

**CHALLENGES IN TEACHING AND LEARNING
MATHEMATICS BY VISUALLY IMPAIRED PUPILS**

By

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**A dissertation submitted to the University of Zambia in
partial fulfillment of the requirements for the award of
Master of Education (M.ED.) in Special Education.**

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DECLARATION

I, Magdalene Simalalo, do declare that this dissertation is my own work, which has not been submitted for a degree at the University of Zambia or any other University.

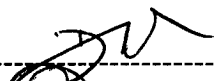
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APPROVAL

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ABSTRACT

Scholars such as Osterhaus (2002) have stated that teachers and visually impaired pupils face challenges in mathematics. The aim of this study was to find out the challenges teachers and pupils encounter in mathematics. It further identified the compounding factors and some strategies teachers and pupils put in place to overcome the challenges.

The sample comprised teachers and pupils from four schools where the visually impaired learn and also the lecturers at a special education training college. Sixty participants took part in the study. They were sixteen teachers, forty pupils and four lecturers.

Questionnaires, focused group discussions and lesson observations were used to collect data. The data was analyzed using qualitative methods to form categories and themes. Simple quantitative analysis was done to come up with percentages.

Results of the study revealed that specialist teachers, ordinary teachers and pupils face challenges in mathematics. There were no significant variations in the challenges faced by teachers and pupils. The study found that the effects of the challenges teachers face spill over to the pupils. There were several factors, which made the challenges complicated. The compounding factors emanated from the teachers and the prevailing supply of materials and equipment in schools. In some instances teachers and pupils abandoned mathematics due to challenges coupled with compounding factors.

The study also found that teachers and pupils put in place certain measures to overcome challenges. The attitudes of teachers and pupils towards the subject influenced the kind of

coping strategies they put in place in order to continue teaching and learning mathematics.

The study recommended that schools where the visually impaired pupils learn be provided with learning and teaching aids. The teachers of visually impaired pupils must be adequately trained in teaching mathematics.

Dedicated to the loving memory of Dennis Mweemba, whose love,
encouragement and inspiration made this study a reality. Rest In Peace.

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CHAPTER ONE

INTRODUCTION

1.0 *Background*

The education of the visually impaired in Zambia began in 1905 at Magwero. Since then, the visually impaired pupils have been learning mathematics just like all other pupils. The government of Zambia took over the running of special education in 1971. Since then, all policies on education have been talking about special education provision (MoE, 1996). Special education emanates from the overall educational policies and programs. This means that the objectives of the curriculum for the non disabled children also apply to special education (Education Reforms, 1977).

Mathematics is often not valued for the visually impaired, even though basic mathematics skills are necessary for independent functioning in daily life (Morris and Blatt, 1986). Mathematical notations are inherently visual and as such not accessible to the visually impaired pupils. However, there is no reason to believe that the visually impaired pupils are less able mathematically than anyone else. Without access to written notations they have great difficulty in communicating mathematical information.

To be denied access to mathematics education is a severe handicap. Mathematics is compulsory in many educational systems, including the Zambian educational system. Lacking mathematical qualifications can present barriers to other subjects

such as Science and Technology and other social sciences that rely on branches of mathematics.

Mathematics involves mastering of basic number facts and processes, and then the combination of both facts and processes for problem solving and computation. The progression step by step from grade to grade is the same for the visually impaired and the sighted. The difference is in the methods of teaching because the visually impaired pupils have to use tactile methods of reading and working out mathematics calculations (Napier, 1974).

Early language development in mathematics is gained through hearing counting rhymes and joining in rote counting, supported by visual experiences.

As sighted children enroll in school they bring with them certain learning based on prior number experiences. Mason (1997) said that early language development in mathematics is an essential foundation for learning mathematics. The children who are visually impaired have not had enough incidental experiences and concepts before entering school. Visually impaired children will need to be given basic information such as the number of fingers on one hand and that a dog has four legs. The visually impaired children need to have such kind of mathematical experiences built.

The pupils who are visually impaired use other channels of learning such as touch, smell and hearing. The remaining senses and motor kinesthetic avenues must be

employed to facilitate learning. The teachers who are effective in the teaching of mathematics to the visually impaired pupils use as many aspects such as auditory presentations of materials and tactile explorations so that learning can be comprehensive, enduring and useful. Quite often it is argued whether what brings about success in mathematics is the method of teaching or the material itself. Napier (1974) argued that a competent teacher uses a variety of approaches mainly because certain concepts are more communicable via one method than others.

