bowey, 2005). Secondary data can be obtained through Historical location, that is the collection of data related to past events, ethnographic and documentary review among others. The advantage of using secondary source of data is that it helps to make primary data collection more specific since with the help of secondary data, enables the researcher to identify the gaps and deficiencies and can provide comparative and contextual data, (Kotze, 2005). On the other hand, the system has also its drawbacks that the data can be inaccurate and have some errors. Secondary data may not suit the researcher's level of need to fully comprehend the whole research project.

3.9 VALIDITY RELIABILITY

The despondence is reluctant to admit to participation in any illegal or socially unacceptable activity. The researcher created questionnaires with the help of consultants who offered guidance on how to enhance the instruments' behavior to guarantee the quality of the data collected (Dane, & Twycross, 2015). All participants were given the assurance by the researcher that no other outsiders were responsible for the study and that all comments and information would be kept confidential. As a result, the respondents' motivation to collaboration increased significantly. According to Masarirambi (2017), a study's methodology has a bigger impact on its credibility than any other element. This is due to the fact that the methodology establishes the procedures for gathering and analyzing data, both of

which can significantly affect the outcomes. To guarantee the validity of the study's findings, the researcher in this instant took care to follow the established ideas of research technique, this indicates that they minimized bias by using a methodical and thorough approach to data collection and analysis. Throughout the entire procedure, including sampling, data collection, analysis, and result presentation , scientific methods were used to ensure the accuracy of the research (Cohen ,Manion , & Morrison, 2017).

3.10 Data presentation and analysis

After the data has been collected, it was analysed by employing descriptive statistics. According to Orodho (2005) these techniques can present quantitative description and give summary of data in a manageable form. Demographic data was analysed using frequency and percentages then presented in the form of charts. The problems faced by pupils in learning construction in rural area were analysed using means and standard deviation and then presented in the form of a graph. Means and standard deviations will also be used to analyse the benefits of mathematical instruments in the learning and teaching of construction in Mathematics in rural areas.

3.11 Summary

This chapter looked at the descriptive survey research design that were used in the research. The chapter discussed the Mazunga Secondary School population of 40 mathematics teachers and learners, the sampled 38 learners and 2 teachers and the procedures that were used to select the respondents. The questionnaires and interviews and their application in the research were discussed, noting their advantages and disadvantages. The data gathering procedures and methods that the researcher used to present and analyse data were discussed. The next chapter presents, analyses and discusses the research findings.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.0 Introduction

The following chapter focuses on data presentation and analysis of the research findings obtained through questionnaires and self-administered interviews. Data is presented in the form of tables, graphs and pie charts with explanatory notes to give a better interpretation and understanding of the data.

4.1.0 Performance of the learners

Table 4.1.0: performance of the learners

	Frequency	Number of learners passed the exercise	Percentage
Class taught with a supply of mathematical instruments	**19**	**12**	**63 %**
Class taught without mathematical instruments	**19**	**3**	**16%**

The above table 4.1.0 shows a summary of the results obtained after the learners have been taught, in the first class, the teacher provided the learners with mathematical instruments and allow learners to construct on their own. Also on the second class, the teacher just used the traditional method of teaching the topic of construction where the learners were just listening to the teacher while the teacher was demonstrating. The classes were equal in numbers as each class had 19 learners. The results obtained proved that, teaching learners with mathematical instruments helps learners to grasp the concepts as compared to the second class which was taught using the traditional method. The first class obtained 63% pass rate as compared to the second class which got 16% pass rate. Mberi & Phambili (2016) states that using mathematical instruments can develop mathematical understanding, and also can support student learning. This then is being supported by the results obtained above.

4.2 Response rate

Table 4.1: Response rate of questionnaires distributed

Questionnaires	**Frequency**	**Percentage (%)**
Returned	26	65
Unreturned	14	35
Total	40	100

The researcher distributed 40 questionnaires to students doing Mathematics at Mazunga Secondary School. The response rate was 65% since 26 questionnaires were answered out of the 40 questionnaires which were distributed. According to (Ncube & Sibanda, 2016) a 63% response rate is good while a 75% response rate and above is excellent. The researcher expected a response rate of at least 63% based on the De Vos's findings therefore her response rate was acceptable since it was more than 63%.

