

Improving Mathematics Instructions for Secondary Schools Learners with Visual
Impairment in Kilimanjaro and Tanga Regions Tanzania

(The role of Mathematics and Science Plan)

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Declaration

I hereby declare that this thesis entitled “*Improving Mathematics Instructions for Secondary Schools Learners with Visual Impairment in Kilimanjaro and Tanga Regions Tanzania (The role of Mathematics and Science Plan)*” is an original report of my research, has been written by me and has not been submitted for any other degree or professional qualification. I confirm that appropriate credit has been given within this thesis where reference has been made to the work of others.

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Abbreviations and Acronyms

AFB.....	American Foundation for the blind
CCTV.....	Closed Circuit Television
CSEE.....	Certificate of Secondary Education Examinations
CWVI.....	Children with Visual impairment
DAISY.....	Digital Accessible Information Systems
DRC.....	Disability Resource Centre
ESCA.....	East, South and Central Africa
ETP.....	Education and Training Policy
ICEVI.....	International Council for Education of people with Visual Impairment
MoEC.....	Ministry of Education and Culture
MoEST.....	Ministry of Education Science and Technology
MoEVT.....	Ministry of Education and Vocational Training
NECTA.....	National Examination Council of Tanzania
NORHED.....	Norwegian Programme for Capacity Development in Higher Education and Research for Development
ON-NET.....	Overbrook school for the blind (USA) and The Nippon Foundation Network
STEM.....	Science, Technology, Engineering and Mathematics
SEN.....	Special Education Needs
TIE.....	Tanzania Institute of Education
TLB.....	Tanzania League of the blind
RNIB.....	Royal National Institute for Blind

UNESCO.....United Nations Educational, Scientific and Cultural Organization
UPIAS.....Union of the Physically Impaired Against Segregation
URT.....United Republic of Tanzania
USA.....United States of America
VI..... Visual Impairment
VICTAR..... Visual Impairment Centre for Teaching and Research
2D.....Two Dimension (images)

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Abstract

The study aimed at investigating the role of mathematics and science plan on improving mathematics instructions for secondary schools learners with visual impairment in Kilimanjaro and Tanga regions Tanzania. The study was guided by four objectives which were; First, to examine mathematics teaching methods used in teaching learners with VI. Second, to determine the mathematics teachers' competencies to teach learners with VI. Third, to examine whether mathematics mode of assessment in use consider the special needs of learners with VI. And lastly, to examine instructional challenges faced learners with VI during learning mathematics. The study used qualitative approach. Semi-structured interview was chosen as the main data collection method. In addition to semi structured interview, non participant observation was also used. To ensure reliability and validity of the results, the tools used were piloted and examined and made unambiguous. Interview scripts were checked several times to check consistency and comprehensibility. In order to generate in depth knowledge of the phenomenon, purposive sampling was used to get participants of the study which involved four mathematics teachers teaching students with VI two from each school, four students with VI two from each school and the Director of special education from the MoEST making a total of nine participants. Data were analyzed using thematic analysis where interview transcription and coding was done to obtain the main themes and categories. Presentation and discussion of the findings was done regarding the emerged themes and categories supported by the verbatim quotes from the participants to ensure validity of the findings. The study findings indicate that teaching and learning mathematics to involve: expository teaching method, remedial sessions and ineffective group discussions; mathematics assessment adaptations including alternative format of questions, additional time, separate examination rooms and examination papers presented in braille format for blind students and large prints for low vision students. The findings show moderate collaboration between mathematics teachers and specialist teachers of students with VI, students with VI were supported by the specialist teachers and lack of cooperation and support between sighted learners and learners with VI in mathematics subject. The main findings revealed challenges encountered by students with VI in learning mathematics to include: shortage of skilled mathematics teachers, shortage of mathematics teaching and learning materials, lack of knowledge of using mathematical devices both to students and their teachers. The study also revealed negative attitude of students, mathematics teachers and teachers with VI towards mathematics. The study recommended the government through the MoEST to incorporate specialized training of mathematics in the curriculum of teachers training colleges in order to produce enough teachers with skills and ability to teach mathematics subject to learners with VI in primary and secondary schools. The MoEST should consider in-service teacher training considering areas of knowledge of braille and mathematics braille notations, the use of specialized devices, knowledge of mathematics subject itself and knowledge of how to teach students with VI. For effective teaching and learning of mathematics to learners with VI, instructional materials such as mathematics text and reference books in braille, curriculum which stipulate clearly all possible modification and the specific needs of the VI students and modern technological learning materials should be considered. The ministry of education should raise awareness on the importance of mathematics to students with VI.

CHAPTER ONE

INTRODUCTION

1.0 Chapter overview

This chapter intends to present the background of the study, statement of the problem, purpose of the study, research objectives, research questions and significance of the study. It also presents delimitations, limitations of the study, definitions of operational terms and theoretical framework.

1.1 Background of the study

Numeracy skill is important especially in this era of science and technology. It is more imperative to the world today than it ever has been before in the history of human kind.

Most traditional education instructional strategies globally are based on the sense of vision. Mathematics is an abstract discipline which involves much visual representations. It involves diagrams, symbols, graphs, figures and others which demand vision. Sighted learners find it easy because they can see. In fact the faculty of vision is our primary source of information about the world. The largest part of the cerebrum is involved in vision and it controls the perception and the elaboration of words, the forms, color and movement of objects. To see makes someone to engage his/her cognitive functions to get meaning from symbolic context of which facilitate in building concepts and meanings which could have easily by passed in the absence of sight.

With this regard it is obvious that acquisition of mathematical skills can be more difficult for students with VI due to the abstract nature of many essential concepts and the highly visual presentation as mentioned earlier. Graphs, charts and other pictorial

representations need some modification to be accessible for learners with VI. It comes therefore that, different from their sighted peers, students with VI face many challenges to grasp mathematics concepts. In one of their report, the Royal National Institute for the Blind (RNIB), a UK-based organization indicates that, visually impaired students need to deal with extra challenges in learning mathematics (RNIB, 2011). It is in this due fact where various SNE activists and organizations emphasize research in mathematics to visually impaired students globally.

Rowe (2013) recorded that in 2011 much effort was put to ensure accessibility of mathematics to visually impaired learners. Rowe (2013) identifies some prominent activists such as the Royal National Institute for the Blind (RNIB), International Council for Education of People with VI (ICEVI), Digital Accessible Information Systems (DAISY) and the Visual Impairment Centre for Teaching and Research (VICTAR) of the University of Birmingham and Sight Savers. Their mathematical researches help to increase knowledge on the subject and how it can be made accessible to learners with VI following the fact that, as the time goes on mathematics becomes popular and its significance is obvious in development.

In their effort to improve the accessibility and provision of least restrictive mathematics learning environment and to expand education and employment opportunities for students with VI in eight Asian countries namely; Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam, Overbrook School for the Blind (USA) and The Nippon Foundation (Japan) ON-NET members conducted researches in 2001 and noted weak mathematics instruction for visually impaired students across the region

placing significant impediments in the career path of otherwise well educated blind persons who wanted to pursue careers in the areas of science and technology. To that reason in 2003 the ON-NET regional advisory group met in Bangkok and made a plan and strategies focusing on improving secondary level mathematics instruction to the students with VI. The plan led to the preparation of learning package for teaching mathematics which helped also to improve the ability of special educators teaching mathematics to blind children and materials were useful for general classroom teachers as well (ON-NET & ICEVI, 2005).

Many countries such as Zambia, Kenya and also Tanzania this area of study is compulsory to all students in ordinary level secondary schools. The studies conducted in Zambia and Kenya indicate that, mathematics is compulsory and that, lacking mathematical qualifications can present barriers to other subjects such as science and technology and also other social sciences that rely on branches of mathematics (Simalalo, 2006 & Wanjiru, 2014).

The context of Tanzania secondary school curriculum considers preparing students aspects of social, political, and economic environment to enable them fit in the society; and compete in the global economy (TIE, 2007). To reach this end, numeracy skills are crucial. For instance TIE, (2007) emphasizes mathematics to remain as a key subject area requirement in higher education and employment sector and hence given many periods per week in the syllabus compared to other subjects from form one to four. For that matter mathematics education dominate the school curriculum.

In a similar view above Bethell (2016) argues that, “there is mounting evidence that having poor numeracy skills is a greater barrier to economic and social well-being than having poor literacy skills” (p.31). In their overview concerning the relationship between Mathematics and Science Wright and Chorin (1999) suggest that, “Outside the traditional spheres of science and engineering, mathematics is being called upon to analyze and solve a widening array of problems in communication, finance, manufacturing, and business “(p.1). Generally this presents the fact that thorough understanding of mathematics enhances educational and occupational opportunities for all people.

Despite the progress in special education provision, Tanzania faces the following problems; lack of specialized equipment and teaching/learning materials; insufficient specialist teachers for special needs education. Due to such limited opportunities, for example, visually impaired students cannot study mathematics or science at post-primary levels (URT, 2007). A study conducted by Smith and Smothers (2012), identifies such difficulties to include problem solving, gaining access to the problem information, representing problem information, and calculating the answers. In addition, mathematics is highly visual in nature and often uses graphics to convey important information this presenting an additional obstacle for students with VI.

Agrawal (2004) identifies some challenges that students with VI encounter when learning mathematics, he observed that such challenges can be overcome when the content is taught in an appropriate manner, for instance through the use of programmed instruction. The programmed instruction includes developing a sequence of instructional activities and the use of proper teaching materials to be potential in maximizing learning and

increase motivation for students with VI. In view of the above American Foundation for the blind (AFB) (2000), suggests that, students with VI have special instructional needs to be able to access academic subjects, including academic supports and specialized curricula.

It has been established that children who are visually impaired learn mathematical skills at the same level as their sighted peers (Tindell, 2006). For many years learners with VI in Tanzania, were taught mathematics subject only in primary school level. In ordinary level secondary education, mathematics is compulsory to every student.

However, students with VI either were to drop the subject or attend the sessions partially. They were not benefiting may be because teachers had no enough knowledge to impart arithmetic skills to students with VI and other instructional challenges. Furthermore these learners were not assessed in mathematics subject in their form four final examinations despite the fact that mathematics subject is compulsory to all learners in ordinary level secondary education. TIE (2007) affirms that, “the Certificate of Secondary Education is awarded in four divisions. The divisions shall be computed basing on the best 7 subjects...” (p.33). Means that, for a student to get division one or two, must score a pass in Mathematics because was a compulsory subject. Due to that unfair grading system, students with VI were automatically awarded division three as a penalty even if their performance in all other remaining subjects was excellent. That came only because of not doing mathematics.

It was due to international pressures such as United Nations statements like the Salamanca Conference and framework of action 1994 and the Dakar conference of 2000

among others, which advocate the right based approach to education and which stress the principle that every child including those with special needs have the right to education (UNESCO, 1994; UNESCO, 2000). In recent years awareness about disability issues has increased among people with disabilities themselves. The increasing in the number of people with VIs enrolled in the universities fortified Mathematics and Science subjects' agenda national wide. These scholars and their disability organizations such as Tanzania League of the blind (TLB) played a great role in fighting to make sure that students with VI get their rights to learn mathematic like others.

In understanding the importance of mathematics knowledge in life, the government of Tanzania through MoEST in late 2014 launched Mathematics and Science plan for secondary school students with VI, intending to enable all secondary students including those with VI to learn mathematics and other sciences. Mathematics knowledge automatically becomes a cornerstone to achieve the objectives of the plan. Lack of arithmetic knowledge limits access of other areas of curriculum, it is prominent in education, society and critical for further education.

Although there are some studies done in areas of mathematics in secondary schools in general, little have been done in part of the same area for visually impaired learners. One study conducted by Chawala in 2006 investigated teaching and learning conditions of natural sciences and mathematics to the visually impaired students in integrated Tanzania secondary schools. The results showed that, most of mathematics topics and subtopics that are taught in secondary can be taught to people with VI but are not taught in spite of

their importance, only because of the government's negative feeling that they cannot be taught to the visually impaired students due to their complexities (Chawala, 2006).

The results and recommendations of the current study may aid references and some improvements of the mathematics instructions to students with VI. Furthermore the findings may act as a stepping stone for more research studies to investigate other aspects of this current plan of the MoEST.

1.2 Statement of the Problem

The current study was designed to investigate the role of Mathematics and Science plan on improving the mathematics instructions for secondary schools learners with VI in Tanzania. Tanzania is among active nations that have signed and ratified various international policies such as the United Nations Convention on the Rights of Persons with Disabilities including Universal Declaration of Human Rights (1948), UN Convention on the Rights of Person with Disabilities (2006) resulting in the Persons with Disabilities Act of 2010 and Salamanca Statement and Framework for Action (1994). The 1977 Constitution of Tanzania and its amendments recognize the rights of persons with disabilities and prohibit all forms of discrimination (URT, 1977).

Furthermore, the National Strategy for Growth and Reduction of Poverty (MKUKUTA) 2010-2015 (Goal 3), specifically addresses children's rights, including the rights of children with disabilities (URT, 2014). The policies above guide the government to provide equal rights to in Education to all learners without discrimination. The quality

education opportunity must consider everyone including minority groups and persons with disabilities such as those with VI.

It was due to the above fact various endeavors have been made since 1990s to date to ensure that, secondary school students with VI also learn mathematics as their counterparts do (URT, 2016).

Before the implementation of the plan, science and mathematics meeting of educational stakeholders, was held in 2013 to discuss curriculum needs in teaching physics, chemistry and mathematics to students with VI. The development of teacher's guides and their study materials for students with VI were made for the mentioned subjects (URT, 2016).

Despite the endeavors of the MoEST and the policy guidelines some challenges still exist in the education of students with VI in ordinary level secondary schools in Tanzania especially in the area of mathematics. The current study aimed to focus in this particular area because little has been researched.

1.3 Purpose of the study

The primary concern of this study was to investigate the role of Mathematics and Science National plan in the improvement of the mathematics instruction to secondary school learners with VI.

1.4 Objectives

This study has the following objectives;

- i). To examine mathematics teaching methods used in teaching learners with VI.

- ii). To determine the mathematics teachers' competencies to teach learners with VI.
- iii). To examine whether mathematics mode of assessment in use considers the special needs of learners with VI.
- iv). To examine instructional challenges faced by learners with VI during learning mathematics.

1.5 Research questions

This study to investigate the effect of mathematics plan to learners with VI was guided by the following questions;

- i). Are mathematics teaching strategies in use benefit learners with VI?
- ii). Are the mathematics teachers trained with techniques to teach numeracy skills to visually impaired students in secondary schools?
- iii). What are the views of mathematics teachers who teach mathematics to learners with VI?
- iv). What are the challenges faced by students with VI when learning mathematics?

1.6 Significance of the study

The current qualitative study aimed at investigating the impact of the mathematics and Science plan established by the MoEST in improving mathematics instructions to the learners with VI in secondary schools in Tanzania, who for a long time were superficially, learn mathematics or not learn it at all. The data collected in this study may provide information to the MoEST and other education stakeholders to make more improvements to the mathematics instructions for the benefit of learners with VI in

Tanzania. The study may pave the way for other scholars to investigate other important areas of education for secondary school learners with VI in Tanzania.

It was anticipated that, the results of this study could be beneficial as well to the MoEST, policy makers and curriculum developers in the improvement of the secondary school curriculum, arithmetic studies in particular to suit the needs of Visually Impaired learners. In future, improved mathematics instructions may enable them to be accommodated well and acquire required arithmetic skills and competences.

1.7 Delimitations of the study

Although the MoEST launched this plan for mathematics and Science subjects, the current study intended to investigate only mathematics subject for secondary school students with VI. It did not intend to cover other subjects because the researcher thought that, arithmetic skills were the foundation of learning science subjects.

This study involved Ordinary level learners with VI who directly were affected by the newly introduced mathematics plan. These learners represented sample of students with VI in other regions and the country who started learning mathematics as compulsory subject. The current study also involved teachers who were teaching mathematics to learners with VI to the selected schools. The reason for that was, they were people who conducted teaching mathematics to learners with VI in classrooms. They knew nature, strength and weakness of learners, pros and cons they encountered when providing mathematics instructions during teaching sessions. The Director of Special Needs

Education from the MoEST was involved to provide important details of the plan including objectives of the plan and details of its preparation and implementation.

1.8 Limitations of the study

Although the current research achieved its aims the researcher faced some challenges. First, a lot of time was used to seek for the research permit from the government authorities. That caused delaying in data collection activities, the situation which forced the investigator to do a lot of work within a very short time. However, the investigator managed to collect data accordingly. Another challenge was that, during interview some participants, students with VI in particular, were not cooperative enough to answer the interview questions. The investigator spent a lot of time to ask additional questions to probe them, in order to get the enough from them. Furthermore the investigator tried to build good relationship to all participants for the purpose of getting enough information from them.

Finally, there were minimal studies done in the area of mathematics to students with VI in Tanzania secondary schools. Due to that, even literatures explaining that area of study were scarce. With this regard, few resources referring mathematics instructions to learners with VI in Tanzania and some literatures with similar theme written elsewhere were utilized.

1.9 Operationalization of the key terms and concepts

1.9.1 Visual Impairment

In the current study visual impairment refers to impairment in vision that, even with correction, adversely affects student's educational performance. In this context also Visual impairment includes both partially sighted (low vision) and blindness. Educationally a student with low vision implies the one with some sight who can learn by optical devices such as magnifiers, CCTV among others or material printed in large fonts and blind student refers to a student with very limited light perception so they depend on reading and writing using braille or by audio formats.

1.9.2 Impairment

In the context of this study the term impairment refers to a problem in structure or organ of the body.

1.9.3 Disability

This term is defined according to social model of disability. According to this model, disability refers to as the loss or limitation of opportunities to take part in society on an equal level with others due to social and environmental barriers.