Osterhaus (2002) stated that both the teachers trained in special education and the ordinary teachers face a lot of challenges in teaching visually impaired pupils in mathematics. One of the challenges is that it is not easy to minimize imaginative experiences in order to include tactual, manipulative and auditory materials. This challenge is clearly seen in the teaching of Geometry where teachers are unable to put drawings and pictures into tactile modes. Pupils are usually compelled to imagine things.

The teachers of mathematics also have difficulties in determining the content (Osterhaus, 2002). Most of the teachers of visually impaired pupils find it difficult to teach mathematics because the content of the syllabus is not adapted to meet the learning needs of the visually impaired pupils.

Another challenging matter in teaching mathematics is in keeping up with the advancement in mathematics technology. There is a lot of advancement in technology in education. For example, in the Zambian schools pupils are using

scientific calculators, which have become a requirement in both mathematics and science. The visually impaired students have difficulties keeping up with their sighted peers because they cannot use the ordinary calculators and instruments such as talking calculators are not easily accessible. Although visually impaired students can work on most of the problems without scientific calculators, they are at a disadvantage if they have to do everything manually.

In Zambia, pupils with visual impairment have been learning mathematics using the same syllabus as the sighted pupils. The syllabus is formulated with the assumption that the learners were going to use sight to learn. This subject is highly visual and this in itself is a challenge for those who lack sight(Morris and Blatt, 1986).

Researchers such as Osterhaus (2002) have shown that both visually impaired pupils and their teachers have challenges in this subject and some strategies can be put in place to overcome these challenges. In Zambia, the current information on the education of the visually impaired especially in mathematics does not show a wide spread study in this subject except student assignments. This means that there is lack of comprehensive information from research on the challenges of learning and teaching mathematics by the visually impaired pupils. There was need for research into the teaching and learning of this subject, which presents challenges for both pupils and teachers in the formation of concepts and the methods of presenting work. This research endeavored to find out the challenges visually impaired pupils

and their teachers encounter in mathematics and the coping strategies, as they manifest in the Zambian schools where the visually impaired pupils are learning.

1.2. STATEMENT OF THE PROBLEM

Despite an increased interest in special education, the education of the visually impaired has continued to pose serious challenges. Challenges have persisted in the teaching of the visually impaired pupils in mathematics and other science based subjects. In Zambia, the major challenges of teaching mathematics to visually impaired pupils have not been researched on. The coping strategies are also not known. This study endeavored to find out the challenges in teaching and learning mathematics.

1.3. PURPOSE OF THE STUDY

The purpose of the study was to determine the challenges faced by teachers and visually impaired pupils in teaching and learning mathematics. The study also found out the compounding factors in mathematics for the visually impaired. It further established measures that the teachers and pupils put in place to minimize the challenges.

1.4. OBJECTIVES

The objectives of the study were to:

1. Determine the challenges faced by teachers and pupils in mathematics.
2. Identify the compounding factors in the challenges of teaching and learning of mathematics.

3. Establish the strategies that pupils and teachers use to overcome the difficulties that they encounter.

1.5 RESEARCH QUESTIONS

The following questions guided the study:

1. What challenges do teachers and pupils encounter in teaching and learning mathematics?
2. What are the compounding factors in the teaching or learning of mathematics?
3. What strategies do the teachers and the pupils employ to overcome challenges in mathematics?

1.6. SIGNIFICANCE OF THE STUDY

This study has brought to light the challenges teachers and visually impaired pupils encounter in mathematics. The findings of this study might assist the trainers of teachers in special education, curriculum planners and the teachers to find and implement alternative teaching strategies and content. The findings can further help to minimize the challenges to enable visually, impaired pupils to learn mathematics. Further, it was hoped that the information from this study would be useful to the Ministry of Education in that no big study has been conducted to look at challenges of teaching the visually impaired in a particular subject.

1.7. DEFINITIONS OF KEY TERMS IN THE STUDY

- a. **Visually impaired**-low vision or no vision at all.