4.3 Demographic data

4.3.1 Gender of respondents

The researcher pursued to find the gender of the respondents just for general demographic pattern. The response rate was analysed and the results are shown in table 4.3.1.

Table 4.3.1: Gender of respondents

Gender	Frequency	Percentage (%)
Male	16	62
Female	10	38

From table 4.3.1 male respondents constituted 62% while female respondents constituted 38%. This indicates that majority of the students at Mazunga secondary school who participated in the research are male. This shows that the students at Mazunga secondary school were not equally distributed in terms of gender. This is also being supported by Mugenda and Mugenda (2016) that the gender gap in Mathematics performance can also being caused by socio-cultural influences such as stereotypes, bias, and cultural expectations. These can affect motivation, confidence and performance even in this topic of the study that is investigating the importances of using Mathematical instruments in the teaching and learning of construction in Mathematics.

4.3.2 Age of the respondents

The researcher sought to find out the age of the respondent from the students doing Mathematics at the case study. The responses were analysed and results shown in table 4.3.2.

Table 4.3.2: Age of respondents

Age	Frequency	Percent (%)
14 years and below	2	8
15 years	18	69
16 years and above	6	23
Total	26	100

From table 4.2.2 age of the respondents indicated that 14 years and below constituted 8%, 15 years constituted 69 % and 16 years and above also constituted 23%. This results indicates that the majority age group of the research was 15 years. Considering responses from these age groups gives the researcher an opportunity to have effective results since data will be collected from different ages of people (Pervez, 2017). The average age of form threes at most secondary schools is 14-16 years and this aligns nicely with the findings of this research.

4.3.3 Age level of the respondents

The researcher considered the education level of the respondents. The data on the academic class of respondents was analysed and the results are presented in figure 4.3.1.

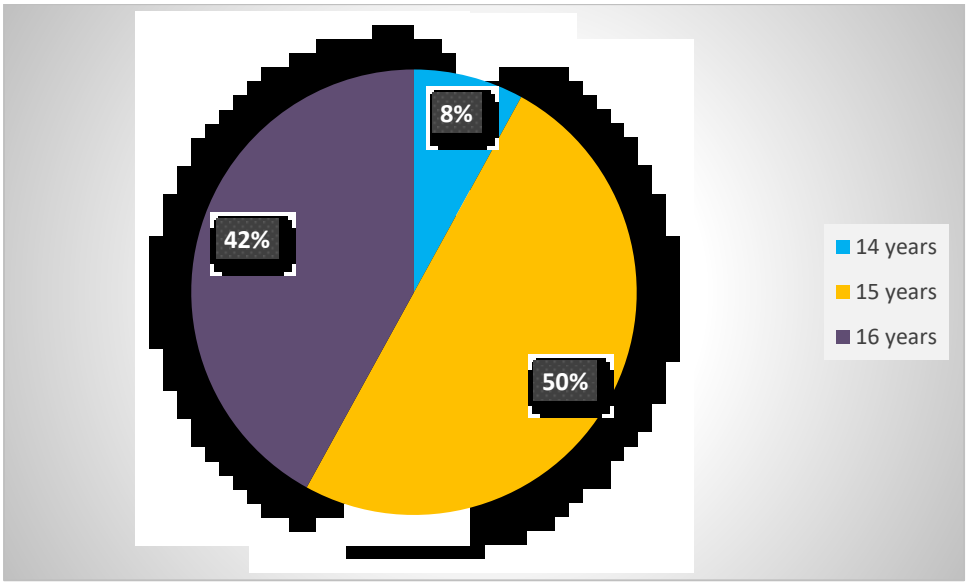

Figure 4.3.1: level of qualification (age)

From figure 4.2.1 results indicated that of the 26 students who responded 0% were 12 years and below, 8% were 14 years old and below, 50% were 15 years old and with 42% were 16 years and above. This shows that the majority of students doing Mathematics in form 3 at Mazunga Secondary School were 15 years old.