1.9.4 Mathematics

Mathematics is the study of quantity, structure, space, measurements and change. Mathematicians seek out patterns, formulate new conjectures, and establish truth by rigorous deduction from appropriately chosen axioms and definitions.

1.10 Theoretical framework

The current study to investigate the role of mathematics and Science plan in the improvement of mathematics to learners with visual impairments in secondary schools in Tanzania, borrowed social model of disability developed in 1970s by UPIAS activists and slowly promoted by scholars such as Vic Finkelstein (1980, 1981), Colin Barnes (1991) and strongly advocated by Mike Oliver (1990 & 1996). Mike Oliver is a British Professor of disability studies at the University of Greenwich and also is an activist on disability issues.

According to Professor Oliver, society is the main cause in disabling people. This is because disabilities such as physical, sensory, intellectual or psychological differences may cause individual function limitations or impairments but they don't make disability. Disability is caused by the society failure to take action and include people regardless of their individual differences. The model identifies the barriers, negative attitudes and exclusion purposely or unintentionally that the society is making to people.

The interesting thing in social model of disability is the clarification of the terms impairment and disability. "Impairment" according to this model is the lack of attributes, the abnormality, of a person, whether in terms of limbs, organs or mechanisms and or psychological. "Disability" is said to be the restrictions caused by the society failure to give equivalent attention and accommodation to the needs of persons' impairments.

The main concern of social model is equality. To achieve the goal social model of disability emphasizes the society to change by; first, not to underestimate the potential quality of persons with impairments. Secondly, to provide social support, for example

help dealing with barriers to have resources, aids and thirdly; full involvement in all social aspects and to overcome any possible discrimination which leads to unfair wellbeing of their life.

In similar view, the government science and mathematics subjects plan established was the result of voices from various organizations and individuals with visual impairments themselves to change the long time notion that learners with VI were unable to study mathematics. The social model of disability believes that if people are given equal rights, empowerment and ability to decide they get opportunity to live independently. In the same instance, students with VI can learn all subjects like others if given support and empowered with facilities together with curriculum flexibility according to their needs.

The researcher believed that, when mathematical teaching and learning instructions would be improved; support provided in accessing information for example using suitable formats such as braille or large fonts and simple language in explaining mathematics concepts; accessibility of physical learning environment; availability of mathematical learning resources and flexible working hours for this group with VI according to the working pace such as additional time for tasks which needed more concentration could make them excel in this area of education like others.

The study adopted social model of disability by Professor Oliver as it was correlated with the variables that were measured. The model helped the investigator to determine independent variable which was 'the role of the mathematics and science plan' as the affirmative action of the government, which played the role of the society, trying to remove barriers existing for many years which excluded secondary school learners with

VI from getting their right to this area of education. And the dependent variable of the study 'the improvement of the mathematics instruction to secondary school learners with VI, as the output of the plan, the model assisted to investigate that, to what extent measures taken by the MoEST was profitable. The current study enabled the researcher to reveal accommodations and curriculum adjustments that were applied to enable students with VI to acquire arithmetic skills. The model also helped the study to check the extent in which mathematics learning accommodations have helped to bridge the gap of mathematical knowledge between them and sighted students. The researcher believed in the fact of equal rights. If given suitable learning facilities and opportunities students' impairment cannot cause disability.

However, the researcher was also aware of some shortcomings of using social model of disability. According to this model, to cure or treat an individual with disability is regarded as discriminatory and prejudiced. This is not always true because some of the visual impairments are caused by diseases and conditions which can be medically cured or reduce the severity of it. For instance glaucoma, cataracts and refractive errors among others need systematic treatment involving either eye operations, medications or prescription of correct lenses. The impact of some these visual conditions can be minimized through medical attentions. However, it sounds true that doctors cannot alleviate social circumstances impacting people with impairment but they have role to play in all individual healthy. The researcher was also aware that, categorization of people in terms of their impairments is not always bad but in some circumstances it helps in service provision and solving specific challenges individuals are facing.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Tanzania education system takes into considerations various national and international policies statements, conventions and agreements. This makes her to comply with both local and global educational demands and cater for the diversities on the needs of all learners and the society in this very fast changing and growing world. To accomplish this end the government has great responsibility of maximizing support to students with VI, to make them learn mathematics subjects like sighted ones.

The current study examined the role of mathematics and science plan established by the MoEST for secondary schools aiming at increasing the involvement of blind and partially sighted students in mathematics and science education. The study was trying to check whether the plan was helpful in the developing and improving mathematics skills to students with VI in that level.

Thus the review of related literatures focused on the above subject of study under the following sub-headings;

Instructional methods applied by mathematics teachers teaching students with VI, competence of teachers who teach mathematics to learners with VI, assessment modalities used to assess mathematics performance and the challenges faced by students with VI when learning mathematics. It further discussed theoretical framework underpinning the study variables and finally, summary of the whole chapter.

2.1 Mathematics instructional methods

Being involving many visual presentations such as tables, graphs, formulae and their manipulations, students with visual impairment face some challenges to learn it. However through the use of appropriate teaching and learning support may open the door for students with VI to access mathematics information. Mathematics instructional methods and techniques used may facilitate or hamper the learning of mathematics to VI students. In this view Cryer (2013) argues that, another area which may be inaccessible to blind and partially sighted students is lack of appropriate support is the way in which STEM subjects are taught.

Some empirical studies indicate effective teaching methods to facilitate VI students' participation in learning mathematics. The study by Cliffe (2012) to explore methods of producing flexible and accessible learning resources for mathematics support the above by emphasizing the accessibility of full notes in suitable format enables the main activity in class to give the desired engagement with concepts and logical arguments. The scholar suggested further the format such as those presented in clearly structured documents, coloured background, formats which can be adapted by students to their fonts, spacing and colour requirements or structural highlighting of equation scope, audio and video formats of real time manipulative. Furthermore, the explanation added materials to include visual organizers such as mind maps, flow diagrams and notes which can be copied and passed on electronically all to be helpful.

Another study conducted in South Africa to examine the view of technicians on teaching science and mathematics to students with visual impairments affirms that, the main

reason why blind and partially sighted learners are unable to participate in pure sciences is due to the lack of appropriate access technologies and teacher attitudes than about the psychological incapacity of blind and partially sighted learners themselves (Maguvhe, 2015).

In their contribution, Brawand and Johnson (2016) highlight the most effective methods for delivering mathematics instruction to students with VI combine things like abacus, braille codes, tactile materials and concrete materials during teaching mathematical skills. Other scholars suggest that, when teaching students with VI, it is imperative to consider the background knowledge of the learner and use it to fill the gaps in knowledge and experience (RNIB, 2012). Kohanova (2006) supports by arguing that, one of the most important conditions of successful pedagogical activity on visually impaired student is knowledge of her/his personality and understanding of her/his abilities, as well as the respect for her/his handicap. The scholar suggests collaboration of all members of a classroom including both visually impaired, sighted students and teachers as being of paramount importance.

Various instructional methods and techniques seem to help students with VI according to different literatures although there are no straight forward or specific methods by which mathematics instructors may use though, this might also depends on the factors such as the knowledge base of subject presentation to students with VI, creativity of the teacher him/herself and flexibility in terms of time and content for VI students in accomplishing certain mathematical tasks.

2.2 Competence of teachers who teach mathematics to learners with VI

Like most of African countries, Tanzania special education teachers for the visual impairment students, were mostly receiving general training which only enable them to read, write Braille and psychology of visual impairment. They may also get training of orientation and mobility and activities of daily living skills. There was no tailored training to guide them to the methods and appropriate methods and or strategies of teaching specific subjects such as mathematics and others. The UNESCO report about challenges in basic mathematics education globally Artigue, (2012) identified that in many countries, “the quality of teacher education is far from satisfactory, even when there is no quantitative problem... the report recommended that, teachers must be well trained mathematically, didactically and pedagogically...This context makes their initial and in-service training all the more problematic” (p. 26). In line of the above argument, another study done in Slovakia secondary schools it was found that, most teachers are not special education teachers so, they often have to use the ”trial and error” method to find out the best way of teaching their blind students who are integrated among sighted students (Kohanova, 2013).

In another instance, the study conducted in Turkey to explore perceptions of visually impaired learners on inclusive mathematics, participants who were learners with VI reported that, their teachers to lack knowledge about learners with VI. They pointed out that, some teachers don't believe that VI learners can do mathematics and others do not know braille alphabets. They also revealed also their teachers to use inappropriate methods of teaching and they don't know how to use abacus (Bayram, Corlu, Aydin, Ortactepe & Alapala, 2015).

In similar vision, Stacy (2013) report focusing on education of CWVI in East, Southern and Central Africa (ESCA) found that, there is the need to change training modality for teachers by introducing new processes and training that is less costly and more time efficient. The education reviews conducted in, Sierra Leone, Ghana, Nigeria and Tanzania revealed a need for teachers to possess a strong knowledge of Braille and also receive specific training on teaching Mathematics to CWVI.

The empirical study conducted in South Africa by Maguvhe in the year 2014, to explore teaching science and mathematics to students with visual impairments the participants opinions revealed that, teachers lack specialist training to teach blind and partially sighted learners, and no rigorous supervision during their teaching practices. Due to that fact, they were not competent in transferring their knowledge to learners with special learning needs, particularly the blind and partially sighted (Maguvhe, 2015).

The same experience is shown in another empirical study which involved four schools conducted in Zambia to investigate challenges in teaching and learning mathematics to visually impaired pupils by Simalalo (2006). The results indicated incompetence of the teachers who teach mathematics to be one of the challenges. In their views learners from two schools among four schools under study reported that, their teachers are ignorance on the use of certain mathematical concepts. In School A they said; “Some teachers do not know most of the mathematics signs in braille and this affected the way the teachers taught” (p.27). In school B learners reported that; “Most teachers complain about teaching mathematics to visually impaired pupils” (p. 27).

The above is evidenced also by the study conducted in Uganda by ICEVI in 2005 investigating the educational inclusion of children with visual impairment. The results showed that, for children with VI to be successful in mathematics, the availability of specialist teachers, learning materials such as braille, availability of tactile equipment and tools were important. The study emphasized that better teacher preparation and the availability of assistive devices as the key factors for success in Mathematics (ICEVI, 2005).

Inadequate knowledge for teachers who teach mathematics to visual impairment may affect the education of students with VI especially in mathematics performance.

In studies done in Tanzania to investigate education of VI in inclusive settings, it was observed that, there were insufficient competences in teaching VI students. The studies suggested that, in order to deal with such challenges, general teachers need to have the necessary knowledge and skills on inclusion (Mmbaga, 2002; URT, 2008).

2.3 Assessment modalities for students with visual impairment

Tanzania is using centralized education curriculum. So the assessment of students' academic achievements, grading and certification of their final examinations is done by the National Examination Council of Tanzania (NECTA). This is to say all students including those with VI are evaluated together with others by the same measurement and same grades. One scholar pointed out that, issues relating to assessment equity and validity were apparent in the information gathering for the countries. It seems then that several countries are very conscious of issues relating to equity and validity (Pepper, 2007).

Research done by Fraser and Maguvhe (2008) shows that, the context in which the learning occurs; inflexible curriculum and inappropriate assessment procedures are some of the factors leading to ineffective learning among students with visual impairments. Such ineffective learning and performance is supported by the guide book on teaching VI students by Carney, Engbretson, Scammed and Sheppard (2003) which indicates mathematics assignments and examinations to pose some difficulty for the student with blindness. Carney et, al.(2003) suggest some good practices in assessing VI in mathematics to consider the student's well-being particularly if extensive reading or writing is required,... they further emphasized to allow; additional time for completion of assignments and examinations, student to complete an examination in more than one sitting, ...reduce the number of questions to be answered, provide an alternate way of testing the student's knowledge, provide a scribe, give the examination orally and to accept a computer printout or answers recorded on an audiocassette among others.

The Disability Resource Centre (DRC) of Cambridge university (2013), insists on making adaptations which include examination papers produced in alternative formats such as Braille, audiotape, large print and the provision of extra reading and/or writing time depending on the nature some students with visual impairments the time may be doubled, use of amanuenses or readers and VI students to have separate exam room. DRC (2013) stipulates other adaptations as follows;

“... For example, questions that refer to pictures or ask students to interrogate complex diagrams. Simple diagrams can be made accessible using Braille. For partially sighted students, again you should ensure the exam paper is in an accessible format, for example enlarged font, or a colored background. Certain fonts such as Arial and other sans serif

fonts are better than others...if a student will be completing the assessment electronically ensure the invigilator knows whether the student is expected to hand in the disc or a printed hard copy...for partially sighted students such as the positioning of computers etc. to avoid glare from a window. When marking exam scripts it is important to note that blind students can make spelling mistakes based on a phonological spelling of words. They should not be penalized for this...” (p.7).

To stress the assessment protocols overview, the empirical studies conducted in 25 countries worldwide shows that assessment modalities vary from country to country considering the issues of equality of opportunity, equity and validity of the assessment (Pepper, 2007). The report indicates most of the countries consider the needs of learners with visual impairments. For instance in New Zealand the special assessment conditions which were commonly approved were;

“Extra time, supervised breaks or rest periods, modifications to the visual presentation of booklets (usually for sight-impaired candidates) - enlarged/large-print papers, Braille versions of papers, special coloured papers, use of computers or other technological aids such as Closed Circuit Television, (for candidates who have difficulty with reading or writing) if this is the usual method of communication, assistance by a reader, writer or reader/writer” (p.13). The report further shows that in South Africa special arrangements reported involve District Based Support Team to assist teachers in preparing alternative formats of exam paper such as audio-taped, in large print or Braille, provision of an amanuensis/scribe, assistive devices, special equipment among others (Pepper, 2007).

Like other countries Tanzania National Examination Council Act Cap 107, (2015) stipulates special treatment for candidates with exceptionalities. These are clearly stipulated on Part V of the provisions section 29 (2), (3) & (4) which state that;

“... (2) a visual impaired candidate shall- a) be provided with special examination room,
b) dictate the answers to an amanuensis or type on a standard typewriter;

(3) a visual impaired candidate may be allowed to sit for mathematics and science subject examinations in a manner as shall be prescribed by the Minister.

(4) a candidate with disability which slows down his writing speed in the examinations shall be offered with additional of twenty minutes in every hour for mathematics and ten minutes in each hour for other subjects” (URT, 2015, pp. 24-25). Despite the above special assessment adjustments, students with visual impairments in secondary schools in Tanzania were automatically placed out of the top grades because they were exempted from some subjects or topics. UNESCO (2006) identifies that these students in addition to mathematics, are not performing questions involving calculations, drawing diagrams, reading and drawing maps among others. The reason was the government had not adapted the curriculum enough to help these students access all the subjects like other students.

However, no empirical evidence showing if all teachers and the school administrators understand and implement modifications suggested by the government, when teaching and administering tests and examinations to learners with VI in various levels of education in Tanzania.

2.4 Challenges faced by Visually Impaired students in learning mathematics

Generally visual impairment as a sight loss brings a significant negative impact on academic achievement to an individual. Learners who lack a major sense such as vision may construe the world in different ways than those with full sensory equipment (Ostad 2000). Therefore, learners with VI need to be provided with opportunities, concrete experiences and activities in order to acquire what sighted learners acquire in natural world.

The study conducted in England, Wales, Scotland and Northern Ireland in 2009 focusing on educational achievement in secondary education, showed the influence of visual impairment on educational attainment. In England research indicated that, the attainment levels of pupils with visual impairment were below those of pupils without Special Educational Needs (SEN). This applied to students whose visual impairment was their only special education need as well as to pupils who had additional special education needs (RNIB, 2013).

Since most of the concepts in mathematics involve equations and figurative illustrations, a lot of energy and time is needed for non-sighted student to grasp especially if the lesson is not well prepared. The above observation may draw evidence from the study to investigate Teaching Mathematics to visually impaired children in low income settings such as Zambia, Mali, Ghana, Tanzania, Kenya and Sierra Leone by sight savers which indicated, CWVI to have lack of tactile materials that made them to rely on visual descriptions of diagrams and shapes in order to gain and understand form, position, or contour which impacted their learning negatively (Rowe, 2013). This is substantiated by

Kohanová (2003), in the study to investigate the ways of teaching mathematics to visually impaired students in Slovakia schools, the results revealed that, blind pupils face frequent mathematical problems including finding the similarities in different activities of everyday life, translating activities and actions into mathematical language, lack of flexibility in problem solving and in calculations. The same study indicated difficulties in understanding geometrical drawings of cubes from a perspective view because they lack visual experiences making them fail in enlarging and minimizing two dimensional forms.

In another study conducted in 2013 shows visually impaired students to encounter the problem of insufficient textbooks, study material and limited Braille notation for mathematics (Kohanová, 2013).

Similarly, the report of study to investigate teaching STEM subjects to blind and partially sighted learners by Cryer (2013) identifies some challenges to include accessibility to technical notation involving conversion of equations to accessible formats, accessing visual resources such as graphs, diagrams and charts which need alternative formats to make VI students to understand visual concepts and explain in words or through 2D images. The study further reveals some aspects of engagement in classroom activities such as experiments to be difficult for blind/partially sighted students with no appropriate resources and clear explanation. Inaccessible teaching methods in STEM subjects commonly taught through 'chalk and talk' methods which involve listening to the teacher and working through examples on the board, ineffective teaching strategies all these cause learning challenges to VI students. The study pointed out that lack of insufficient training to equip teachers to overcome these problems to be the major cause. It may be

due to such challenges that most of the students with VI were excluded or themselves felt that were unable to learn mathematics subject.