- b. **Braille**- a system of embossed signs, which are formed by the combination of six dots. It is used by the visually impaired in reading and writing.
- c. **Abacus**-device used in calculations, made up of a frame and beads.
- d. **Talking Calculator**-a calculator that gives audible sounds of calculations.
- e. **Mathematical Braille Notations** –Braille symbols representing ink print mathematical concepts.
- f. **Ordinary Teacher** –A teacher not trained in special education.
- g. **Nemeth Code**-mathematical symbols from elementary to high school. It uses a linear format, spatial arrangements and symbols to convey meanings.
- h. **Special education teacher**- an individual who is formally trained to teach pupils with disabilities.
- i. **Challenges** -difficulties that require thoughtfulness in order to find solutions.
- j. **Mainstream**- ordinary education in the ordinary class.
- k. **Talking scales** – measuring scales that give audible sounds of weight of the items being measured.

Organization of the Remaining Chapters

This dissertation comprises four other chapters. The next chapter contains the review of related literature, especially research findings in other countries in mathematics for the

visually impaired pupils. In chapter three, the methodology used in this study is presented. The chapter includes the sample size and characteristics, the instruments used in data collection, data analysis and the limitations of the study. The results of the study are presented in chapter four. The discussion of the results is presented in chapter five and conclusions and the recommendations follow in chapter six.

CHAPTER TWO

LITERATURE REVIEW

The pupils with visual impairments have problems in mastering mathematical skills and concepts. If we are to educate them then we need to put in effort and resources (Myers, 1978). Mathematics is the basis of many other disciplines. Exclusion from mathematics can be a serious handicap in education and work. Communication of mathematics is usually visual - the formulas, diagrams and graphics and this makes mathematics very difficult for visually impaired pupils to work out mathematics and effectively bars them from many work and educational opportunities (Stevens, 1996).

A study by the College of State Island (2000) revealed that calculus as a component of mathematics has presented a formidable barrier to student seeking a career in science and engineering. Calculus is required for students who wish to be engineers. However, visually impaired pupils have difficulties in this aspect of mathematics. The difficulty is mainly in the graphical components in the presentation of geometrical objects, especially the graphs of functions then the presentation of mathematical formulas as a graphic display.

Bowers (2002) stated that one obvious challenge in mathematics is that it is highly visual. He also stated that much of the exposition of mathematical techniques rely

on the use of verbs such as "look at" "look for", "can you see", "identify" and so on. The use of such mathematical language is quite frustrating for a pupil who has visual impairments. Equally worrying was the inconsistency in reading mathematical expressions. Teachers use alternatives, which they consider to be equivalent. For example, a teacher might say, "two into X plus one" such an expression would require the pupils look at what has been written to make sense out of the utterances. Expressions such as the one in the example are a major part of mathematics and they pose challenges on visually impaired pupils.

One of the most important instruments in teaching mathematics to visually impaired pupils is the Nemeth Code. The Nemeth Code comprises mathematical symbols from elementary to high school. It uses a linear format, spatial arrangements and symbols to convey meanings. However, this piece of technology has had deficiencies in that it does not include symbols for advanced mathematics. The problem is that advanced mathematics texts, articles are written in print. Most of this information can be tapped electronically but few visually impaired pupils can access it (Osterhaus, 2002).

Research has shown that teachers of visually impaired are poorly prepared in the Nemeth code. In his doctoral thesis, Staut Wittenstein (1993) in a study to determine the extent to which teachers received training in the Nemeth Code, found that only about 50 percent of teachers of pupils with visual impairments reported having to demonstrate proficiency in the code or mathematics in their preparation

programmes. Only 35 percent reported that their knowledge of the Nemeth Code was satisfactory. Another study by Kapperman (1994) investigated how much the teachers knew the dots configuration of five symbols, which is a small proportion of the whole mathematical code. The results demonstrated equivocally that knowledge of the mathematics code among the teachers was lacking; the percentage of correct answers was exceedingly low, about 24 percent. The most distressing thing was that 76 percent of the people in the study had no knowledge of the Nemeth Code whatsoever.

In a much recent study Demario and Lian (2002) revealed similar findings. They queried teachers of visually impaired youngsters to determine their perceived level for competence with regard to Braille Code as compared to the Nemeth code. Results were that teachers indicated that they felt better prepared using the literary Braille than the Nemeth Code and their attitude towards the Nemeth Code was not as positive as was their attitude toward literary Braille. Demario, Lang and Lian (1988), found that overall, the mean anxiety ratings increased as the level of mathematics materials to transcribe became more advanced. As the mathematics became sophisticated, teachers experienced more and more difficulties.