4.4 Provision of the mathematical instruments by the school

This section shows the responses given by the learners on whether the school provides the mathematical instruments or not. This was a question which was asked in order to see whether it's necessary for the school to provide or it's not necessary. All the learners responded that the school does not provide the learners with Mathematical instruments in

order to cater for such topics of construction so that it will be easier for the teacher to conduct this topic. The provision of Mathematical instruments to the learners by the school can help the vulnerable learners who does not afford to buy Mathematical sets. The performance of the learners who were using Mathematical instruments proved that , it's very necessary for the school to provide the instruments considering the learner's low income background. This is also being supported by the view of Jean Piaget , he emphasised the importance of hands on experiences and manipulation of objects in the learning process , particularly in the context of cognitive development and constructivist learning theory.

4.5 coverage of the topic

All learners responded that they covered this topic already.

4.5.1 Learners understanding the concepts of construction

The table 4.5.1 shows the respondents given by the learners on whether they grasped the concept of construction or not.

Response	Percentage
Understood	20 %
Did not understand	80%

Table 4.5.1: Learner's understanding the concept of construction.

The table 4.5.1 above shows the percentage result of whether the learners grasped the concepts or not when they covered this topic before. 80% of the learners who were asked responded that they did not understand the concepts of constructing shapes and angles. However, the other 20% said that they understood. The researcher found out that those who said they understood the concepts were actually the very fast learners and some of them had the instruments. Those who did not understand were average and slow learners and they had

no mathematical instruments in the lesson. This shows the al the learners must have the instruments which helps them to grasp the concepts.

4.5.2 Interest in learning the topic of construction

This section required respondents to indicate their interests in learning construction. The researcher sought to found out this information in order to know whether the students has interest in the topic or not. Results were analysed and are shown in figure 4.4.1 below.

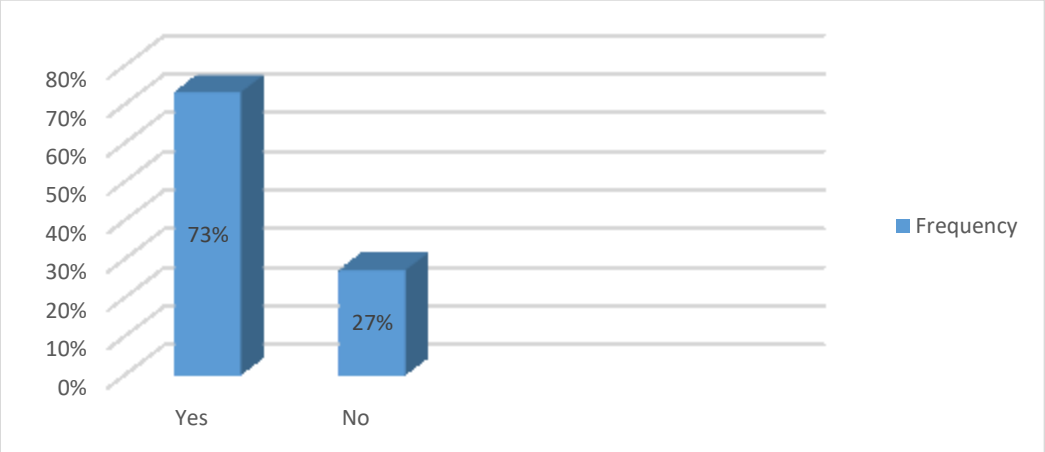

Figure 4.4.1: Interest of the respondents

From figure 4.4.1 students who have interest in the topic constituted 73% and those with no interest constitute only 27%. This indicates that most of the students in the study has strong interest in doing Mathematics generally and construction in particular. Stewart (2014) 'constructivist learning and teaching suggests that learners are more likely to be interested in construction when they are actively engaged in hands-on activities and problem solving. This then shows that it is important to use Mathematical instruments in the teaching and learning of construction.

4.6 Is construction difficult to the respondent

The researcher also looked into the perception of the respondents with respect to whether this topic of construction is difficult to them or not and the respondents were required to tick in the appropriate box indicating their views. Data was analysed and presented in figure 4.4.2.