2.5 Summary

Literatures indicated the importance of mathematics skills to students with visual impairment. Many scholars proposed various instructional methods, techniques and learning materials that might be utilized in teaching mathematics to students with visual impairment. The empirical studies have maintained that effective teaching methods and strategies; well trained teachers on how to impart mathematics knowledge all these can provide room for learners with VI to be active participants in mathematics class sessions. Some adjustments in the way curriculum was set and flexibility of the procedures when assessing students' achievement in mathematics seemed to account for visually impaired students' success in acquiring numeracy skills. The scholarly articles reviewed assisted and paved the way on how the current study was conducted.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter intends to describe and presents the paradigm underpinning the study, research design, target population, sample and sampling procedures, sample size, data collection instruments, procedure of data collection and location of the study. It further describes the aspects for data analysis procedure, issues of reliability and validity and finally ethical considerations.

3.1 Research paradigm

The term paradigm can be defined in a number of ways. Willis (2007) explains that “A paradigm is a comprehensive belief system, world view, or framework that guides research and practice in a field” (p.8). In another view, Walliman (2011) pointed out that, a paradigm refers to the overall effect of the acceptance of a particular general theoretical approach, and the influence it has on the scientists’ view of the world. So a paradigm is essentially a worldview, or a whole framework of beliefs, values and methods within which research takes place. It is this world view within which researchers works.

The current study used constructivism/interpretivism paradigm. The paradigm believes that reality is socially constructed and reality is upon the individual perception. It refers to the idea that the mental world – or the experienced reality – is actively constructed or “brought forward,” and that the observer plays a major role in any theory. Researcher opted to use constructivism/inter-pretivism paradigm in order to get insight on the influence of mathematics and science plan; through the views and beliefs of students with

VI themselves and other people; behaviours we have to be aware of, their experience and attitudes towards arithmetic studies. It was through this paradigm the study enabled to investigate how students with VI were learning mathematics focusing into special accommodations available to facilitate the learning process.

3.2 Research design

In order to be able to explore and get enough knowledge and understanding about the effectiveness of mathematics and science plan to learners with VI, the current study employed a qualitative approach, case study of two secondary schools. Creswell (2007) pointed out that, qualitative research design involves process of understanding of the meaning individuals or group of ascribe to a social or human problem. He added further that, the process involves emerging questions and procedures of data typically collected in the participant's setting and data analysis is inductively building from particulars to general themes which enable the researcher make interpretations of the meaning of the data.

That means in qualitative approach, researchers study things in their natural settings, attempting to make sense of or interpret phenomena through the meanings given from people. Another scholar commented on the concept of qualitative study as "Grounded in a philosophical position which is broadly 'interpretivist' in the sense that it is concerned with how the social world is interpreted, understood, experienced, produced or constituted" (Manson, 2002, p. 3). Following the above perceptions of the approach, the current study intended to build a complex and holistic picture of the mathematic plan established by the MoEST. The study was conducted in school setting where teaching

and learning process was done. This enabled the investigator to make observations on how mathematics instructions were delivered to visually impaired learners. Furthermore the design allowed the study to get the detailed views of informants on the issue under investigation through interviewing them. Both observation and interview enabled the study to explore properly the plan through the prior set of research objectives. Through direct enquiry, it was possible to get direct perspectives and views of the visually impaired learners themselves, who were for long time excluded either purposely or unintentionally to study mathematics, though it was said that, mathematics subject was compulsory to all learners in ordinary level secondary education.

3.3 Location of the study

The current study was conducted in Kilimanjaro region in Moshi municipality and Tanga region whereby Korogwe Town council was involved. Both two regions were located in the northern part of the United Republic of Tanzania. The regions were intentionally selected basing on the fact that they were among the regions in Tanzania, having schools accommodating students with VI, which was the target of the study. Two secondary schools were selected; school **S** from Moshi municipal council, Kilimanjaro and school **K** was from Korogwe town council in Tanga region. The schools involved in the study were among the old secondary schools in the country. School **S** being boys secondary school while school **K** was for girls. However, both were boarding schools for students with VI something which simplified organization of the interview sessions, due to flexibility of investigator schedule which compromised with the students' class timetable. Other considerations included reasons such as travel logistics, familiarity to the place and

options for places to stay during research activities. All of the reasons above made possible the process of data collection.

3.4 Target population

The population of the current study included one special education Director from MoEST, mathematics teachers who teach students with VI, two from school **K** in Korogwe Town council in Tanga region and two from school **S** from Moshi municipal council Kilimanjaro region. The study also involved four students with VI two from school **K** and two from school **S**.

3.5 The sample

Alvi (2016) defines a sample as “a group of relatively smaller number of people selected from a population for investigation purpose”. (p. 9). In its broadest sense Gentles, Charles, Ploeg and McKibbon (2015), define qualitative sampling in research as “the selection of specific data sources from which data are collected to address the research objectives” (Gentles et, al. 2015, p.1775).

Furthermore, Kothari (2004) affirms that, “in selection of the sample size a researcher needs to consider the parameters of interest in a research study that must be kept in view such as budgetary constraint must invariably be taken into consideration” (p.56).

The current study intended together detailed information on the role of the mathematics plan to students with VI in secondary schools. To achieve this intention and compromise with time and resources, Director of special education from the MoEST and two mathematics teachers who teach students with VI from each secondary school involved in

the study were interviewed. Other participants included two students with VI from each secondary school under the study. This constituted a total number of nine participants.

3.6 Purposive sampling

In view of answering the question of which people to sample, Mason (2002) affirms that, the process should be driven by an interpretive logic of which questions and evaluation of different ways of classifying people in the light of the particular concerns of your study. Mason (2002) added that the process “must be a concern to identify who it is that has, does or is the experiences, perspectives, behaviours, practices, identities, personalities, and so on, that your research questions will require you to investigate” (p. 129).

To accomplish the investigation, the current study used purposive sampling technique to obtain participants. Scholars like Kothari (2004) pointed out that, in purposive or judgmental sampling the organizers of the inquiry purposively choose the particular units of the universe for constituting a sample on the basis that the small mass that they so select out of a huge one will be typical or representative of the whole (Kothari, 2004; Pandey & Pandey, 2015).

Mathematics teachers who teach students with VI were purposively selected based on their experience of teaching students with VI. As instructors had enough information on the process of teaching and learning mathematics to students with VI. The main criterion of preference was a mathematics teacher teaching the classes having students with visual impairments. The fact was that, in Tanzania secondary schools, general teachers were the one teaching in inclusive classrooms. It was therefore important to see how students with visual impairments were involved in learning. Researcher included also Special

Education Director from the MoEST in order to get rich information about the preparation and implementation of the plan. The same sampling technique was used in getting students with VI who participated in the current study.

3.7 Methods for data collection

The current study used two methods of collecting data namely, interview and observation. Below is the detailed description of each method.

3.7.1 Interview

Interview is a kind of social interaction in which there is exchange of information or views between a researcher and the participant. It involves verbal stimuli in form of questions from the interviewer and the respondent reply by giving responses verbally.

Many researchers agree the fact that an interview is simply the interactional exchange of dialogue. Mason (2002) maintains that “qualitative interviews may involve one-to-one interactions, larger group interviews or focus groups, and may take place face to face, or over the telephone or the Internet” (p.62).

Kothari (2004) analyses the role of using interview method that, more information and too in greater depth can be obtained and the interviewer by his own skill can overcome the resistance, if any, of the respondents. Furthermore the interview method can be made to yield an almost perfect sample of the general population, greater flexibility and opportunity to restructure questions and Observation method can as well be applied to recording verbal answers to various questions. Kiomoka (2014) supported the above by saying that, “conducting face - to – face interview enable the respondents to tell the

interviewer a lot of information and also helped in managing the information provided by the respondents through probing questions” (p.39).

Furthermore, through the establishment of trust and rapport, with the respondents, an investigator is likely to gather information that could not be obtained by any other method of data collection. Several interactions therefore, were made before the interview sessions, to ask for consent, to build trust and rapport with the research participants. The current study used semi structured interview. The investigator prepared interview guides with open ended questions for Director special education, mathematics teachers and students with VI (see appendices 7, 8, and 9).

3.7.2 Observation

Observation is the data collection technique which involves researcher to study certain behavior(s) occurring directly. Kothari (2004) noted that “Observation becomes a scientific tool and the method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded and is subjected to checks and controls on validity and reliability” (p.96).

Other scholars commented that, observation method seeks to ascertain what people think and do by watching them in action as they express themselves in various situations and activities (Pandey & Pandey, 2015). In another view others believe that observation unlike interview methods, the approach is likely to lay some considerable emphasis on the claim that the data were ‘naturally’ or situationally occurring, or at least generated through a contextual setting, rather than clearly artificially made (Mason, 2002).

Observation method provided more detailed and new information in addition to the interview, about how mathematics instruction was done to visually impaired students and how they learn this subject in and out of the classroom.

In the current study, the researcher assumed the role of non-participant observer. The investigator observed what was taking place within the mathematics classrooms, out of the classroom, special education resource rooms and other possible learning premises. The investigator recorded what was happening without sometimes interacting with participants directly. Given (2008) pointed out that, non-participant observers sometimes may physically present with participants in a naturalistic setting, but other times may not be present in the setting. And added that, one reason of opting this method may be the researcher may have limited or no access to a particular group and therefore may not have the opportunity to engage in participant observation (Given, 2008). The investigator decided to use that kind of observation method because it is consume little time in the process of collection data. The researcher used observation schedule to guide and maintain the focus of the aspects of intent. Creswell, (2008) emphasizes the significance of researcher to take field notes on the behaviour and activities of individuals at the research site.

The aspects observed from teachers and students were recorded through writing notes immediately as the aspect was occurring. As an attempt to avoid wrong interpretation in some instances a researcher found time to ask teachers and students if what was recorded from the observation match with their intentions. The study tried to observe in details the learning process, how teachers adapted their mathematics teaching to students with VI

from initial stages to final stages of teaching. The study used interview and observation to collect data or triangulation in order to ensure the quality of data. Bryman (2004) claims that, observation itself cannot provide a reason for the occurrence of behaviour; therefore it is better if it is used in combination with another method, because it is through the other method(s), where the reasons for occurring of a specific behaviour will be stated.

To insure the accuracy of the recording, Kiomoka (2014) observed that, the strength of the observational methods is that it helps the investigator to acquire first-hand information from the original source as behaviours are recorded as they are happening in the natural environment. The scholar noted that, the method also provides accurate and reliable data which helps in strengthening the validity of the research. So the use of interview and observation methods together therefore, it was meant to supplement each other.

3.8 Procedure for data collection

To get desired information the researcher prepared semi structured interviews. The interview guides comprised probing open-ended types of questions which were asked face to face to the respondents. Three different interview guides were used; guide one (Appendix 7) was answered by the Director Special Education from the MoEST, guide two (Appendix 8) was for mathematics teachers and the third was for students with VI (Appendix 9). All questions were organized systematically in sections to reflect and gather information that will answer the research questions and focusing the objectives as well. Participants were free to choose between English and Kiswahili to make them free to express themselves better. The investigator used audio recorder to record the information delivered by the participants. An audio recording helped the investigator to

collect information in detail at the same time maintained the continuity of the interview. Sound recording helped the researcher to minimize missing data. Participants were asked for their permission to before recording their voice.

Researcher prepared and use observation schedule to guide and maintain the intention of the research theme. The researcher was also taking some notes of interest things occurred in the class during mathematics teaching and learning sessions. The study conducted interim data analysis every after interview session to ensure no missing of important information.

3.9 Data analysis

In its original form, raw data collected from the field do not give much meaning. Kothari (2004) pointed out that, processing implies editing, coding, classification and tabulation of collected data so that they are amenable to analysis. The scholar affirms that “The term analysis refers to the computation of certain measures along with searching for patterns of relationship that exist among data-groups” (p. 122). So data analysis involves a rigorous process of refining, organizing and summarizing the data to enable researcher make interpretation.

In the importance of data analysis one scholar commented that, once the data are sorted and ordered, the researcher will start to make some interpretive sense of them, and to build their explanations and arguments (Mason, 2002).

In the initial stage of making analysis, data from recorded interviews and field observation memos were catalogued to simplify identification. Interviews in Kiswahili

were transcribed to English language before data analysis process. The recorded information were then written down systematically and chronologically regarding coding and symbolizing important aspects of the dialogue such as missing information, emphasis, repetitions among others to simplify categorization.

The current study used thematic Analysis. Alhojailan (2012) affirms that “thematic analysis allows the researcher to determine precisely the relationships between concepts and compare them with the replicated data ... All possibilities for interpretations are possible” (p. 40). Researcher spent enough time to read transcriptions for the sake of familiarizing with the data and have in mind what exactly was in the data. Researcher used word processor to construct codes. The initial coding process started by identifying the axial codes from research questions. A specific list of labels or descriptions of ideas was developed from the transcription as already read. Similar descriptions were grouped together under the similar axial code. After generation of initial codes, researcher organized related codes under different themes. Then frequencies of occurrence of descriptions were recorded. The descriptions which were in large number were identified and were used to make themes and categories. Investigator reviewed the process several time to check for their relevance and legitimacy of being called themes and categories.

Kothari (2004) emphasizes that, before embarking upon final interpretation, to consult with other people with insight to the study and who is frank and honest and will not hesitate to point out omissions and errors in logical argumentation and that it is through such a consultation will result in correct interpretation and, thus, will enhance the utility

of research results. Similar to the above fact, investigator after being satisfied with the themes developed, the overall content were defined and used in the preparation of report.

3.10 Reliability and validity of the study

3.10.1 Reliability

Mason, (2002) argues that, reliability involves the accuracy of your research methods and techniques. This is the measure of accuracy and consistency of the research findings in the extent when other investigators repeat and use the same instruments the same results can be obtained.

So reliability is the extent to which measurements are repeatable – when different persons perform the measurements, on different occasions, under different conditions, with supposedly alternative instruments which measure the same thing (Drost, 2011). Reliability was ensured in the current study. Semi-interview guide questions were piloted and corrected several times to ensure accuracy before using them in the field. During this process two research supervisors from Kyambogo University, Faculty of Special Needs and Rehabilitation inspected them as well. passed through them possible corrections were made. Kothari (2004) insists that, whichever method is selected, questions must be well examined and be made unambiguous.

The investigator repeated many times to read interview transcripts to examine for consistency, completeness, comprehensibility and actual meaning of the participants. Furthermore, during analysis thematic coding was repeated several times as well for the sake of obtaining proper themes and categories related to research questions and objectives of the study.

3.10.2 Validity

Validity is the most critical criterion and indicates the degree to which an instrument measures what it is supposed to measure. (Kothari, 2004; Kimberlin & Winterstein, 2008). So validity simply implies the accuracy of the data.

In explaining more on the concept of validity, Ary, Jacobs, and Sorensen, (2010) added that, validity is not on the instrument itself but on the interpretation and meaning of the scores derived from the instrument.

The investigator ensured validity by testing and updating data collection instruments before embarking on the actual data collection process. The study adopted multiple methods of data collection or triangulation in which interview was used together with observation. With triangulation the methods supplement one another, increase internal validity and strengthen reliability. Bell (2005) recorded that, triangulation of instruments means the application of more than one method of data collection to ensure richness of the findings.

Verbatim quotations were used during data analysis and presentation stage to correlate the investigator description to the real participant statements.

Investigator also used three categories of participants who were mathematics teachers teaching students with VI, students with VI and director of special needs education from the ministry of education for the sake of obtaining rich information about the issue under investigation.

3.11 Ethical considerations

Orb, Eisenhauer and Wynaden (2000) claim that, the protection of human subjects or a participant in any research is imperative. So institutional authorities and participants of this study were informed and negotiation made in advance to seek their consent. Another ethical principle considered in this study was the principle of autonomy.

Given (2008) affirms that, the qualitative research starts by deciding the type of participants and to approach them for consultation. The scholar added that, it is important to inform senior management within the institution because the research findings and report may be reported to them for constructive and institutional advice.

The investigator obtained the research clearance from the Vice Chancellor of the University of Dar es Salaam on behalf of Tanzania Commission for Science and Technology (COSTECH) which has authority to register and coordinate researches undertaken in the country (Appendices 2A and 2B). The studies also obtained permission to conduct research from the Ministry of Education Science and Technology (MoEST), Tanga and Kilimanjaro regions authorities (Appendices 3A, 3B, 4 and 5). Furthermore, school administrations were informed through letters sent directly to the heads of schools involved in the study. The researcher informed then all participants and asked for their consent. Every mathematics teachers was asked to freely read and sign a form of informed consent which was then securely kept by the investigator (Appendix 6). Researcher informed them about the nature of the study, the risks, benefits and alternatives, and they were given opportunity to ask questions before deciding whether or not to participate. Participants' confidentiality was also ensured by hiding their names and instead, letters and numbers were used to identify them. The final report did not

include participants' names, addresses and phone numbers. The names of schools were as well not displayed instead letters S and K were given to them, to avoid the possibility of tressing the students or teachers who participated in the study.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND INTERPRETATION OF FINDINGS

4.0 Introduction

This chapter presents, analyses and interprets the study findings. The current study was investigating the role of mathematics and science plan on improving mathematics instructions for secondary schools learners with visual impairment. Four objectives were addressed which are:

First; to examine mathematics teaching methods used in teaching learners with VI.

Second; to determine the mathematics teachers' competencies to teach learners with VI.

Third was, to examine whether mathematics mode of assessment in use considers the special needs of learners with VI. And the last was, to examine instructional challenges faced by learners with VI during learning mathematics.

The findings were obtained from semi-structured interview among students with VI from two secondary schools, their mathematics teachers and the director of special needs education from the MoEST. In addition to the above, non participatory observation was used to collect data from the field.

For the purpose of protecting their anonymity, names of participants were not used. Instead, composition of letters and numbers were used to identify them. Similarly, ages of participants were not included as well.

However, the number added to the identity of participants aimed to indicate the number of a given participant in a particular group. (For instance, SmT-1 and SmT-2 means mathematics teacher 1 and 2 from school S). The numbers have nothing to do with values or ranks of participants.