Amato (2002) carried out a study in the training in Braille for the teachers of pupils with visual impairments. The study was targeted at instructors representing thirty-seven of the forty-two American and Canadian universities where teachers of visually impaired pupils are trained. The most significant finding in teaching Braille was that 20 percent of the programmes offer no training whatsoever in the Nemeth

Code, while 22 percent reported that their students achieve competence in the Nemeth Code, 24 percent rate their students as incompetent in this area.

According to Craig (1987), a review of the Nemeth Code text revealed that it is inadequate for providing thorough training in Braille Mathematics for the purpose of studying upper level mathematics. For example, the text does not include symbols such as integrals, partial derivatives, limits, summation, and trigonometric functions. Matrices and determinants are not mentioned. The symbols included in the study of probability, logic and statistics are not found in the text. Most researchers and authors contend that a significant number of students possess less than sufficient knowledge and expertise in the Braille Code which will enable them to instruct their pupils in the reading and writing of the symbols which are basic to the study of mathematics.

Spungin (1989) stated that visually impaired children were not taught Braille Codes because the teachers who are supposedly trained to do so themselves do not know the Braille Code sufficiently, much less the teaching methodology. Garvin (1994) also agreed that an honest reflection of the situation suggests that the real culprit is the inadequate and inappropriate education of special education teachers. The teachers are not competent or confident themselves in using Braille and who also believe that their students should not be expected to compete successfully in school or in life.

Characteristic of Visually Impaired Learners in Mathematics

The ways in which pupils with visual impairments learn have posed a lot of challenges for both pupils and the teachers. Mason (1997) stated that pupil with visual impairments learn mathematics differently. It is this factor that spells out the challenges faced in this subject.

Whole Numbers

Children with visual impairments have problems understanding or grasping the properties of whole numbers. They will not view six chairs together at a glance, but will move from one chair to another to discover they are six. The pupils also find the concept of zero difficult because when visual representation cannot be used, zero needs to be taught by comparing the auditory or tactile representation of nothing to one or some.

The Department for Education and Skills in England (2001) found that visually impaired pupils might not get the same level of support from visual material as their sighted peers. The pupils also lack the necessary early experiences that support estimation skills. Direct teaching using auditory and tactile experiences will be necessary to compensate for the restricted experience learners may have to visualize quantities.

Calculations

Learners may find it difficult to locate information on a page and will often lose track of where they are in a calculation. Within the horizontal lay out to model correct use of the equal sign in calculations, Pupils with visual impairments will often take longer to record their work. However, the visually impaired pupils are good at rote learning. The numbers are perceived as words, and this can mask a lack of basic understanding of number combination. Learners need to practice in grouping numbers in different way so that the numbers can be experienced as wholes or as component parts.

Problem Solving

Mason (1997) stated that visually impaired pupils have problems in problem solving. The main areas are those involving concepts of 'same and different'. Learners will need many matching and sorting activities using real objects with great difference in size, shape, texture and weight. Solving word problems that rely on visualization skills and they have difficulties to participate in-group problem solving activities. They rather focus more on the oral language element of problem solving. There is need for mathematical and problem solving languages to be used consistently. The teachers working with the pupils need to agree on both the vocabulary and the structure of the problems.

Osterhaus (2002) in a study to evaluate teaching strategies found that visually impaired pupils have problems in mathematical problems involving distance, time and 2-dimension problems. Relating time and distance is not easy because these are real experiences. Pupils may not grasp the concept of perimeter. The understanding of "all way around" is very difficult for the pupils who are unable to see something as a whole. The pupils with visual impairments exist in a 3- dimension world, but find it very difficult to comprehend a 2- dimension drawing, which represent a three-dimension object. The visually impaired pupils are accustomed to examining one aspect of an object at a time. It is far more difficult to examine the wholeness of an object by tactile methods than by visual inspection. The use of tactile or talking scales will support pupils in measuring activities. This strategy also applies in teaching planes such as triangles.

Tools Used In Mathematics

Teachers and instructors need to understand that if the tools are provided for pupils with visual impairments, they become abled. In order for the visually Impaired pupils to be able to learn mathematics tools are very important. The lack of tools makes learning mathematics almost impossible (Garvin, 1994).