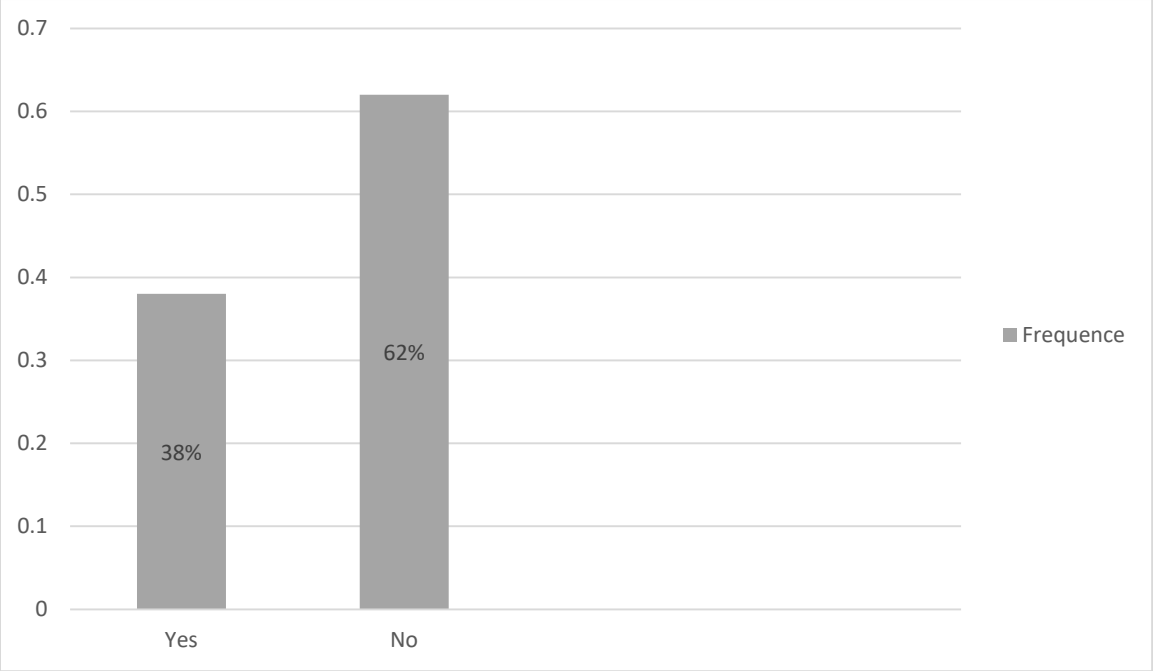

Figure 4.4.2: Is construction difficult?

This section shows responses given by the learners after both classes were taught and the first class was taught using Mathematical instruments and the other class without. From figure 4.4.2 respondents who feel that in Mathematics the topic of construction is a difficult topic to undertake constitute on 38% and those who think otherwise amounted to 62%. This indicates that the majority of the respondents view this topic as an easy topic. This just cemented the result shown above, that the majority of the respondents has strong interest in doing construction in Mathematics. Vans (2014) states that this topic of construction cannot be difficult for some learners especially to those with spatial reasoning. Learners with spatial reasoning skills can visualise and manipulate geometric shapes. This shows that, the despondence on the above questionnaire shows that the majority of the learners interviewed have spatial reasoning skills. The majority of the learners who said that the topic is not difficult were the ones who were taught using Mathematical instruments.

4.6.1 Benefits of using Mathematical instruments

The study also explores the benefits of performing Mathematics practical lessons and using Mathematical instruments in particular. The results from the research shows that practical lessons inspire learners, teachers described the enjoyment students gained from learning with mathematical instruments- “the hands-on materials would excite the students and make the learning more meaningful as they would be experiencing and playing around with things and

ideas rather than being a mere passive learner". The hands-on activities encourage children to engage in collaborative Mathematics inquiry and generate multiple artifacts of their understanding of Mathematics. When children engage in Mathematics inquiry, the resulting artifacts enable discussions where children compare the effectiveness of their designs with the designs of their classmates. Mathematics practical is one of the fundamental tools enabling students both to learn scientific knowledge, and how to do science particularly mathematics.