Table 1: A profile data of participants

Students with Visual Impairment (VI)	Name of school	Gender	Class
SVI-1	S	M	Form II
SVI-2	S	M	Form I
KVI-1	K	F	Form II
KVI-2	K	F	Form I

Mathematics teachers (mT)	Name of school	Gender	Experience of teaching mathematics to students with VI
SmT-1	S	F	3 yrs
SmT-2	S	M	6 yrs
KmT-1	K	M	7 yrs
KmT-2	K	F	2 yrs

Officer	Station	Gender
DsEN	MoEST	M

The results were obtained from themes and categories developed from the data through thematic approach of data coding in relation to the main areas, of literature review of the study. The results are presented according to the views of the participants focusing on emerged themes during data analysis and the observation methods done by investigator in the field. In view of the above the study used verbatim quotations to ensure validity of the study at the same time to offer greater depth of understanding of the mathematics and science plan designed by the MoEST.

Table 2: Themes and Categories

Themes	Categories
Teaching process	Group discussion
	Question and answer
	Expository methods
	Mathematics remedial sessions
Teachers' competencies	Teacher skills and training
Support and Collaboration	Specialist teacher-Mathematics teachers
	Specialist teacher- Students with VI collaboration
	Sighted students-Students with VI
Mathematics assessment Modalities	Time allocated during examinations
	Mode of presentation of examination papers
	Examination venue
	Examination supervision
	Format of examination
Teacher views on the plan	Opinions of teachers about the implementation of mathematics and science plan
Challenges faced by students with VI	Shortage of teaching and learning materials
	Shortage of skilled mathematics teachers
	Negative attitude towards mathematics

Table 2 shows themes and categories emerged during data analysis. Column one is the list of themes and column two indicates the categories of themes in column one. Five themes were derived from data analysis focusing on the objectives and research questions of the study, while one 'support and collaboration' emerged during analysis of the data. Since the study investigated the role of mathematics and science plan in the improvement of mathematics instructions to learners with VI in secondary schools, the study found

necessary to get insight on level of support and collaboration that contributed to the learning of mathematics to students with VI.

4.1 Teaching and learning methods

This theme was important to investigate in order to get clear understanding of various methods which were used in teaching and learning Mathematics to students with VI. Under this concept, participants identified various teaching and learning methods and techniques which were used by mathematics teachers to impart knowledge to learners with VI.

However, the study revealed majority of teachers were using expository teaching method in most of their mathematics instructions. Through interviews the study revealed the reasons as to why they were using mostly that method. The reasons included lack of skills and knowledge to teach a class of students with visual impairment, shortage of teaching and learning materials and large number of students in one class. However, the investigator captured other methods such as group discussion, question and answers and remedial teaching.

4.1.1. Group discussion

Following the fact that, the schools involved in the study were inclusive schools, teachers formed groups involving sighted and visually impaired students. When assignments were disseminated they sat together and solve them in their respective groups.

For example, one of interviewed participants from school S when asked whether students with VI were involved in group discussions, the explanations was, “Yes! They participate in group discussions. Sometimes I involve them” (SmT-1).

Likewise, the students with VI when enquired about support from peers responded that, “Sometimes we are discussing together with them as well. The discussions are held after class hours” (KVI-2).

The study found that, such group discussions were useful method of learning because it enhanced the level of participation to the academic activities among learners with VI, like teacher narrated that, “Yes, they participate in the class because are given some assignments, they discuss with their friends, they listen and they also attempt assignment” (KmT-2).

4.1.2 Questions and answers

The responses from participants indicated that, during mathematics lessons teachers were also using questions and answer method to impart knowledge to all students. In school S the study observed mathematics teacher in form one asking questions, and told the students to rise up hands if they know correct answer or procedure of the mathematical problems required.

One participant when asked the strategies used in teaching in the inclusive class within which students with VI were there responded that, “First is question and answer. You ask students questions so as they can answer” (SmT-2).

Another argued that, “It is like my fellow [Sighted] students. When the teacher asks the question, I raise up my hand then I explain if I know the answer” (KVI-2).

Another participant added that:

They [students with VI] participate. They are willing, because you have to go there and mention the name or ask who can be able to add this, they rise up their hands. It means they like to participate. They explain some solutions without writing... When I was teaching fraction without writing they participated in the lesson (**SmT-1**).

However, the study revealed that when the teacher was asking questions, sighted learners were calculating solutions on their exercise books quickly and answer the problems. On the other side learners with VI were just calculating by heart and tell the solutions. One student from school S narrated with feeling that, “It is difficult [to solve long equations] because we use our brain to answer those questions. When we are calculating such questions or equations, we don’t have the place to write rough work like others” (**SVI-2**).

4.1.3 Expository method

The investigator revealed majority of mathematics teachers to apply lecture methods in their classes. It was also found that, they had difficult moment to teach inclusive class which has sighted learners and students with VI. The fact that, mathematics periods have 40 minutes for single period and 80 minutes for double periods; with the shortage of teaching and learning materials and lack of skills on how to handle learners with VI, made majority of mathematics teachers to use lecture method explaining mathematics concepts on chalkboard. Sighted learners were observed to easily copy in their exercise books main concepts and draw figures or tables using mathematical sets they possessed. On the other hand students with VI were depending on the imaginations and grasp little from teachers’ explanations.

During interview, one participant explained what was just happening during mathematics lesson that:

Only the thorough elaboration because now I don't know the use of this braille [Perkins braille], what I normally do is thorough explanation. Whatever I am doing I have to explain thoroughly so that they [students with VI] can be able to catch the point (**SmT-1**).

One participant informed the study that, shortage of learning materials made their mathematics teacher to explain to them mathematics figures and diagrams. The participant pointed out that:

In fact that is a challenge to us [students with VI] because no learning materials. If it is diagrams no diagrams. For example if it is rectangle we [students with VI] are only told height times width. Teacher can only explain to us things like figures (**KVI-2**).

When **KVI-2** asked whether teacher was coming to the math lesson with any tactile teaching and learning materials, participant replied that, "She comes with nothing".

The study captured response of participant **KmT-1** who narrated challenges they face when teaching mathematics subjects to students with VI. Participant lamented that, it is a challenge to teach a class of students with VI in absence of tactile teaching and learning aids. Participant illustrated that:

It is real a challenge, sometimes we are just using some images and sometimes we create using sands and rope. Sometimes we have them by explanations because even in the examinations they are not giving a question in graph (**KmT-1**).

The data obtained through observation indicated the presence of few teaching and learning aids in the resource rooms of the schools which the study was conducted. However, mathematics teachers do not use them. When investigator wanted to know exactly the situation teachers said first, they don't know if these resources were there. Second, they do don't know how to use them.

4.1.4 Mathematics remedial sessions

When mathematics teachers were asked whether they had special programs apart from normal teaching, mathematics teachers from school **S** said that, students with VI were taught together with the students who are slow learners. The school had special program after class hours when students who are slow learners were taught. One participant who was mathematics teacher from school **S** informed this study that, they get opportunity to repeat concepts more and more hence to make them understand well.

For instance, the participant stated that:

Yaa! Sometimes we have remedial [remedial session] for those slow learners. We [School administration] put them [Students with VI] in the group of slow learners because you know although not all of them are slow learners, but we put them ...so that you [Teacher] will be able to teach them more (**SmT-1**).

The study found that students in school **K** were not full involved in usual mathematics class. But they were taught again the same mathematics concepts separately after normal session. Information given by **SmT-2** was that, "We find the remedial time, remedial

approach, we find extra time to find programs in areas of mathematics difficult to them and we help them”. In support of this, another informant said:

Main support I provide myself [not in school program]. If they [students with VI] do not understand in the class I use extra time. There are periods which they [students with VI] don't attend, I use to teach and explain more to them. For instance computer, ICT they [students with VI] don't study so I call them in another room and help them where they did not understand (**KmT-2**).

On the other hand one student elaborated clearly how their teacher used extra time to teach them:

For us here, it is like I told you [investigator]. When the teacher is teaching, she [math teacher] does not involve us effectively but teaches us later privately or sometimes she prepare lesson notes, when teaches others she gives us our lesson notes. While she writes on chalkboard for sighted learners we follow her through reading our notes which is in braille format. This is how she involves us (**KVI-1**).

Another participant argued that, “And even during teaching the teacher starts to teach sighted learners then she [Math teacher] teaches us [students with VI] alone. We sit privately with the teacher then she teaches us” (**KVI-2**)

4.2 Teachers' competencies

The role of the teacher of students with VI is to provide support and to ensure the students understand concepts introduced in academic subjects. Another role is to enhance student learning by adapting activities and be able to utilize various teaching and learning materials accordingly regarding students' abilities and unique needs. Therefore, the roles

of the teacher cover a wide range of teaching and learning activities aiming to guide students to learn swiftly.

4.2.1 Teacher skills and training

The study found shortage of teachers who have knowledge and skills to handle students with VI. The schools investigated were inclusive kind of settings. The study observed most of the time teachers to use lecture method and explanations using chalkboard. Only sighted students were favored and so very little concentration to students with VI. When asked whether MoEST had considered teacher training before the implementation of the plan, the SEN official from the Ministry replied that, teacher training was conducted.

For instance the participant said, “Teacher training was part and parcel of the plan because the Ministry of Education had a clear understanding that, there were no specialized teacher training programs for mathematics especially for students with visual impairment” (DsEN).

The officer elaborated further that; “The in-service training...yes, we did. We had two in-service teachers training up to the moment for secondary school teachers. It was a ten days seminar and the other one was fourteen days” (DsEN).

However, the current study discovered that, the trainings conducted were not effective enough to equip pedagogical skills and knowledge for mathematics teachers to manage teaching students with VI in secondary schools.

Majority of Participants among students with VI reported that, their teachers had no skills and knowledge to teach them. For instance, when asked to explain how mathematics teacher teach mathematics visual objects, participant reported that, “It is difficult because

a lot of time is used to write on blackboard. Sometimes she [math teacher] explains to us [students with VI] that, she doesn't help us because she doesn't have knowledge of special needs education" (SVI-1).

Likewise another participant with feeling of dejection replied that, "Even teacher says that, she [math teacher] has no knowledge to help students with visual impairment. So I don't have alternative and I have already despair. Now I have decided to base my efforts to other subjects" (SVI-2).

When told to explain the challenges faced by students with visual impairment participant **KVI-1** responded that:

In order for him [math teacher] to explain well to us [students with VI] that you [students with VI] do this way or that way. The teacher who taught us mathematics doesn't know braille. It was until specialist teachers to help her to prepare notes (KVI-1).

Similarly **KVI-2** said the same that, "She [math teacher] will not manage to teach me and understand unless there are available teaching and learning materials. Because herself does not know braille until she finds another teacher who knows braille".

The study found that, only half of mathematics teachers interviewed attended that training organized by the MoEST. It was found however that, two such seminars were not enough to enable them manage teach students with VI.

For instance, the study wanted to know from **KmT-1** whether has any training or not on teaching class of VI students, the answer was, "Eh, yes".

But when asked whether, knowledge of mathematical braille notations, participant responded shortly that, “No” (**KmT-1**).

Another participant elaborated that:

It is somehow difficult to teach them [students with VI] you [teacher] know when you don't know braille and when you are not particularly for them. We [math teachers] discourage them because I don't have someone to translate for me. I have those papers [unmarked assignments] a lot of them Ooh! God! (**SmT-1**).

The study found several unmarked sheets of responses for various mathematics exercises and assignments of students with VI in the office of mathematics teacher in school S.

Again data obtained through observation indicated that, all mathematics teachers had no knowledge of braille and braille mathematics notations. Due to that reason, they were not able to teach properly students with VI. They have to find help from specialist teachers especially for braille transcription and preparation of teaching aids. The study found also that, in school K specialist teachers had no other work apart from reading to students with VI. The specialists also assist other teachers in transcription of Braille. In school S teachers were assigned also subjects to teach. Due to the later fact, specialists in school S, they don't have enough time to deal with students with VI.

Similarly, the observation showed that, specialist teachers of students with VI didn't know mathematics. The specialist teachers also were not competent in braille mathematics notations.

4.3 Support and collaboration

The study investigated whether there was support and collaboration provided to students with VI when learning mathematics. The investigator found collaboration of specialist teachers to mathematics teachers, support of specialist teachers to students with VI and sighted students supporting students with VI. The following is the presentation of each category of support found in the field.

4.3.1 Specialist teacher - mathematics teachers' collaboration

In mathematics lessons students with VI need specific instructions such as the use of assistive devices like a braille kit, talking calculator, abacus and tactile mathematical diagrams and figures among others. The materials help them to get insight of mathematical graphical representation and spatial relationship of non visual format.

Specialist teachers play various roles among them include to advice on the useful devices for students with VI, to make braille transcription, orientation and mobility skills training, preparation of proper teaching and learning materials, sitting plan of students in the classroom among others.

The study wanted to investigate whether MoEST considered availability of specialist teachers and the role they play in assisting mathematics teachers who teach students with VI. The study found specialist teachers to support subject teachers in different ways.

For example, one of mathematics teacher from school S maintained that:

Yes ...Let say you [teacher] are teaching area of the square. You can bring a square and put it on the table, blind can start to feel the shape. And sometimes a certain teacher does not have teaching aids. If you tell the department of visual

impairment that, next week I am planning to teach this one may you [specialist teachers] please prepare teaching aids for your students so that, when they go to class they may understand (**SmT-2**).

Another participant from school **K** explained the kind of support obtained from specialist teachers that, “I prepare assignments inform of questions then converted into braille [by specialist teachers] then I give them [students with VI]. I also give them notes. For notes I prepare them in advance before going to the class” (**KmT-2**).

The Specialist teachers are liaison between mathematics teachers and the students with special education needs. They advice subject teachers on the technical knowhow to go about when they seem to stuck. In line of the above fact, one participant from school **S** appreciated support provided by the specialist teachers of VI by saying that:

Support is quite enough because if the teacher is preparing paper for form one, he should also send a copy to visual impaired department. The specialist teachers will discuss on how to write the figures and type in braille or put in large fonts. And after examination has been done, the examination paper is interpreted by specialist education teachers to come back to teacher [math teacher] to mark (**SmT-2**).

On another hand, **KmT-2** when explaining the process of teaching in which specialist teachers play a great role participant argued that:

Because it is inclusive class so you cannot concentrate more to them only you will teach normally but another method, is to give them [students with VI] some questions. Which I have already prepared so they come and copy them [math questions], transcribed in braille and they do them for more practice. After they

attempt the questions they give me I take them direct to specialist teachers, they de-braille, and then I mark and return the feedback.

4.3.2 Support of specialist teachers to students with VI.

The study found out that specialist teachers provide support to students with VI in various areas. In schools K specialist teachers were appointed to be readers of students with VI.

For example, one participant supported this by saying that:

Those specialist teachers have been appointed also to read for them [students with VI] because if you let them study by themselves sometimes there are so many mistakes and challenges. So teacher is the one who can put things in a good way. Yaa! (KmT-1).

Parallel to that, another participant from school S notified the study that:

We have the teachers from the department [specialist teachers] to help them [students with VI] after normal sessions to understand the concepts. Those teachers who are teaching mathematics are normal teachers they don't have skills to care for visually impaired students even in terms of preparing the modals. But these teachers [specialist teachers] will help them to understand, by preparing some teaching aids (SmT-2).

The investigator had found also that specialist teachers play a great role in counseling students with VI about their academic achievements as well as social affairs. During data collection in school 'S' the study captured a counseling session conducted by three

specialist teachers and two teachers with visual impairment. They were counseling a form three student with VI who went home before doing annual examinations.

For example one of the mathematics teacher from school **K** informed the study concerning that role that, “Sometimes they [specialist teachers] call the students to the resource room and not in the class... first of all is to encourage them to make them love mathematics. We help them so that they can do better” (**KmT-1**).

For instance in school ‘**K**’ school administration has released all specialist teachers from teaching their respective subjects instead they work with students with VI in the resource room. During data collection, investigator found three specialist teachers in VI students’ resource room. Two of them were reading and students writing notes in braille. However, in school ‘**S**’ specialist teachers supported students with VI while they had few periods for their respective subjects to teach.

4.3.3 Support from sighted students

The study revealed good cooperation between sighted students and students with VI. However, it was found that, sighted students provide much support to other subjects and very little to mathematics subject. The fact is that, in both schools the administration pointed some sighted students as a personal reader for student with VI. For example participant pointed out that:

Each student with visual impairment is having one student [sighted student] to read for him the question and notes. So each student is having one. Now we exclude them [sighted students] from other activities for example, doing cleanliness so that they could be able to read for them (**SmT-1**).

When one participant asked about the kind of support students with VI get from sighted peers pointed out that, “They [sighted students] help me when I don’t understand certain concepts and they read for me as well. Sometimes we are discussing together with them as well. The discussions are held after class hours” (KVI-2).

Another explained to the current study that, “We have readers for them [students with VI]. There are some students who have been appointed to read for students with visual impairment and this is done after classes” (KmT-1).

It was observed that, sighted students allocated as readers and other sighted ones were willing to provide support in solving mathematics assignments but they failed because they don’t know how they can help them because first, they don’t see and another reason was shortage of learning materials.

When asked about support in mathematics subject SVI-1 said with feeling of seclusion that:

Mathematics is very difficult for me and for them [sighted students] to assist me because first, that subject needs more facilities for me to perform. And those facilities are like drawing facilities and writing facilities. Some signs in mathematics are not there in braille writings, so it is difficult for example in logarithm there are signs we must write there. But according to my problem is too difficult.

Another student claimed that, “No support because when you ask them [sighted students] for support they say that, no way they can do to help students with visual impairment”(SVI-2).

The study also came to find that, students with VI have inferiority complexes due to the feeling that, they don't know mathematics. They think that, they don't have anything to contribute to such discussions. Due to that fact, they don't like to join discussion groups with sighted learners. To support the above participant from school **K** commented that:

Another thing I think they [students with VI] don't interact with others who are learning mathematics. So they feel that they don't know mathematics. During discussions, when they are asked questions and failed to answer they feel bad, because sometimes they do not know correct answers. So I think that's' is why sighted students study themselves and students with VI study themselves (**KmT-2**).