- ***Graphing Calculators***

As a visual learning tool the graphical calculator has stirred a good deal of excitement. Unfortunately this tool is not accessible to visually impaired pupils.

- *The Taylor Frames*

This was one of the earliest manipulative/ tactile aids for visually impaired pupils of mathematics. It measures about 27.5 by 42.5 centimeters, has a tray to hold pegs and an array of holes to contain these pegs. There are 22 holes across and about 22 holes in a column. These holes are shaped similar to a plus sign overlying an 'x' and the pegs have the same shape. Additionally at each of the one-inch pegs to one side is a bar and at the other end two conical projections. The angle of insertion determines the numerical value with the bar side up the positions run one through 8 and flapping the pegs over the value 9 and 0, with the remainder of the position determining the operation (Garving 1994).

- *The Brennan slate*

The slate consists of a 16 by 16 array of square holes. These hold small dice like cubes, which have raised numbers. The position of the cube determines what Braille number is being used. One side of the cube indicates the operation. Thus, blind children can set up their own problems.

- *The Cranmer Abacus*

Tim Cranmer adapted the abacus to serve as a calculating tool for the blind and visually impaired. This abacus is snugly mounted on a red felt board, which prevents the beads from unintentionally slipping. The use of white beads as counters provides enough contrast for visual impairments.

- *Nemeth Code*

These are mathematics symbols from elementary to high school. It uses a linear format, spatial arrangements and symbols to convey meanings.

If the individual is a proficient Braille reader, this code can be used for computation.

- *Large scale drawing tools*

The graphing aids include embossed Braille paper, wicky sticks made of wax in long stripes. These can be used with embossed paper. Sewell raised-line drawing kit consists of a clipboard with a rubber, pad stylus and Mylar sheets. A Mylar sheet is inserted under two-thumb screen; the stylus is used to create the picture. A raised line is formed because of the stretching capability of the thin Mylar. Others are a drawing kit comprising a stylus, protractor, 4.4-centimetre ruler, a square and 100 sheets of Mylar, (Garvin 1994). The Trace Center, (1994) also use special paper which when heated provides a tactile image. One system involves printing or copying an image onto the paper, then leaving the paper with a tactile image enhancer. Another tool uses a special hot pen. With this pen a student can draw a raised picture.

Technological Auditory Aids.

- *Talking calculators*

These were some of the earliest auditory aids. A lot of technological advancements have taken place. Many types of talking calculators are in use. They help students do calculations using auditory output. The scientific and financial calculators with speaking keys were released in 1994. The scientific calculator has trigonometric, a calendar and other features.

- *The Nomad Pad*

This is an interactive audio- tactile graphics. The touch pad enables the student to study a series of prepared graphs independently. However, it does not allow visually impaired students to create their own graphics.

The tools and materials discussed above are important in order to successfully teach mathematics to the visually impaired pupils.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

The study was a survey and it employed both qualitative and quantitative methods. A survey is a collection of information or data at a particular point in time with the intention of describing the nature of existing conditions or identifying standards against which the existing conditions can be compared, or determining the relationship that exists between specific events (Cohen and Manion, 1994). This study gives a detailed description of challenges faced in mathematics as given by the teachers, pupils and other stakeholders. The compounding factors in the study of mathematics bring out the relationships that occur among the various issues related to the teaching and learning of mathematics by the visually impaired pupils.

3.2 Participants and sampling procedures

The sample in the study comprised sixty participants. A convenient sampling technique was used to select the schools and the participants in the study. The small numbers of visually impaired pupils in schools necessitated this technique. The teachers and pupils were drawn from Magwero School for the Blind, Lions School for the Blind, Munali High School and St. Mulumba Special School and the trainers at the Zambia Institute of Special Education (ZAMISE). The College lecturers were selected because they train teachers in special education and were in a better position to give information on the kind of training that they give to teachers who handle visually impaired pupils in schools. The total sample comprised the following characteristics:

- A) Four trainers of teachers in special education at ZAMISE. The four trainers were conveniently sampled from the visual impairment section of the College, which had four members of staff at the time of collecting data.
- B) A total of forty visually impaired pupils drawn from the grades five, seven eight, nine, ten, eleven and twelve. These grades were chosen because the pupils have been in school long enough to comprehend challenges in mathematics better. The variation in the grades were due to small numbers of visually impaired pupils in the schools where the total population in the school was ten pupils, therefore the population became the sample.
- C) A total of sixteen mathematics teachers both specialist and ordinary, were drawn from the classes where the researcher observed mathematics lessons and others who were teaching the pupils that participated in the focused group discussions.