These results are in line with the findings by Wosenga (2020). The results revealed that students' use of mathematical instruments had a significant effect on mathematics process skill acquisition in mathematics practical work of construction. Based on the findings of this study, it was recommended among others that teachers' should update their knowledge on the integration of mathematical instruments in teaching of construction for enhancement of students' acquisition of mathematical process skills in mathematics.

4.5.2 Problems faced by respondents in learning Construction

The researcher investigated the problems faced by student in learning the topic of construction. A number of problems were identified. The results of the analysis were presented in figure 4.5.1.

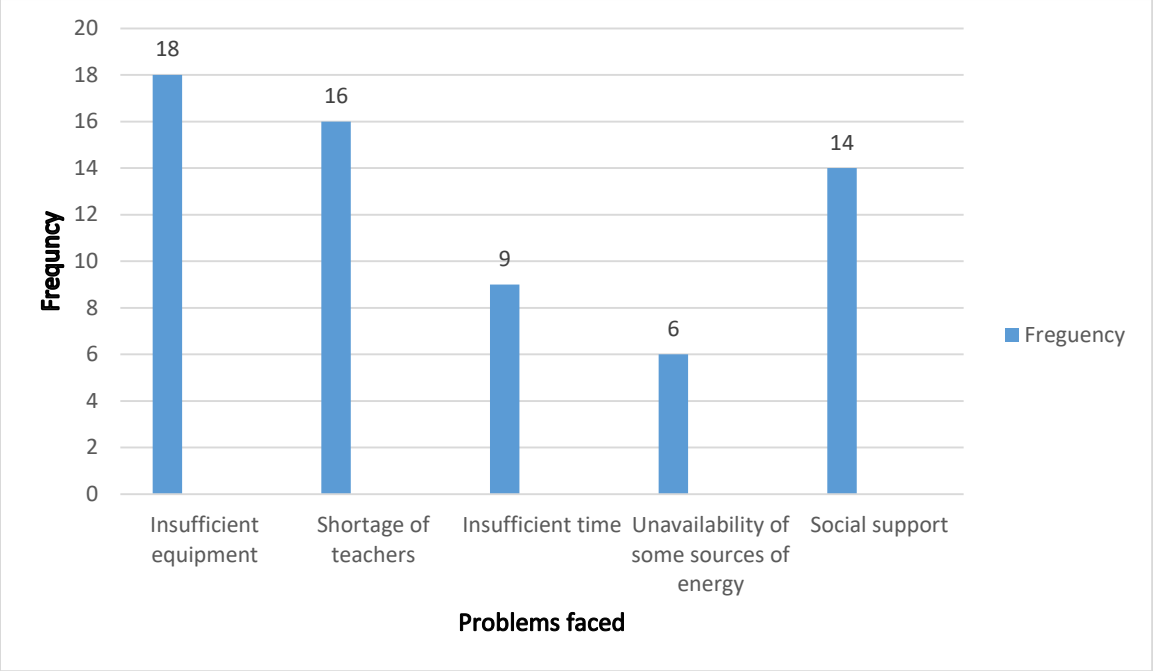

Figure 4.5.1 Problems faced in doing construction in Mathematics

From figure 4.5.1 respondents indicated the challenges they are facing in learning construction. Insufficient equipment had a frequency of 18 (69%), shortage of enough teachers 16 (61.5%), insufficient lesson time 9 (34.6%), unavailability of some sources of energy 6 (23%) and social support with 14 (53.8%). This indicates that the majority of the respondents identified insufficient equipment, shortage of teacher and social support in that order as they key problems faced in learning this topic. These problems if addressed can bring in better results in terms of construction lessons and mathematics performance in general. These findings align with what Mtsi and Maphosa (2016) reviewed. They identified lack of required infrastructure and resources for mathematics teaching, learners' background, language of instruction, and lack of parental support among the factors affecting mathematics learning in general and this topic of construction in particular. The unavailability of some sources of energy is affecting in the sense that , this topic of construction can be easy to learn using power point presentations , but because of poor supply of energy , it becomes so difficult for the teacher to do all the demonstrations to the learners manually.