4.4 Mathematics assessment modalities

For the sake of getting clear understanding of the plan, the study investigated the way assessment was done to the students with VI. The study investigated whether there were special adjustments made to enable students with VI to perform smoothly mathematics assignments, internal examinations and National examinations as well. Therefore this part presents and analyses findings concerning special accommodation adopted during assignments and examinations focusing on; additional time given to students to accomplish a given task, the way papers are presented and nature of questions. It also presents the kind of invigilation, venue where examinations and tests were conducted. Finally, students' mathematics assessment feedback was also discussed.

4.4.1 Time allocated during examinations

When investigator wanted to know whether students with VI are given enough time to accomplish a given mathematics assignments, tests and examinations majority responded students with visual impairment were given additional time whenever doing tests and examinations. One student with visual impairment said, “Half an hour. For example, if the paper is of one and a half hours, then for us we do it for two hours” (KVI-1).

Another student maintained that, “We are given the same duration like others but, when other finish, we are given thirty minutes more”.

When the same student asked whether such extra minutes satisfy the needs student said, “Yes, it satisfies the need for all questions” (SVI-2).

SmT-2 mathematics teacher after explaining other accommodation during examination added also that, “Also they are given extra time for those who are braille users”.

In explaining special support and accommodations given during national examination, participant said that, “They [students with VI] get extra time ten minutes per hour [Each examination hour there is addition of ten minutes]. So if you have three hours it will be half an hour” (KmT-1). And also **KmT-2** another mathematics teacher supported the above by citing that:

They are given extra time. Even in the school time table there is addition time. I think it is not more than half an hour. For instance, if the paper is of two hours, for them [students with VI] it will be two and a half hours time.

However, there was slight discrepancy of actual time reported by the participants although majority reported addition of ten minutes per examination hour. With subject to the conveniences of the device which is used some more minutes may be added.

4.4.2 Mode of presentation of examination papers

The study revealed students with VI to be given examinations and tests in accessible format. Responses from interviews and also investigator got chance to see past tests and examination papers and the study confirmed that, students who are blind are given papers made in braille format and low vision were given papers in large prints.

When asked about how papers were presented to students with VI, one mathematics teacher elaborated that:

For low vision we enlarge the papers. So for low vision there is no problem. For the blind, for them, I will just write the paper and then send it there [to the specialist teachers] so that they will be able to rewrite again in braille (**SmT-1**).

On another hand, **KmT-1** admitted that:

When it comes to the issue of NECTA [National examination council of TZ] off course they are very carefully, off course they are very systematic and very carefully because they bring large print for low vision, they give standard braille.

All students with VI interviewed said that their examinations, tests and assignments were presented in braille for blind students and large prints for low vision students.

A student from school **S** elaborated that, “According to the categories of students, examinations are prepared in braille for blind students and large prints for low vision” (**SmT-2**). Similarly, **KVI-2** said that, “They type for us [paper changed in braille] and we

just read for ourselves in braille and for low vision the paper is presented in large fonts” (KVI-2).

4.4.3 Examination venue

The place where students with Visual Impairment sit for their examinations and tests, were investigated. The findings were obtained from students themselves and among mathematics teachers as well.

Majority of mathematics teachers pointed out that, students with VI they don't mix with sighted students in examinations.

For instance participant avowed that, “During mathematics tests and examinations students with visual impairment sit in different room, because they use Perkins brailers in typing which may disturb other students” (SmT-2).

Another participant **KmT-2** explained the study that, “They [students with VI] do it [exam or test] in this room here and there is another one there [two different rooms]. They have their own room, they don't mix with others” (KmT-2).

When explaining accommodations done during national and internal examinations participant explained that, “Even in internal we give them their class. We don't include them with others. We give them their class. They will be added that ten minutes for each one hour. They are there alone with their teachers [specialist teachers]” (SmT-1).

Responses from some of the students with VI interviewed showed it was true that students with VI did not sit for examinations with their fellows sighted students.

One interviewee told the study that, “In National examination because we are sitting in separate classroom, if our fellow students have finished we continue up to two hours and forty minutes. Yes, we get additional minutes” (KVI-2). The study revealed in school ‘S’ students sit for their examinations in the resource room where the devices were there. However in school ‘K’ the study observed two venues, resource room where devices are kept and another classroom reserved for that purpose.

The study found some reasons for the students with VI to sit in separate venues during examinations. Among them are to avoid noises from Perkins Brailers machine during writing, easy to manage time as they have additional time different from their counterparts and the study recorded the management of the devices breakdown among others.

4.4.4 Examination supervision

In one observation done in one of the schools during mathematics test revealed that, students with VI were supervised by specialist teachers who also assist them to make clarification whenever problem arise and who also communicate with subject teacher if need be. The interview responses mostly from mathematics teachers indicated the students with VI to be given their supervisors both internal and even examinations from NECTA.

When investigator interrogated **KmT-1** concerning to examination invigilation, teacher said, “Yah! Good thing is that, they [NECTA] also appoint specialist teacher to supervise examinations...are from anywhere but they make sure that, there must be a specialist teacher” (KmT-1).

When explaining the kind of support students with VI were getting one participant also said, “They have their own room, they don’t mix with other students [During National examinations] invigilators are from NECTA” (KmT-2).

SmT-1 explained that, “Even in internal [internal examinations] we give them their class. There alone with their teachers [specialist teachers]. I think that one will help them” (SmT-1).

Another participant from the same school added that, “Also sometimes support teachers and invigilators are there at least to help them understand what is written. Not to solve but to make clear [questions and instructions] to them” (SmT-2).

4.4.5 Format of examination

The study investigated to check whether there was any consideration to the examination format for VI. The investigator discovered some examination questions to be difficult for students with VI to attempt. These include calculations involving many digits, diagrams and figures.

One participant explained that, “Especially questions written in figures, they cannot understand, and so poor understanding of the concepts leads to poor performance. That is a big challenge (SmT-2).

Another participant commented that:

Also a format may be a problem to them [Students with VI]. When it comes in arranging the questions they get problems of arranging the questions. Also when

it comes the student has written an error it is not easy to correct compared to sighted students (**KmT-1**).

KmT-2 told the study from experience that, “If you give them more than four digits are too much to them actually” (**KmT-2**).

Also the study discovered that, students with VI use a lot of energy and time to organize numbers on answer sheets when calculating solutions. Majority calculate by heart then write the answers while some start to calculate solutions on paper then transfer answers to answer sheet. Participant **KVI-1** explained that, “Ahaa! Those equations, I use braille paper which is not for answering examination or test. I set the paper in the machine. I attempt my question then after finishing I take answer sheet then transfer already manipulated answers” (**KVI-1**).

On the other side participant explained that, “It is difficult because we use our brain to answer those questions. When calculating such questions or equations we don’t have the place to write rough work like others” (**SVI-1**).

The study discovered however that, teachers and NECTA provide alternative formats for those questions they see were difficult. When asked students with VI were given alternative questions during tests and examinations participant replied that:

Yes, instead of graphs, or by using table, I prepare data which they will understand easily. Yes, But as I said question can be the same but I can change arrangement of numbers. If you give them more than four digits are too much to them actually (**KmT-2**).

Another interviewee on the same issue added that:

Sometimes there are some questions obvious a blind student cannot do especially for drawing. So you have to give them alternative questions, instead to do this you do this. For example sometimes one time I was giving them question of drawing. Show on the number line even number less than ten. So instead of giving them like that, I just told them mention even numbers less than ten. (SmT-1).

The findings showed that even NECTA examinations students with VI were given special attention including alternative questions.

To support that, participant affirmed that:

Ahaa! The good thing with NECTA which is responsible national assessment is that it has a long experience in working with students with VI at primary and secondary school levels for science related subjects like agricultural science, biology, geography, it is the same experience that is applied also in constructing examinations for students with VI at least they give them alternative, theoretical questions (DsEN).

4.5 Teacher views on the plan

Participants had different views about the establishment, implementation, progress and effectiveness of the science and mathematics plan introduced by the MoEST to students with VI in secondary schools. During the field work it was revealed that majority of participants who are mathematics teachers seemed to know that plan.

For instance when asked whether participant knew the plan, participant said:

The plan of the government is to make sure that students with visual impairment, I mean those with low vision and totally blinds are doing mathematics and also science. And also they bringing some materials but it were not enough (**KmT-1**).

On the same view another participant said:

I know and some teachers attended seminars. I did not go for seminar but what I know is Ministry of Education has planned blind and visual impairment[students] to study mathematics and science subjects because previous time they [students with VI] were excluded because of their disability (**SmT-2**).

4.5.1 Opinions of teachers about mathematics and science plan implementation

Majority of mathematics teachers said the idea of including students with VI to learn mathematics was good. On the above issue, participant from school **K** was captured commented that:

In fact the plan is good, their [MoEST] aim was good but they failed to consider time factor. According to them, they planned form one to start learn mathematics. It is ok we started with them [students with VI] but they [MoEST] did not distribute teaching and learning materials. So, that is to say the plan has failed. Everything they planned to achieve will not be achieved because they promised to give us a lot, but up to this time nothing was managed (**KmT-2**).

In similar vein another participant added that:

The plan is good! But for me I think is good for form one and two if they will learn those things as basic things. But for form three, it needs more preparation especially teachers who are special for VI students (**SmT-1**).

Majority of mathematics teachers insisted about training that may add knowledge and skills which can enable them embark on teaching mathematics subject to students with

VI. For example, one participant pointed out that:

There are seminars but few of them, if you take the number teachers in our school, special education teachers are sixteen, but those who have gone for seminars were two, they took the training only once. And some of them are not mathematics teachers may be. So if the Ministry of Education could do a number of seminars for teachers and preparing teaching and learning materials, this program could be very successful compared to now (**SmT-2**).

Talking about the MoEST officials to visit schools to check the progress of the plan, participant maintained that:

They were planning to come [MoEST officers] to schools to check how we are conducting the exercise of teaching them [students with VI]. We were prepared but I think they don't have time. They did not come" (**SmT-1**).

However, they recorded various issues which give the implication that, the plan was not effective enough due to lack of preparations. In a nut shell mathematics teacher avowed that:

Ahaa! To be honest I can say that it [math plan] is very poor. Because we don't have mathematics braille books, there are no good preparations off course; I have to be honest about that. We don't have also curriculum, but also they are studying from one to form two, when it comes to form three, we are lacking preparations. I think they [MoEST] need to make follow up on that (**KmT-1**).

Mathematics teachers seemed to be ready to teach students with VI, if the plan would be well prepared in terms teaching and learning facilities and teachers' training to equip them with skills to handle students with VI. In line of the above **Smt-2** said that:

My view is that, they [MoEST] set policy without being prepared still we are facing a lot of challenges. These challenges are in terms of equipment, teaching and learning materials, because we find for normal students, they [sighted students] have books for mathematics. But for the blind students the Ministry of Education did not prepare books.

4.6 Challenges faced by students with VI in mathematics subject

The current study aimed to investigate the role of science and mathematics plan in improving mathematics instructions to secondary school students with visual impairment. To accomplish that end, it was necessary to explore various challenges encountered by the students with VI when learning mathematics. Through responses from the informants and observation method, the investigator captured three categories of challenges prevailing learning of the subject as presented hereunder;

4.6.1 Shortage of teaching and learning materials

When were asked if there were challenges faced learners with VI during learning mathematics, all participants mentioned shortage of mathematics teaching and learning materials. For instance, mathematics teachers didn't understand how they could implement MoEST science and mathematics plan without the presence of curriculum modified to suit the needs of learners with VI. One mathematics teacher pointed out that:

There are no good preparations off course. I have to be honest about that. Because we don't have mathematics braille books, we don't have also the so called curriculum. But also they are studying from forms one to form two, when it comes to from three, we are lacking preparations (**KmT-1**).

When asked to tell learning materials they were using in learning mathematics **SVI-1** who was in form two replied that, "Only Perkins brailier, abacus and spur wheel".

When asked about mathematics braille books **SVI-1** explained that, "Are there but not enough and are in form one only". In support of that **KVI-1** a form one student notified that, "...the book title is written mathematics but when you open inside is not mathematics". The same student added that, "Not all topics were prepared".

KVI-2 on another hand commented with feelings that, "Teacher will not manage to teach me and understand unless there is available teaching and learning materials. We don't have even mathematics books in braille. There are no books".

Another participant who was **SmT-2** supported the above by saying that, "These challenges are in terms of equipment, teaching and learning materials, because we find for normal students, we have books for mathematics but for the blind students the Ministry of Education did not prepare books".

Referring to the promise given by the MoEST that they could be given technological teaching and learning assistive devices, **KmT-2** claimed that:

They said that, they would distribute talking calculators but up to this time we did not received anything so I am teaching without talking calculator. So even when

you assign mathematics tasks to students they [students with VI] say this number is big, reduce some digits”.

4.6.2 Shortage of skilled mathematics teachers to teach students with VI

The findings showed shortage of skilled mathematics teachers who can manage to impart numeracy skills to learners with VI in secondary schools. The study revealed mathematics teachers who teach mathematics to students with VI were regular teachers thus, lack skills and knowledge to handle learners with visual impairment and sighted learners taught together in inclusive classroom. This was illustrated by the statement captured from form two students who explained that, “Teacher herself said that, she doesn’t have knowledge and skills to teach students with visual impairment. But I [student with VI] attend mathematics lessons accordingly” (SVI-2).

Likewise **SmT-1** elaborated that:

I can’t mark their [Students with VI] exercises because every time I went to the class, I have to give them exercises. Yes! They are here [Students with VI], they don’t know now how, if they get correct, they don’t know if they get right. Ooh! Please teachers are needed! (**SmT-1**).

Through observation to the sites the study revealed most of specialist teachers are not mathematicians and they don’t have knowledge of mathematics braille notations and they don’t know how to use some of mathematical assistive devices. So they don’t manage to provide effectively mathematics skills to students with VI.

For instance when explaining the challenges students with VI face when learning mathematics, participant said:

First challenge is teachers. It is good for mathematics teacher to know braille in order for him to explain well to us that, you do this way or that way. The teacher who taught us mathematics did not know braille. It was until specialist teachers to help her to prepare notes (KVI-1).

Another student insisted that:

Among challenges we face when learn mathematics include lack of teachers, special to teach us with knowledge to teach mathematics and students with visual impairment. I have Braille Kit and Abacus yes, but I don't have technical knowledge on how to use abacus. Only if we get teachers who can teach us on how to use it, I will use it (SVI-2).

One participant among mathematics teachers elaborated what was happening when giving assignments or examinations to students with VI. The teacher was saying after preparing assignment or examination, the paper is sent to specialist teachers for transcription into braille. When asked if there is possibility for specialist teachers to modify certain questions, the teacher responded as follows:

No, no they have to come to me again, because they don't know mathematics you see, they teach other subjects not mathematics. They come and ask what about this case. I have to change because they don't know mathematics (SmT-1).

The study revealed that, only half of mathematics teachers interviewed attended short in-service training on how to teach science and mathematics to students with VI organized by the MoEST.

4.6.3 Negative attitude towards mathematics

The findings indicated that students with visual impairment had negative attitude towards mathematics subject. Majority of the mathematics teachers said that, students with VI don't like the subject and were just forced to learn it. For example, one participant informed that:

I think they feel that they don't know mathematics. During discussions, when they are asked questions and failed to answer they feel bad, because sometimes they do not know correct answers. So I think that's' is why sighted students study themselves and students with visual impairment study themselves (**KmT-2**).

Interviewee added that:

I used to interrogate one student, she said I use a lot of time to explain so they think that, they are wasting time of others. Those from my class one time requested to be taught separately and not with others.

Concerning to negative attitude another informant recorded the following response that, "I told you, they are forced to learn. Is not their willing, so they take mathematics as an option. So you find that when it comes to the issue of mathematics, they just do for granted" (**SmT-2**).

During interview one of the participants among students with VI told the study that, their mathematics teachers told them that, they don't have knowledge to teach students with VI. The student repeated what the teacher told them, "This lesson is not easy for you [It is difficult to students with VI]" (SVI-1).

Due to comments from their teachers another student with VI was found discouraged therefore argued that, "Even teacher says that she has no knowledge to help students with VI. So I don't have alternative and I have already despair, now I have decided to base my efforts to other subjects" (SVI-2). The study found that, such statements from mathematics teachers and other people seemed to inculcate bad impression to students with VI that mathematics subject is difficult.

Furthermore, the current study revealed the MoEST to know such situation when captured DsEN, talking about the same issue. The officer said even some teachers with VI contribute to propagate that bad seed of feeling that mathematics is not for persons with VI. According to the DsEN some teachers and persons with VI have an assumption that, students with VI were struggling with arts subjects. Now for science and mathematics situation would be worse. They discouraged students with VI to learn because themselves they did not benefit from it.

DsEN informed that:

The issue of negative attitude towards mathematics is there especially those students with VI who didn't have this opportunity [of studying math]. Sometimes they [teachers and ex-students with VI] discourage their colleagues that

mathematics is not for us [persons with VI] you [student with VI] are wasting your time.

The officer concluded that, “That is a challenge and even some of their teachers with VI [secondary school teachers with VI] might not support very serious because they did not benefit with mathematics”.

However, the MoEST reported that, they had already done awareness rising and expect to make some visits to schools for follow ups, sensitization and awareness rising.

The study also revealed that, teachers were left behind; there was no effective follow up done by the MoEST to the schools implementing the plan. Due to that, teachers were discouraged and stranded to the extent that, they also agree mathematics was not for students with VI.

CHAPTER FIVE

DISCUSSION OF THE FINDINGS

5.0 Introduction

The primary concern of this study was to investigate the effectiveness of Mathematics and Science National Plan in the Improvement of the Mathematics instruction to Secondary School Learners with VI.

The study to investigate the effect of mathematics plan to learners with VI was guided by the following questions;

- Are mathematics teaching strategies in use benefit learners with VI?
- Are the mathematics teachers trained with techniques to teach numeracy skills to visually impaired students in secondary schools?
- What are the views of mathematics teachers who teach mathematics to learners with VI?
- What are the challenges faced by students with VI when learning mathematics?

Therefore, this chapter intends to present the discussion of findings basing on the themes and categories emerged during data analysis. The discussion also was focusing on various related literatures and theoretical framework as discussed earlier in chapter two of this study.

5.1 Teaching and learning methods

As emphasized by the National and international policy documents, education is the right of every child. UNESCO (2015) stresses that, not merely the right to education, but also

particularly the right to quality education for all. It is also addressed in the World Declaration for Education for All (UNESCO, 1990), the Salamanca Statement and Framework for Action (UNESCO, 1994), the Convention on the Rights of the Child (UNICEF, 1989) and the Convention on the Rights of Persons with Disabilities (Schulze, 2009).

Equality is also addressed by the social model of disability which emphasizes the society to provide social support in dealing with barriers, providing aids, to have resources and to involve people with disabilities in all social aspects and to overcome any possible discrimination which leads to unfair wellbeing of their life.

Participation is an active involvement in the whole process of education that build an educational community where all learners are welcomed and feel safe, as they are respected, valued and their individual needs are met (MoEVT, 2009). The findings of many studies however demonstrate that, there are many difficulties faced by blind/partially sighted students in terms of the way teaching is delivered (Cryer, 2013).

Contributing to mathematics instructions, Cryer (2013) argues that, another area which may be inaccessible to blind and partially sighted students is lack of appropriate support in the way in which STEM subjects are taught. In similar view, Penda, Ndhlovu, and Kasonde-Ng'andu, (2015) pointed out that, there is a problem of teaching learners with visual impairment in the teaching fraternity. The problem is lack of using appropriate teaching method to learners with visual impairment. So, good selection of Mathematics instructional methods is important in facilitating mathematics knowledge acquisition by VI students.

The current study discovered the following methods to be applied in teaching and learning mathematics to students with VI in the schools involved in the study;

5.1.1 Group Discussions

Findings showed that group discussion was among the methods used in teaching mathematics subject. Mathematics teachers said that, when students were given mathematics assignment they were discussing in their groups involving sighted and VI students. Teachers said that sighted students in the group helped their peers with VI to understand mathematics concepts which were difficult. This was in line of UNESCO (2001) which pointed out that, students with visual impairments in inclusive classroom should be paired with their fellow students without VI who would assist them in their work, finding the correct page during learning and repeating some teacher's instructions. Anthony and Walshaw (2007) argue that, working with partners and in small groups can help students to see themselves as mathematical learners. Such arrangements can often provide the emotional and practical support that students need to clarify the nature of a task and identify possible ways forward. For instance, when asked about involving students with VI in group discussion, participant **SmT-1** from school **S** narrated that, "Yes! They are involved in group discussion. I involve them".

The findings revealed however that, in practical the method can help very little as sighted students had no knowledge of braille notations. This applies the same to the VI students who also know very little mathematics braille notations. So the blind students can benefit only through grasping few simple mathematics concepts. However, it worked well to low vision students who use a pen and can read normal prints. That may be the reason

why majority of students interviewed said they didn't have any support from sighted students in mathematics subject.

For example participant **KVI-1** from school **K** asserted that:

No support, only teachers are helping us, because they[sighted students] use formula or procedures to solve calculations while we blind students we are not using formula but we solve by head then we write only answers....so no any support we receive from sighted peers.

The findings revealed the method to be used effectively in other subjects but not in mathematics. The method could be useful however if the teacher in collaboration with specialist teachers could make one or two problems solved in the class be transcribed into braille format for the student to follow during discussion with friends.

5.1.2 Question and answer

One of the methods which can improve students' learning is the use of a variety questioning techniques that engage students in mathematics lesson. This teaching method involves the teacher asking questions and pupils giving answers or vice versa. Scholars pointed out that, the method provides an advantage of listening to pupils' answers and enabling the teacher establish how much learning has or has not taken place. It helps provision of immediate feedback on what pupils have learnt. (Penda,. et al (2012). Similarly, Al Shamiya (2012) called this method the Socratic teaching method. In one study the scholar found that, this method of teaching involves not pouring new ideas and information into an already empty brain, but rather drawing out universal truths that are already present, yet hidden in the mind. This study showed that teachers' lack of

knowledge about their content and instructional strategies hindered their ability to provide sound pedagogical reasons for their classroom behaviors. (Al Shamiya, S. (2012)

The traditional used method of asking a question involve picking a student with his or her hand in the air, but this should be combined with other techniques to maximize student learning for all students, even those who do not get picked or who do not raise their hands. The findings discovered that mathematics teachers use this method of teaching in their mathematics lessons.

Participant from school **S** when asked to explain the methods used in teaching and learning mathematics, participant explained that, “First is question and answer. You ask students questions so as they can answer or we use group discussion as well (**SmT-2**).

The study captured participant from school **K** who narrated that, “It is like my fellow students. When the teacher asks the question, I raise up my hand then I explain if I know the answer” (**KVI-2**).

However, the number of students reported in school **S** was about 40 students and school **K** the number was 80 students per one class. So using question and answer method could not benefit learners with VI especially when elaborations of some concepts involve illustrations on chalkboard. The findings were similar to one study done in Tanzania which indicated questions and answers to be considered useful to learners with VI as it can help them to engage in oral responses as well. The study indicates however that, in case where there is large number of the learners in the classes, teachers are likely to fail to manage the class. This causes some difficulties for the teacher to manage the children’s behavior during teaching and learning process (Ngonyani, 2010).

5.1.3 Expository methods

The findings revealed the dominance use of lecture method in teaching mathematics in the schools involved in the current study. Teachers reported to use lecture method of teaching due the fact that it is easy method of teaching in the class with large number of students. Studies show that, mathematics requires exactness, definiteness, totality and comprehensibility of presentation (Kohanova, 2003).

The study revealed participant from school **S** using lecture method adding with thorough elaboration to enable learners with VI understand mathematics concepts. However, observation in form two class indicated that, it was difficult to ensure all students understand the instructions. It was observed also that, sighted and low vision students were taking notes and follows the lesson, while blind students were just listening.

In similar case, the study found mathematics teachers in school **K** to use mostly lecture method preceded by giving notes to students with VI, of what would be taught during the specific session of the day. The study discovered good collaboration between mathematics teachers and specialist teachers. Specialist teachers helped mathematics to make notes in braille and in large prints for students with VI. Studies show that, Expository teaching method or rather lecture method was difficult for student with special learning needs to acquire the intended knowledge and skills. The study to investigate teaching of mathematics to students with VI in Slovakia secondary schools, indicates that, it is very arduous only by oral communication (e.g. when modifying expression or by geometrical construction) and so it is supported by graphical way - text or picture. The same study indicates further that, this connection is typical for mathematics; because of insufficient style of expression some students rather prefer

notation or picture (Kohanova, 2003). The above indicates that, students with VI mixed with sighted students did not benefit from the instructions due to the fact that, there was no proper teaching and learning aids, no mathematics books in braille and teachers did not have skills to teach students with VI.

That is due to the fact that, the method involves the provision of an explanation of a particular concept, thought or experience in the classroom context to a learner by the teacher with very little participation or involvement of a learner. The class focuses on the teacher who explains or disseminates the information and learners are involved minimally (Penda et al, 2012).

So generally, method of teaching in inclusive learning environment should be different from the ordinary learning environment, because an inclusive classroom contains students with different learning needs and abilities (Simon et al, 2010). The findings revealed lack of commitment of mathematics teacher to affect teaching and learning process of mathematics, because the study found Braille kits and some few mathematical models which were just stored in the resource rooms of the two schools. The materials could be utilized to enhance proper involvement of students with VI in mathematics lessons. In school **S** for example, it was said that, they don't know if these resources were there and school **K** they said they did not know how to use them.

5.1.4 Mathematics remedial sessions

A big concern in working with the blind is time. Blind students need many explanations, comparisons, taking repeated dictation to check the spelling, the use of specific teaching materials among others. All these operations take up a great deal of time out of the

lesson, which means less time for applications. The findings showed that, the schools had remedial sessions for students with VI in mathematics subject. The findings revealed the presence of mathematics remedial sessions in school **S** whereby students with VI were mixed together with students who mathematics teachers called them as slow learners. Participant **SmT-1** who was mathematics teacher informed this study that, students with VI had opportunity to repeat concepts more and more hence to make them understand well. The school had special program after class hours when students who are slow learners were taught.

The findings discovered in school **K** students with VI were not full involved in normal mathematics lessons but they were taught again the same mathematics concepts or topic separately after normal session. Participant **KmT-2** narrated that:

Mmh! Main support I provide myself [not in school program]. If they [students with VI] do not understand in the class I use extra time. There are periods which they [students with VI] don't attend, I [Math teacher] use to teach and explain more to them. For instance computer, ICT they [students with VI] don't study so I call them in another room and help them where they did not understand.

On the other hand one student elaborated clearly on how their teacher used extra time to teach them:

For us here, it is like I told you. When the teacher is teaching, she does not involve us effectively but teaches us later privately or sometimes she prepare lesson notes, when teaches others she gives us our lesson notes. While she writes

on chalkboard for sighted learners we follow her through reading our notes which is in braille format. This is how she involves us (KVI-1).

5.2 Teachers' competencies

Teaching mathematics to visually impaired learners needs thorough preparations. Mathematics teacher must have knowledge and skills to impart intended concepts at the same time make students not to be bored with the learning process. In knowing that, one scholar argued that, STEM education for blind and low vision students the world over, and similarly in India, has been held hostage to a combination of fear, doubt, lack of knowledge, lack of teacher training skills and resources combined to give the false verdict (Taraporevala, 2015).

To improve the accessibility of STEM subjects for blind/partially sighted students, Cryer (2013) suggested the development of training to increase the confidence of teachers/lecturers in teaching blind/partially sighted students STEM subjects. The scholar recommended also bringing together specialists in visual impairment and specialists in STEM subjects to work together on access solutions (Cryer, 2013).

Therefore, mathematics teacher of visually impaired students must be competent in mathematics subject matter at the same time, to know a lot of methods of teaching mathematics to learners with VI. In order to make students learning more effective, the teacher needs to be more creative in preparing and using proper mathematics teaching and learning materials (Fraser and Maguvhe, 2008) considering tactile graphics, clear labeling and to make spatial orientation of the diagrams.

5.2.1 Teacher skills and training

The findings revealed that mathematics teachers who teach classes with VI learners were regular teachers and hence they didn't have skills and knowledge to teach inclusive classroom.

It was revealed that MoEST had organized only two seminars for science and math teachers who were to teach students with VI. One was conducted for ten days and another was for fourteen days, which all participants who were mathematics teachers claimed to be not enough to build their teaching capacity. Due to that, only few teachers had opportunity to attend that training. The findings resemble to the study done in South Africa in 2014 to explore teaching science and mathematics to students with visual impairments the participants opinions revealed that, teachers lack specialist training to teach blind and partially sighted learners, and no rigorous supervision during their teaching practices. Due to that fact, they were not competent in transferring their knowledge to learners with special learning needs, particularly the blind and partially sighted (Maguvhe, 2015).

In line of the above, education review conducted in Sierra Leone, Ghana, Nigeria and Tanzania revealed a need for teachers to possess a strong knowledge of braille and also special training on teaching mathematics to learners with VI (Stacy, 2013).

Contrary to above study, participants who were mathematics teachers interviewed didn't know braille skills so they depended much to specialist teachers. They also failed to make tactile teaching and learning aids. For example, Participant **S_mT-1** pointed out that:

In fact I don't have specific teaching aid I just use normal things for the one used by normal students ... I don't have specifically that this is for blind, I don't have. ...Because I don't know how to use braille. So I don't know how to write braille.

Similarly the study done in Zambia by Simalalo (2006) in investigation of challenges in teaching and learning mathematics to VI indicated the same that, most teachers were incompetent to teach learners with VI and hence some of them didn't know mathematics signs in braille and hence poor teaching. Other empirical studies with similar results were conducted in Slovakia secondary schools which also indicated most teachers who taught students with VI, were not special educational teachers and hence they used trial and error in teaching (Kohanova, 2013).

However, findings showed that specialist teachers in both schools 'S' and 'K' provide support to mathematics teacher when needed to do so. However, in school 'K' Mathematics teachers, specialist teachers and students with VI meet and clear some challenges regarding to the academic issues for students with VI faced.

5.3 Support and collaborations

Collaboration is the act of working together jointly for a common goal. Habulezi and Phasha, (2014) pointed out that, providing learning support to learners with visual impairment requires adjustments, modifications and adaptations to the classroom, curricular and pedagogical practices.

On the same note, in order to meet the unique educational needs of students with VI, support is needed from many professionals among them are specialist teachers, regular

teachers, parents and sighted students. However, the findings identified collaborations between for specialist teachers and mathematics teachers, Support of specialist teachers to students with VI and support of sighted students to students with VI.

5.3.1 Collaboration between specialist teachers and mathematics teachers

The study observed mathematics teacher in school K to ask specialist teachers for one examinations script of a form two student which was sent for transcription from braille to normal prints ready for marking. The findings discovered also that, specialist teachers were advising on the proper format of the student's tests and examinations.

It was found that, mathematics teachers prepare lesson notes, tests and examinations and send them to specialist teachers to be converted into braille. Similar results were observed in the study done to investigate challenges faced by VI learners in inclusive education in Tanzania. The findings showed that, good cooperation between teachers, can promote a good relationship among teachers and they can manage to share their knowledge and skills by talking to each other... And they can manage to solve the situation better (Kiomoka, 2014).

In school S however, the collaboration was not strong enough due to lack of commitment. That was evidenced by observation done in the office of participant **SmT-1**, who had students' answer scripts which were there unmarked. The teacher claimed not to know braille. This had two indications one; lack of cooperation between mathematics teacher and the specialist teachers and two; lack of commitment to teach learners with VI.

5.3.2 Support of specialist teachers to students with VI

Students who have special needs that cannot be addressed adequately in the regular program should have access to additional support in mathematics, including the support of special education teachers with specific training in mathematics education (Ontario Ministry of Education, 2004). The findings showed students with VI get support from specialist teachers. However, specialist teachers available did not know mathematics so even the assistance they provided in mathematics was not convincing. In schools 'K' specialist teachers helped students with VI to read when students with VI want to write notes with their braille machines. The study discovered that, in that school, school administration assigned specialist teachers to deal with all academic matters of visually impaired students. For example, one participant supported this by saying that:

Those specialist teachers have been appointed also to read for them [students with VI] because if you let them study by themselves sometimes there are so many mistakes and challenges so teacher is the one who can put things in a good way. Yaa! (KmT-1).

The study found that, specialist teachers in school S were dealing with academic issues of the students with VI at the same time were teaching their subjects. To support the above participant from school S notified the study that:

We have the teachers from the department [specialist teachers] to help them [students with VI] after normal sessions to understand the concepts. Those teachers who are teaching mathematics are normal teachers they don't have skills to care visual impaired students even in terms of preparing the modals. But these

teachers [specialist teachers] will help them to understand, by preparing some teaching aids (**SmT-2**).

The study findings showed that, specialist teachers were acting as counselors to students with VI. For example investigator witnessed a counseling session in the resource. The session involved three specialist teachers and two teachers with visual impairment counseling a form three student with VI who went home before doing annual examinations. The same role was played by specialist teachers in school **K**. For example one of the mathematics teachers from school **K** informed the study concerning that role that:

Sometimes they [specialist teachers] call the students to the resource room and not in the class. First of all is to encourage them to make them love mathematics. We help them so that, know themselves that, they [students with VI] can do better (**KmT-1**).

5.3.3 Support of sighted students to students with VI

The study discovered students with VI to get support from sighted peers in other subjects and very little support in mathematics subject. For instance participant from school **S** lamented that:

There is no co operation... In this subject there is no cooperation...about other subject there is cooperation. For instance when I need to make discussion with them they agreed, and when I want to write notes they come and read for me (**SVI-1**).

The study revealed that, poor support in mathematics is due to the nature of mathematics subject, shortage of mathematics learning materials like mathematics books written in braille and lack of background knowledge of mathematics braille notations of the students with VI themselves. However, the findings discovered low vision students including those with albinism and others who are not braille users to benefit from the support from sighted students.

5.4 Assessment modalities

Assessment is crucial process in learning. It helps the teacher to recognize students' weak areas in learning and plan for proper solutions to improve students' performance.

Due to nature of math subject, learners with VI face some challenges in performing their assignments and examinations. This is in relation to Fraser and Maguvhe (2008) who point out that, the context in which the learning occurs; inflexible curriculum and inappropriate assessment procedures are some of the factors leading to ineffective learning among students with visual impairments. Some scholars went further by identifying the fact that, mathematics assignments and examinations pose some difficulty for the students with blindness (Carney, Engbretson, Scammed and Sheppard, 2003).

5.4.1 Time allocated in examinations

The findings showed students with VI to have extra time when given assignments, tests and when attempting their examinations. Majority of participants interviewed mentioned additional time of ten minutes for every hour of examination or test. It was discovered that internal and National mathematics examination papers were of three hours, so students were given thirty minutes. For instance mathematics teacher from school K

reported, “They get extra time ten minutes per hour [Each examination hour there is addition of ten minutes]. So if you have three hours it will be half an hour” (KMT-1).