4.5.3 Ways of improving the learning and teaching of construction

The researcher explored some of the ways that can improve the learning and teaching of construction in Mathematics. Data was analysed and presented in table 4.5.1 below

Table 4.5.2: Ways of improving the learning and teaching of construction.

No.	Ways to improve learning and teaching of construction	Frequency	Percent (%)
1	Provide more mathematical instruments	18	69
2	Educate the society on the importation of mathematics as a subject	16	61.5
3	Offer incentives and other fringe benefits to teachers	10	38.5
4	Invest in solar energy for power point presentations	13	50
5	Improve the number of teachers	12	46
7	Staff development workshops to the teachers	7	27

The results indicates that providing more mathematical instruments have the highest frequency followed by educating the society about the importance of science so that, they can support students to do Mathematics in general. This means that these two are the most considered ways which can improve the learning and teaching of Mathematics in general and construction in particular. There are other factors though they have low frequency but they are equally important to improve the learning of this and other topics in Mathematics. These include offering incentives and other fringe benefits to teachers, and staff developing the teachers. If also considered these will go a long way of improve the learning and teaching of Mathematics.

4.8 Summary

This chapter is a detail of all the information collected by the researcher. Data analysis and presentation was also presented in this chapter. The researcher also gave her opinion on the data she collected.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter looks into the conclusions that the researcher made after obtaining and analysing data in chapter 4. It also looks into the recommendations that were made by the researcher in order for the schools to maximize all the benefits that can be obtained from implementing the use of mathematical sets in the teaching of construction in mathematics.

5.2 Summary of the findings

This study examined the benefits of mathematical set in the teaching and learning of construction in Mathematics. The study had two specific objectives. These objectives were to examine problems faced by students in learning this topic of construction and examine the benefits of mathematical instruments in the teaching and learning of construction in Mathematics.

The study was conducted at Mazunga Secondary School. Quantitative and descriptive designs were employed in this study using various data collecting tools such as questionnaires, and interviews. There were 40 respondents selected based on the sampling. Quantitative data were organized and coded. The researcher employed descriptive statistics such as frequency, percentages and pie chart. The following are summarized main findings based on the specific objectives of the study.

After analysing all the data obtained from the research study the researcher concluded that the mathematical instruments are very important in the learning and teaching of construction in Mathematics especially in rural areas where there are low income schools. Also, basing on the findings the students and staff were aware of problems which affects the learning of construction in Mathematics. From this research it is evident that increasing Mathematical instruments, educating the society on the importance of Mathematics, offering incentives to teachers and increasing the number of Mathematics teachers can go a long way in improving the learning and teaching of Mathematics in rural areas. This is in line with the conclusions made by Kreitler and KreiÜer (2019) who argued that practical experiences help students

establish the accuracy of their beliefs as well as providing them with direct experience with concepts.

5.3 Conclusion

The researcher answered two questions from the research. The first question was to identify problems faced by pupils in learning Mathematics. The second question was to identify the benefits of mathematical instruments in the learning and teaching of construction in Mathematics.

5.3.1 Problems faced by pupils in learning construction in Mathematics.

The study identified five major problems which include insufficient equipment, insufficient learning time, shortage of teachers, and unavailability of teachers and lack of social support. These problems greatly affected the learning of construction in Mathematics at Mazunga Secondary School.

The majority of the respondents strongly agreed that the insufficient mathematical instruments have a strong effect of the performance of learners in the topic of construction in mathematics. The respondents also indicated that shortage of teacher and social support constraints that the school had been facing in the learning of construction in Mathematics.

The research also finds out that the interest of the students in learning Mathematics also contributed to the performance of learners in Maths. The results indicates that most of the students in the study has strong interest in doing Mathematics generally and the topic of construction in particular.

5.3.2 The benefits of Mathematical instruments to the learning and teaching of Construction

Respondents were required to give their own view on the performance of students before and after the implementation of the mathematical instruments. The results from the research shows that practical lessons inspire learners, teachers described the enjoyment students gained from learning with instruments - “the hands-on materials would excite the students and make the learning more meaningful as they would be experiencing and playing around with things and ideas rather than being a mere passive learner”.

The researcher also finds out that practical activities encourage children to engage in collaborative mathematics inquiry and generate multiple artifacts of their understanding of Maths. When children engage in maths inquiry, the resulting artifacts enable discussions where children compare the effectiveness of their designs with the designs of their classmates. Mathematics practical like that of construction is one of the fundamental tools enabling students both to learn scientific knowledge, and how to do Mathematics practically.

5.4 Recommendations

To improve the performance of the students in Mathematics this study recommends that:

- The organization to take consideration into all the ways of improving the learning and teaching of Mathematics. These factors are very important that a school needs to pay much attention in their efforts of improving the performance of students in Mathematics.
- Rural schools should be aware that they face different problems as compared to their urban counterparts and as such must implement the use of mathematical instruments to harness the benefits of them to give a practical feel to their students.
- The study also proposes that there should always be these mathematical instruments and facilities within the school to facilitate the proper learning and teaching of mathematics
- Teacher should be kept abreast in teaching methodologies and other changes that might be taking place through attending in-service trainings.

5.5 Recommendations for future studies

The study recommends some areas for future research. The researcher recommends that the study can be carried out by looking at other factors that contributes to an improvement in performance of students in Mathematics other than the use of mathematical instruments. Another area the study recommended for future studies was to look into the use of online platforms on the learning and teaching of mathematics.

5.6 Summary

This chapter contained a summary of the findings attained by the researcher as well the conclusion that she made pertaining to the finding. The chapter also highlighted the recommendations made by the researcher to the firm.

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APPENDIX 1

QUESTIONNAIRE FOR LEARNER

My name is Karise Savie a final year student at Bindura University of Science Education. I am studying for a Bachelor of Science Degree in Mathematics. In partial fulfilment of my degree program requirements I am conducting a research on the impact of mathematical instruments in the teaching and learning of mathematics in rural areas. I am kindly asking you to complete this questionnaire which will be useful in drawing conclusions for the research. Please be assured that is for academic purposes only and the responses for the questionnaire shall be kept confidential and as such no personal details shall be requested for in the document.

SECTION A: Demographic data

Please show your response by ticking the appropriate box

1. Gender: Male ☐ Female ☐

2. What is your age?

14years and below	
15 years	
16 and above	

SECTION B

3. Does the school provide mathematical instruments to the learners?

YES ☐ NO ☐

4. Did you cover the topic of construction?

YES ☐ NO ☐

5. Do you enjoy doing the topic of construction in Mathematics at your school?

YES ☐ NO ☐

6. Is the topic of construction a difficult topic to learn?

☐ ☐

YES NO

7. Did you grasp the concepts of how to construct different shapes and angles in the topic of construction?

YES NO

SECTION C ☐ ☐

8. What can you say are the benefits of using Mathematical instruments in the process of teaching and learning of 'Construction' in Mathematics?

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9. What are the problems you are facing in doing construction at your school?

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10. What do you think can be done to improve the learning of construction in Mathematics subject at your school?

APPENDIX 2

INTERVIEW GUIDE FOR TEACHER

My name is Karise Savie a final year student pursuing a Bachelor of Science Degree Mathematics at Bindura University of Science Education (BUSE). I am carrying out a research on the importance of mathematical instruments in the teaching and learning of construction in mathematics in rural areas. You have been selected to participate in this research because you are an administrator or teacher in the sciences department. The information you will provide is purely for academic use and will be treated with high degree of confidentiality. You are therefore required to be as objective and truthful as you can be in your responses.

1. How long have you been working at Mazunga Secondary School?
2. What is your experience using a mathematical instrument when teaching the topic of Construction?
3. Can you comment on the performance of students to both classes, the first class with Mathematical instruments and the second class without mathematical instruments?
4. What can you say are the benefits of using a mathematical instruments?
5. What are the challenges you are facing as a school in implementing a mathematical instruments in the teaching of construction in Mathematics?
6. What do you think should be done to mitigate these challenges?
7. In your views, do you think all the members in the science department have the technical expertise in teaching construction in Mathematics subject?