Such results were found in New Zealand secondary schools where students with VI were given special assessment conditions which included extra time, supervised breaks or rest periods, modifications to the visual presentation of booklets (usually for sight-impaired candidates) - enlarged/large-print papers, Braille versions of papers, special coloured papers, use of computers or other technological aids such as Closed Circuit Television, (for candidates who have difficulty with reading or writing) if this is the usual method of communication, assistance by a reader, writer or reader/writer (Pepper, 2007).

However, it was discovered that, ten minutes was additional time for other subjects not mathematics. According to National examination Council of Tanzania Act, Cap 107, (2015) of special treatment for candidates with exceptionalities part V provisions 29 (4) states;

“ A candidate with disability which slows down his writing speed in the examinations shall be offered with additional of twenty minutes in every hour for mathematics and ten minutes in each hour for other subjects” (URT, 2015, pp. 24-25).

The study discovered also that, there was no uniformity of time reported by the participants; students and their teachers as well because, the additional time reported differ from ten, fifteen, twenty as presented in data analysis (section 4.5.1...). This indicates that both schools S and K failed to translate properly the NECTA rules and regulations.

5.4.2 Mode of presentation of the examination papers

Visual impairment influences negatively the learning achievement of the students with VI. The main media of accessing text information for the blind learners is braille and for the case of partial sighted learners is large print of various sizes depending on the visual condition of an individual and colour of the text background. The findings showed the teachers in both schools under the study to prepare examinations for students who are blind in braille format and those with low vision were given large prints copies made depending on the font size requirement of the student as one participant reported, “So according to the categories of students, examinations are prepared in braille for blind students and large prints for low vision” (SmT-2).

The results were in line of the adaptations said by the Disability Resource Centre (DRC) of Cambridge University (2013), which insists on making adaptations in examination papers for students with VI. DRC stipulated the adaptations to include examination papers produced in alternative formats such as Braille, audiotape, large print and the provision of extra reading and/or writing time depending on the nature, some students with visual impairments may need more. The findings indicated also the same modifications were done to the NECTA mathematics examinations papers.

5.4.3 Examination room

One of the adaptations for students with VI is the room which is proper for examinations. NECTA regulations Act Cap 107, 2015) made clear in Part V of the examinations provisions section 29 (2a) and (2b) which state that;

“(2) a visually impaired candidate shall-

- a) be provided with special examination room
- b) dictate the answers to an amanuensis or type on a standard typewriter (URT, 2015).

The findings discovered schools ‘K’ and ‘S’ to provide special examination rooms for VI candidates during their examinations as per above mentioned regulation. For example when explaining accommodations done during internal and national examinations participant from school ‘S’ explained that:

Even in internal [examinations] we give them [students with VI] their class. We don’t include them with others [sighted students]. We give them their class... They will be added that 10 minutes for each one hour. They are there alone [students with VI] with their teachers [specialist teachers] (**SmT-1**).

5.4.4 Examination supervision

The findings indicated during tests and examinations, students with VI were given their invigilators. It was discovered that, in internal examinations specialist teachers in ‘S’ and ‘K’ were invigilating students with VI in the resource room or any other room selected for that purpose. The findings discovered that, NECTA appoint examination supervisors/invigilators during National examinations for students with VI. Evidenced by participant from school ‘K’ here by saying, “They have their own room, they don’t mix with [During National examinations] invigilators are from NECTA” (**KmT-2**).

5.4.5 Examination format

UNESCO (2006) identified reasons for students with VI to fail in performing questions involving calculations, drawing diagrams, reading and drawing maps among others to be contributed by the government failure to adapt curriculum which helps students with VI to access all the subjects like other students. The study found the same to the schools investigated. Students with VI did not attempt some questions with difficult formats instead teachers as well as NECTA made modifications to enable them perform. The findings revealed teachers and NECTA to provide alternative formats for those questions they see were not accessible to students with VI. For instance, mathematics teacher from school 'K' reported:

Yes, instead of graphs, or by using table, I prepare data which they will understand easily. Yes! But as I said question can be the same but I can change arrangement of numbers. If you give them more than four digits are too much to them actually (KmT-2).

This was in the same note as Carney et al. (2003) in their guide book on teaching students with VI which pointed out that, mathematics assignment and examinations pose some difficulty for the student with blindness. The scholars then emphasized some good practices in assessing visually impaired students in mathematics to consider the student's well-being particularly if extensive reading or writing is required,... they further emphasized to ...reduce the number of questions to be answered, provide an alternate way of testing the student's knowledge, provide a scribe, give the examination orally and to accept a computer printout or answers recorded on an audiocassette among others.

5.5 Teacher views on the plan

The findings discovered that, all participants who were mathematics teachers interviewed were aware of mathematics and science plan established by the MoEST. For instance when asked whether participant knew the plan, participant said:

The plan of the government is to make sure that students VI ...I mean those with low vision and total blinds are doing mathematics and also science. And also they brought some materials but it were not enough (**KmT-1**).

On the same view another participant said:

I know [the plan] and some teachers attended seminars. I did not go for seminar but what I know is Ministry of Education has planned blind and visual impairment [students] to study mathematics and science subjects... because previous time they were excluded because of their disability (**SmT-2**).

The study discovered that, the idea of including students with VI to learn mathematics was good. Basing on the aim of the plan, findings showed the MoEST had started to implement the plan in its premature stage. The study revealed a lot of challenges due to lack of proper preparations which hindered its' implementation.

The MoEST claimed to conduct training for teachers who would teach STEM subjects to students with VI in secondary schools. The findings of the current study discovered first that; the training was conducted twice, one was for ten days and the other was conducted for fourteen days only. There was no another training conducted. For instance the study found two mathematics teachers in school **S** and one in school **K**. The findings relate to the UNESCO report about challenges in basic mathematics globally of 2012. The report

identifies that, in many countries, “the quality of teacher education is far from satisfactory, even when there is no quantitative problem... The report recommended however that, teachers must be well trained mathematically, didactically and pedagogically...This context makes their initial and in-service training all the more problematic” (Artigue, 2012).

Following that, majority of participants insisted the MoEST to provide effective training to teachers who would have enough knowledge and skills to teach STEM subjects to visually impaired learners in secondary schools. For instance mathematics teacher from school S pointed out that, “So if the Ministry of Education could do a number of seminars for teachers and preparing teaching and learning materials, this program could be very successful compare to now (**SmT-2**).

Participants’ suggestions were similar to suggestions made by other studies elsewhere. For instance, the education reviews conducted in, Sierra Leone, Ghana, Nigeria and Tanzania which revealed a need for teachers to possess a strong knowledge of Braille and also receive specific training on teaching Mathematics to CWVI (Stacy, 2013). Another was done by ICEVI in Uganda on educational inclusion of children with VI, which emphasizes better teacher preparation and the availability of assistive devices as the key factors for success in Mathematics (ICEVI, 2005).

Participants also suggested the MoEST to prepare teaching and learning materials for the STEM subjects. Majority complained the MoEST failure to disseminate teaching and learning materials. The findings showed that, there was only one copy of form

mathematics book printed in braille which participants lamented to contain only three topics.

Apart from shortage of text and reference books, the study revealed shortage of other mathematical teaching and learning materials such as talking calculators, geometrical kits, braille printers, thermoforms, abacus, CCTVs, 3D mathematical figures among others. ICEVI 2005 suggests that, in mathematics, most of the teaching aids can be presented tactually because they are aiming at the development of certain concepts. Area, volume, height, weight, elevation, scale value, etc., are some concepts which can be effectively explained through three dimensional teaching aids (p. 18).

The findings revealed as well that, MoEST promised to make follow ups to secondary schools with students with VI to check how the plan was implemented but there was no any follow ups made until when the current study was conducted. Talking about the MoEST officials to visit schools to check the progress of the plan, participant maintains that:

They were planning to come to schools to check how we are conducting the exercise of teaching them [students with VI]. We were prepared but I think they don't have time. They did not come" (SmT-1).

In a nut shell mathematics teacher avowed that:

Ahaa, to be honest I can say that it is very poor, because we don't have mathematics braille books, there are no good preparations off course; I have to be honest about that. We don't have also curriculum, but also they are studying from

form one to form two, when it comes to form three, we are lacking preparations. I think they need to make follow up on that (KmT-1).

However, they recorded various issues which give the implication that, the plan was not effective enough due to lack of preparations. However, findings discovered that, mathematics teachers seemed to be ready to teach students with VI, if the plan would be well prepared in terms teaching and learning facilities and teachers' training to equip them with skills to handle students with VI.

5.6 Challenges faced by students with VI

5.6.1 Shortage of teaching and learning materials

Due to visual nature of mathematics, teaching and learning materials are important to enhance acquisition of skills. Materials which give out sound and or those with little or no visual components are recommended. Bayram et al (2015) suggest that, effective materials use is important to further the mathematical achievement of students with VI, especially when they are not benefitting from their teaching at school. The scholars pointed out that, "They can use various materials to have a deeper understanding of mathematics, but the point these materials have in common is that, they allow the student to learn through assessment of their own understanding and seeking immediate support when they need to" (Bayram et al, 2015).

However, shortage of teaching and learning mathematics materials was reported by all participants. The findings from both schools S and K indicate insufficient of proper mathematics teaching and learning materials for students with VI. The only devices which were there available were magnifying glasses, Perkins Braille machines whereby

each student had one. Other devices like braille machines which were reported to be supplied by the MoEST, were preserved in the resource room. Apart from Perkins braille machines, students with VI were using slate and stylus for writing purpose and few of them use abacus in mathematics.

It was revealed also that, MoEST supplied some braille kits which have mathematical devices for students with VI but were not used but just stored in resource room. It was discovered also that, neither school S nor School K mathematics teachers know properly how to use abacus. The same applied to some students with VI who also were not competent in using it. The student **KVI-1** when asked whether knew how to use abacus replied that, “I don’t know. Some other students know but me I don’t know. Teacher wanted to teach us how to use”.

Modern technological devices are important in teaching and learning to students with VI. DePountis, (2015) pointed out that, for a classroom teacher who has a student who is visually impaired, the presence of technology in the classroom is not optional but necessary. However, the investigator told was told that, MoEST promised to purchase and distribute talking calculators but until this study was done no talking calculators were supplied as one mathematics teacher from school K explained:

They said that [MoEST] they would distribute talking calculators but up this time we did not receive anything. So I am teaching without talking calculator. So even when you assign mathematics tasks to students they say that this number is big reduce some digits (**KmT-2**).

Due to visual deficit, visually impaired individuals need concrete materials to understand the intended mathematical concepts. However the study revealed lack of commitment for specialist teachers in preparing mathematics modals and other tactile learning materials that could simplify both teaching and learning process contrary to Brawand, and Johnson, (2016) who emphasize the use of real objects that can be used to sort, match, compare, group, take apart, put together, seriate, and count. The scholars suggest also that, when teaching various mathematical concepts, items that can be used to help students with visual impairments conceptualize what is being taught to include: various geometric shapes of different sizes, textures, and colours; felt boards; symbol stickers; and base ten blocks.

Scholars commented that, teachers' interest in and knowledge about teaching visually impaired students can be increased by implementing need-specific professional development activities or by creating opportunities for interaction between experienced special education teachers and mathematics teachers (Bayram et al. 2015).

In this view, researchers have highlighted the need for further training for teachers to better equip them to teach STEM subjects to blind/partially sighted students (cryer, 2013).

5.6.2 Shortage of skilled mathematics teachers

Learners who lack a major sense such as vision may construe the world in different ways than those with full sensory equipment (Ostad 2000). Knowing the fact that, vision is an important avenue for learning and more important in mathematics subject due to nature of the subject itself, the findings showed shortage of skilled mathematics teachers who

can manage to impart numeracy skills to learners with VI in secondary schools. The study revealed mathematics teachers who teach mathematics to students with VI were regular teachers thus, lack skills and knowledge to handle learners with visual impairment and sighted learners taught together in inclusive classroom. The finding was similar to the study done by Fraser and Maguvhe (2008) on Teaching life sciences to blind and visually impaired learners in South Africa. The scholars reported that, many teachers even some of those working in special schools for the blind/partially sighted have only had general teacher training, and therefore lack the skills and ideas for adapting the curriculum for those without sight. This leads to poor participation and hence negative effects on students learning.

The statement captured from student with VI from school S illustrates the above fact by pointing out that, “Teacher herself said that, she doesn’t have knowledge and skills to teach students with visual impairment. But I [student with VI] attend mathematics lessons accordingly” (SVI-2).

The study findings revealed most of specialist teachers were not mathematicians and they don’t have knowledge of mathematics braille notations and they don’t know how to use some of mathematical assistive devices. So they don’t manage to provide effectively mathematics skills to students with VI. The study by Maguvhe (2015) in South Africa discovered the same. The study revealed that, teachers were not well trained to teach the blind and partially sighted learners, and lacked the necessary innovation where resources for the teaching of science and mathematics were limited.

The current study findings discovered also that, specialist teachers available only few of them knew mathematics. At the same note, mathematics teachers didn't know braille. So when mathematics teachers prepare assignments and examinations, the paper was sent to specialist teachers for transcription into braille. The findings revealed further that, there was no possibility of making modification to questions until the subject teacher come and make modification. This can be evidenced by statement from mathematics teacher of school S who pointed out that:

No, they [specialist teachers] have to come to me again, because they [specialist teachers] don't know mathematics you see, they teach other subjects not mathematics. They come and ask what about this case...I have to change because they don't know mathematics (**SmT-1**).

The finding also revealed that, only half of mathematics teachers interviewed attended short in-service training on how to teach science and mathematics to students with VI organized by the MoEST. Maguvhe, (2015) The recommended that, mathematics and science teachers need to attend regular staff development workshops covering selected topics in mathematics, science and accommodation suitable for blind and partially sighted learners

5.6.3 Negative attitude towards mathematics

Students can be very much affected by the attitudes and beliefs of their teachers. Teachers should promote positive attitudes and actions about mathematics (Ontario Ministry of Education, 2003).

The findings revealed that some of mathematics teachers have negative notion that, mathematics is not for students with VI and hence they discouraged their students to learn it. The findings revealed that, one of the reasons as to why mathematics teachers discourage students with VI to learn mathematics include lack of knowledge and skills to teach them. For instance, one student with VI interviewed said their mathematics teachers told them that, they don't have knowledge to teach students with VI. For example one mathematics teacher from school S one time told the students with VI that, mathematics is difficult for them. The student with VI from school S repeated what the teacher told them as, "This lesson is not easy for you [It is difficult to students with VI]" (SVI-1).

The study done by Adedokun, (2016) in Western Nigeria to investigate teaching resources of mathematics to VI learners, the report pointed out that, some students with VI had a phobia for mathematics and science. Such students felt science and mathematics should not be included in their curriculum. The report explains further that, students with VI exhibited an inferiority complex, and want to be taught separately when the sighted are not there. Report recommended also the need for students with VI to have self-determination and to believe in themselves.

Similarly, the findings revealed that students with visual impairment had negative attitude towards mathematics subject. Majority of mathematics teachers said that, students with VI don't like the subject, were just forced to learn it and they wanted to be taught themselves not together with others. Interviewee from school K explained this here under:

I used to interrogate one student, she said I use a lot of time to explain so they think that, they are wasting time of others...Those from my class one time they requested to be taught separately and not with others”(KmT-2).

The findings discovered that, ex-students with VI and teachers with VI were discouraging students with VI to learn mathematics. The reason was said to be those visually impaired colleagues didn't benefit from mathematics as they didn't study it. .

The MoEST reported to conduct awareness rising and expect to make some visits to schools for follow ups, sensitization and awareness rising. However, the current study revealed no visits to schools which were implementing the plan and so the level of awareness was still low. The study found further that, due to lack of follow-ups even teachers were remaining stranded they don't know the way forward.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

Focusing on the findings of the current study, this chapter presents recommendations for the improvement of mathematics and science plan to enable effective instructions of the subject to VI students in secondary schools. The chapter presents also final reflections which include the structure of the current study and the main findings. The last part discusses recommendations for future research and practices.

6.1 Recommendations

The findings of the current study may not suffice to generalize the status of mathematics and science plan to the mathematics instructions of students with VI in Tanzania. This is due to the fact that, the study was qualitative design that used small sample from two secondary schools. However, the findings of the current study may reflect the same situation of mathematics instructions to students with VI in other secondary schools in the country.

The study wants to make clear however that, recommendations here under were given to enable improvement of the current mathematics status for VI students and should not be seen as criticisms to the MoEST for establishing the plan, but for mere purpose of solving the prevailing challenges and way forward for improvements.

The study makes the following recommendations for future improvement of the mathematics and science plan to the students with VI;

- The government through the MoEST to incorporate specialized training of mathematics in the curriculum of teachers training colleges in order for them to produce enough teachers who will be have skills and ability to teach mathematics subject to learners with visual impairment in primary and secondary schools. On the same note, the MoEST should regularly consider in-service teacher training to sharpen the knowledge and skills of mathematics teachers. Both trainings should consider knowledge of braille and mathematics braille notations, the use of specialized devices, knowledge of mathematics subject itself and knowledge of how to teach students with VI.
- The MoEST should consider preparation of mathematics instructional materials including curriculum for students with VI which stipulate all possible modification and the specific needs of the VI students; and the mathematics text and reference books in braille. This can simplify the teaching and learning of the subject. In similar vein, the Ministry needs to purchase enough special mathematics teaching and learning aids taking into consideration of modern technological learning materials.
- It is also imperative for the MoEST to make regular follow ups to the schools accommodating students with special needs to check the progress of the established plan. Through that, it may be possible to identify the challenges and find immediate solutions.
- The Ministry of education should plan to raise awareness to teachers and to students with VI on the importance of mathematics to students with visually impaired students.
- The school administrations to inculcate the spirit of team work between specialist teachers and mathematics teachers. This can help to share knowledge and skills on how to improve mathematics achievement of VI students in their schools. Teachers should

encourage cooperation between sighted and students with VI especially in learning mathematics.

6.2 Final reflections

The current study intended to investigate the role of mathematics and science plan on improving mathematics instructions for secondary school learners with visual impairment. The study employed qualitative design using interview and observation data collection methods. The Interview method was used to mathematics teachers teaching students with VI and students with VI from two secondary schools. The study adopted purposive sampling to get participants.

Data analysis was done using thematic analysis where interview transcription and coding was done to obtain the main themes.

For the purpose of getting clear understanding of mathematics and science plan the study conducted interview to the SNE Director from the MoEST, four mathematics teachers who were teaching students with VI two from each school and four students with VI two from each school were chosen as well.

The main findings indicate: teaching and learning process to apply: expository teaching method, remedial sessions and ineffective group discussions; mathematics assessment adaptations including alternative format of questions, additional time, separate examination rooms and papers presented in braille format for blind students and large prints for low vision students. The findings show mathematics teachers were not competent to teach mathematics to students with VI; moderate collaboration between

mathematics teachers and specialist teachers of students with VI, students with VI were supported by the specialist teachers and lack of cooperation and support between sighted learners and learners with VI in mathematics subject.

The main findings indicated challenges encountered students with VI in learning mathematics to include: mathematics teachers who teach students with VI to be regular teachers with no skills and knowledge to teach students with VI, shortage of mathematics teaching and learning materials, lack of knowledge of using mathematical devices both to students and their teachers, negative attitude of students, mathematics teachers and teachers with VI towards mathematics.

The main findings show that, teachers support the plan of MoEST to include students with VI to learn mathematics like sighted students, teachers' opinions about establishment and implementation of mathematics and science plan, the MoEST: to prepare mathematics instructional materials such as curriculum stipulating the content of knowledge VI student need to acquire in mathematics, text and references books in braille, to provide mathematics proper and enough teaching and learning materials to secondary schools having students with VI, to train mathematics teachers on skills and knowledge to teach mathematics and to handle students with VI, to make follow ups to check the way teaching is going on to be able solve timely the emerging challenges encountered by the mathematics teachers teaching and students with VI as well.

6.3 Recommendations for future research and practices

The study suggests need for further research to investigate the role of mathematics and science plan on improving mathematics instructions to students with VI in other regions to compare the results. In this way generalizations can be drawn.

The current study recommends further detailed research needs to be carried out to investigate modern technological mathematics teaching and learning materials that can be adopted in secondary schools.

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**APPENDIX 1: LETTER OF RESEARCH APPROVAL FROM KYAMBOGO
UNIVERSITY**



KYAMBOGO UNIVERSITY

P. O. BOX 1, KAMPALA
FACULTY OF SPECIAL NEEDS & REHABILITATION
Tel: 0414-286237/285001/2 Fax: 0414-220464
DEPARTMENT OF SPECIAL NEEDS STUDIES

15th January, 2018

The DEO/DIS/Head teacher/Teacher/Community/Opinion Leader/Church Leader

.....
.....

Dear Sir/Madam,

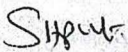
RE: INTRODUCTION OF RESEARCH STUDENT ON DATA COLLECTION

This is to introduce the bearer Rev/D^r/Sr/Mr/Mrs/Ms JEROME VICENT.....
Reg.No: IG/X/13594/GMS.N/P.E. who is a bonafide student of Kyambogo
University in the Faculty of Special Needs and Rehabilitation, Department of Special
Needs Studies. As part of the partial fulfillment of his/her award, he/she is required to
undertake a research on the approved area of study.

The purpose of this letter is to request you to allow him/her have access to information
from your office, school or area of operation necessary for the study.

Kyambogo University will be grateful for any assistance rendered to the student

Yours faithfully,


Dr. Okwaput Stackus
HEAD OF DEPARTMENT

OS/aj

**APPENDIX 2A: RESEARCH CLEARANCE FROM THE UNIVERSITY OF
DAR ES SALAAM**

**UNIVERSITY OF DAR-ES-SALAAM
OFFICE OF THE VICE CHANCELLOR
P. O. BOX 35091 ♦ DAR ES SALAAM ♦ TANZANIA**

General: +255 22 2410500-8 ext. 2001
Direct: +255 22 2410700
Telefax: +255 22 2410078



Telegraphic Address: UNIVERSITY OF DAR ES SALAAM
E-mail: vc@admin.udsm.ac.tz
Website address: www.udsm.ac.tz

Ref. No: AB3/12(B)

Date: 26th March 2018

TO WHOM IT MAY CONCERN


RESEARCH CLEARANCE

The purpose of this letter is to introduce to you **Mr. Vicent Jerome Mbago** who is a bonafide staff member of the University of Dar es Salaam and student at the Kyambogo University.

Mr. Mbago has been permitted to conduct a research titled '**The Role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School Learners with Visual Impairment**'.

The period for which this permission has been granted is from **March to May 2018** and will cover **Kilimanjaro and Dodoma Regions**.

It will be appreciated if you will provide the researcher any assistance that may enable him to achieve his research objectives.


VICE CHANCELLOR
UNIVERSITY OF DAR-ES-SALAAM
P.O. BOX 35091
DAR-ES-SALAAM
VICE CHANCELLOR

**APPENDIX 2B: RESEARCH CLEARANCE FROM THE UNIVERSITY OF
DAR ES SALAAM**

UNIVERSITY OF DAR-ES-SALAAM
OFFICE OF THE VICE CHANCELLOR
P. O. BOX 35091 ♦ DAR ES SALAAM ♦ TANZANIA

General: +255 22 211 2000
Direct: +255 22 211 2000
Telefax: +255 22 211 2000



Telegraphic Address: UNIV DAR
E-mail: v.chancellor@uod.ac.tz
Website: www.uod.ac.tz

Ref. No: AB3/12(B)

Date: 27th April 2018

TO WHOM IT MAY CONCERN


RESEARCH CLEARANCE

The purpose of this letter is to introduce to you **Mr. Vicent Jerome Mbago** who is a bonafide staff member of the University of Dar es Salaam and a PhD student at the Kyambogo University.

Mr. Mbago has been permitted to conduct a research titled '**The Role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School Learners with Visual Impairment**'.

The period for which this permission has been granted is from **April to May 2018** and will cover **Tanga Regions**.

It will be appreciated if you will provide the researcher any assistance that may enable him to achieve his research objectives.


VICE CHANCELLOR
UNIVERSITY OF DAR-ES-SALAAM
P.O. BOX 35091
DAR-ES-SALAAM
VICE CHANCELLOR

APPENDIX 3A: PERMISSION LETTER FROM KILIMANJARO REGION

ADMINISTRATION AND LOCAL GOVERNMENT
THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

KILIMANJARO REGION
Telegrams: REGCOM KILIMANJARO
Telephone:
E-mail:
Fax No:



OFFICE OF REGIONAL COMMISSIONER,
P.O. BOX
MOSHI

Ref.No. FA.191/228/01/33

16th April, 2018

Municipal Director,
MOSHI

Re: **RESEARCH PERMIT**

Refer to the above headlined subject.

2. I wish to introduce to you **Mr. Vicent Jerome Mbago** who is bonafide researcher of University of Dar es Salaam (.....).
3. The title of him research is **"The Role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School Learners with Visual Impairment."**
4. Permission has been granted **from March, 2018 to May, 2018.**
5. Kindly give him required Cooperation and make sure that, he abides by all regulations and directives.

Thank you for your cooperation.

For: **REGIONAL ADMINISTRATIVE SECRETARY**
KILIMANJARO

for, Regional Administrative Secretary
KILIMANJARO

Copy: Vice Chancellor,
University of Dar es Salaam,
P.O. Box
DAR ES SALAAM

✓ Mr. Vicent Jerome Mbago (Researcher)

APPENDIX 3B: PERMISSION LETTER FROM TANGA REGION

ADMINISTRATION AND LOCAL GOVERNMENT

**THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE
REGIONAL ADMINISTRATIVE AND LOCAL GOVERNMENT**

Phone:
Fax:
E-mail:



Regional Commissioner's Office,
P.O. Box
TANGA.

In reply, quote

Ref. No: DA.228/258/03/100

03/05/2018

Town Director,
Korogwe Town Council,
P.O. Box
KOROGWE.

**RE: RESEARCH CLEARANCE PERMIT FOR MR. VICENT JEROME
MBAGO**

The above heading refers.

The name above is a bonfide Phd degree student of University of Dar es Salaam currently, he is about to collect data for his research titled "*The role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School Learners with Visual Impariment*".

He will be collecting data for his research in
Secondary School from the data of this letter to May, 2018.

Kindly, accord him any needed assistance since his permission for this research has been granted.

With thanks.

A handwritten signature in black ink, appearing to read 'Y. J. M.' or similar.

**For: REGIONAL ADMINISTRATIVE SECRETARY
TANGA**

APPENDIX 4: PERMISSION LETTER FROM THE MUNICIPAL COUNCIL

MOSHI MUNICIPAL COUNCIL

(All correspondence be addressed to the Municipal Director)

MUNICIPAL DIRECTOR
ALL OFFICE:
FAX:
E-MAIL:
WEB SITE:
TELEGRAPHIC ADDRESS: MANISPAA



MUNICIPAL HALL,
P.O. BOX
MOSHI.

Ref. No. MMC/A.40/13/1/VOL.I/151

13th April, 2018

University of Dar es Salaam,
Office of the Vice Chancellor,
P. O. BOX
DAR ES SALAAM, TANZANIA.

RE: PLACEMENT FOR RESEARCH WORK

Please refer to your letter dated on 26th March, 2018 regarding an introduction of your student **MR. VICENT JEROME MBAGO** to conduct a research with the title "*The Role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School Learners with Visual Impairment in Moshi Municipality.*"

With this letter, permission has been granted to **MR. VICENT JEROME MBAGO** to conduct the research.

Best regards.

Handwritten signature of Samwel W. Msumary.
Samwel W. Msumary
For; MUNICIPAL DIRECTOR
MOSHI
MANISPAA
MOSHI

C.C: Head Department,
Secondary Education,
MOSHI MUNICIPAL - Please assist

C.C: **MR. VICENT JEROME MBAGO,**
University of Dar es Salaam,
Office of the Vice Chancellor,
P. O. BOX
DAR ES SALAAM, TANZANIA

APPENDIX 5: PERMISSION LETTER FROM THE TOWN COUNCIL



KOROGWE TOWN COUNCIL

(All Correspondence letters should be addressed to Town Director)
P.O.Box: 615, Telephone: 027-2650050 Fax: 027-2650075
E-Mail: info@korogwetc.go.tz/korogwetowncouncil@gmail.com
Website: www.korogwetc.go.tz
KOROGWE, TANGA, TANZANIA

Ref. No. HMK/T.2/03F/27

04/ 05/ 2018


Headmistress
Korogwe Girls sec school
P.O Box 155
Korogwe

**REF: ACCEPTANCE FOR RESEARCH PERMIT FOR MR. VICENT
JEROME MBAGO STUDENT FROM UNIVERSITY OF DAR ES
SAALAM.**

The heading above is concerned.

Please Headmistress for Korogwe Girls secondary schools accept **Mr Vicent Jerome Mbago** from University of Dar Es Salaam to conduct the research Titled "The role of Mathematics and Science Plan on Improving Mathematics Instructions for Secondary School learners with Visual Impairment" at your school as part of his studies.

Thanks,


Gilda Mashuda.
FOR TOWN DIRECTOR
KOROGWE TOWN COUNCIL
FOR KOROGWE TOWN DIRECTOR.

APPENDIX 6: CONSENT FORM FOR PARTICIPANTS

Title of the study

The role of Mathematics and Science Plan on improving Mathematics Instructions for Secondary Schools Learners with Visual Impairment

Background to the study

Quality education opportunity must consider everyone including minority groups and persons with disabilities such as those with Visual Impairment. Visually Impaired students have challenges to learn mathematics subjects at post-primary levels.

Mathematics is important discipline in life of the students due to the fact that, every area of mathematics has its own unique applications to the different career options. It is also a stepping ladder to learn other subjects in school. The Ministry of Education realizes that, Mathematics and Science subjects need to be taught in order to provide students with Visual Impairment with an opportunity to benefit from scientific and technological developments for their personal and national growth.

The primary concern of this study is to investigate the effectiveness of Mathematics and Science National plan in the improvement of the mathematics instruction to secondary school learners with Visual Impairment. The current study intends to examine instructional strategies used and the way Visually Impaired students are involved in learning mathematics subjects following a long time of being directly or indirectly excluded from learning it.

Study procedure

The current study will use interviews to collect data from students with visual impairment and their mathematics teachers for the schools involved in the study.

The study will seek permission from all authorities and participants before embarking on the study activities.

Risks and benefits

The current study is designed in such a way that, will not cause harm or effect to human being physically, mentally, emotionally and will not abuse or interfere ones culture.

However, the current study will enable teachers and students to provide information that will help in making constructive recommendations which may contribute to the improvement of mathematics instructions to students with visual impairment in secondary schools.

Voluntary Participation

Your participation in this study is voluntary so you can decide to withdraw your participation in any stage of the current study. Also you are allowed to ask any question before deciding whether or not to participate.

Confidentiality

Every participant is free to sign this form of informed consent which will then be kept securely by the researcher. The report of present study will not include participants' names, addresses and phone numbers to avoid them being recognized. The same will be applied to all authorization letters.

Contact Persons

In case you have a complain on the way you have been treated and pertaining your rights during the course of this study your free to contact Jerome V. Mbago,
phone No. +255 715 367 646

Full name of the participant

Designation

Signature, date.....

Mobile number.....

**APPENDIX 7: SEMI- STRUCTURED INTERVIEW FOR DIRECTOR OF
SPECIAL NEEDS EDUCATION MOEST.**

Section I: Objectives of Mathematics and Science plan to students with VI

1. What are the objectives of Mathematics and Science plan to students with VI?

Section II: Preparations of the plan

2. How the MoEST considered Teacher training before establishing the plan?
3. How do you rate availability of special mathematics Teaching and learning resources?
What are the special resources available?
4. How do you rate Competency of mathematics teachers who teach students with VI?
5. Do you provide special training to mathematics teachers who teach students with VI in secondary schools?

Section III: Mathematics mode of assessment

6. How mathematics examination papers are presented with regard to the special needs of VI students?
7. How do you collaborate with National Examination Council to ensure invigilation is done by teachers with knowledge on special needs of students VI?

Section IV: Challenges the plan is facing during its implementation

8. What challenges do you face during the implementation of the plan?
9. How do you go about to solve those challenges?

Section V: Evaluation of the plan

10. What are the benefits of the Mathematics and Science plan in improving mathematics instructions to students with VI?
11. Do you think that the objectives of the plan have been met?

**APPENDIX 8: SEMI-STRUCTURED INTERVIEWS FOR TEACHERS OF
MATHEMATICS**

Background information:

What is the number of the learners in your class

Sighted	Visually impaired	Total number

**Section I: Mathematics teaching techniques/methods used during teaching learners with
Visual Impairment**

1. What kinds of special mathematics teaching materials do you use when teaching mathematics to visually impaired students?

Material	Available	Not available
Brailled books		
Braille papers		
Abacus		
Perkins Brailers		
Calculators eg. talking calculators		
Magnifying glass		
Brailled materials eg.rulers, tape		
CCTV		
Other materials		

2. What kind of support do the visually impaired students get in the class during mathematics lessons?

3. What are the instructional strategic methods you apply when teaching mathematics to

- students with visual impairment to make them grasp concepts?
4. What special programs have you planned for the visually impaired students to improve their mathematics performance?
 5. What do you know about the Mathematics and Science Plan made by MoEST to students with VI?
 6. What is your view about the mode of implementation of the plan?

Section II:Teacher training and competence in teaching mathematics to learners with VI.

7. How long have you been teaching students with VI?
8. Give me your experience of teaching students with Visual impairment?
9. Did you attend any workshop or seminars in teaching of mathematics to learners with visual impairments?
10. Have you attended training on Braille mathematics notation?
If yes, how the training helped you in teaching mathematics to students with VI?
11. How do you rate the level of participation for the VI students in mathematics sessions?

Section III: The way students with VI are assessed in Mathematics subject

12. What kind of special support and modifications are made during mathematics tests and internal examinations for students with visual impairment?
13. Do you think support and modifications provided consider special needs of students with VI in performing their tests and exams properly?
14. What special support and modifications are provided during national examinations for students with visual impairment?

Section IV: Instructional challenges faced by learners with VI during learning mathematics.

15. What challenges do the students with visual impairment face when learning mathematics?

How do you solve them?

16. What challenges do the students with visual impairment face when write mathematics tests and examinations?

How do you solve them?

The information you have provided will be used only for this study no one else will be involved to know your names and identification in any how

APPENDIX 9: SEMI- STRUCTURED INTERVIEW FOR STUDENTS WITH VISUAL IMPAIRMENT

Background information

-What is your present class?

Section I: Mathematics learning methods

1. What kind of learning support do you get from your peers sighted learners during mathematics lessons?
2. What kinds of mathematics learning materials do you use in class?
3. How many extra minutes are provided to enable you accomplish mathematics tasks?
4. What kinds of mathematics exercises are assigned to you after normal lessons?

Section II: Teacher competency

5. How does the teacher explain to you concepts that are of visual objects?
6. What kinds of involvement you have during Mathematics lessons?

Section III: Mathematics mode of assessment

7. How do you do mathematics examinations and tests?
In which way are they presented to you?
8. What devices do you use to write your mathematics tests and examinations?
Mention them...
9. How do you manage to manipulate long mathematical equations? Eg. Algebra
10. How many extra minutes are provided to enable you finish the examination?
11. Do you get feedback of your mathematics assignments and tests?

Section IV: Challenges faced by VI when learning mathematics subject

12. What challenges do you face when learning mathematics subject?

13. How do you solve them?

14. What challenges do you face when using mathematics assistive devices?

The information you have provided will be used only for this study no one else will be involved to know your names and identification in any how!

Thank you for your time!