3.3 Research instruments

A review of literature on challenges in teaching and learning mathematics among the visually impaired guided the formation of research instruments. Four data collection instruments were used in this study.

3.3.1 Teacher's Questionnaire

Self-administered questionnaires were developed for the teachers of visually impaired pupils in the selected schools. The questionnaires comprised both close ended and open-ended questions. The open ended questions were meant to give teachers an opportunity to give detailed information about the subject of investigation.

3.3.2 Trainer 's Questionnaire

A semi-structured questionnaire was administered to the selected trainers in the department of visual impairments at the Zambia Institute of Special Education (ZAMISE). The trainers' questionnaire aimed at obtaining information about the kind of training that is given to the teachers of visually impaired pupils. The information obtained helped in understanding or making connections with the information given by the teachers. Questions on the content of the syllabus, the duration of training of the teachers and the challenges the College faces in the training of teachers of visually impaired pupils were crucial in the study.

3.3.3 Observation Schedule

Observations of mathematics lessons were done in three of the four schools in the study. At the fourth school, lesson observations were not done because visually impaired pupils were not learning mathematics. Two lessons were observed at each of the three schools. The lesson observations were aimed at giving information or a true picture of the situation in the classroom. The focus was on the topic being taught, the teaching and learning aids present, the challenges faced in the topics and how the teachers and the pupils tried to overcome the challenges.

3.3.4 Focused Group Discussion Guide

Focused group discussions for pupils were conducted using a discussion guide. The major topics for discussion were focusing on whether pupils were learning mathematics, the tools available in the subject, challenges that they were facing and also the coping

strategies used in the subject. For the pupils not learning mathematics the same guide was used with the major focus on why the pupils were not learning mathematics.

3.4 Data Collection.

Data was collected from the teachers, the pupils and the trainers of teachers. The use of four instruments in this study helped to achieve in depth findings. Data was collected between September and November 2005. The researcher had to carry out the research faster because the pupils were about to begin the final examinations. At all the four schools the deputy head teachers helped the researcher to mobilize the teachers and the pupils to assist the researcher to carry out her work.

The teachers' questionnaires were administered during lessons, and so were the focused group discussions, which disrupted the classes. Before the focused group discussions could begin, the researcher explained to the pupils the purpose of the study and also assured the pupils that the information obtained was going to be used for academic purposes and in confidence. Each discussion group comprised ten pupils. The focused group discussions were put on audiotapes for the researcher to use during data analysis. The discussions lasted between sixty and ninety minutes. The lesson observations were done as per timetable of the observed classes after having made arrangements with the class teachers.

The questionnaire for the trainers and the teachers had instructions for completion. In order to ensure anonymity and confidentiality, the teachers and the trainers were not allowed to write their names on the questionnaires.

3.5 Data analysis

The data collected in the study was largely analyzed using qualitative methods. Qualitative methods involved data cleaning, reduction, editing in readiness for analysis. The data was further analyzed and put in themes and categories as they emerged. These themes are presented as subheadings of the findings. The data from the focused group discussions were listened to and transcribed and presented as emerging categories in the three research questions. The quantitative data and some of the qualitative data were computed and presented as percentages using a calculator.

3.6 Limitations of the Study

The study limited itself to the education of visually impaired pupils. The results of this study can only be generalized to visually impaired pupils. Financial constraint and a lack of time to visit all the schools where the visually impaired pupils are based also limited the study. The schools where the visually impaired pupils learn are scattered in the country. Therefore, the study was conducted at only four schools. The small numbers of pupils in the schools limited the study. Thus the study drew a total sample of forty pupils, sixteen teachers and four trainers from the Zambia Institute of Special Education.

3.7 Ethical Considerations

The researcher obtained permission from the school managers before conducting the study. The teachers and trainers were assured of confidentiality by not writing their names or identity numbers on the questionnaires they completed. Before the focused group discussions began the researcher explained the purpose of the exercise and told the pupils that the discussions were going to be put on audiocassettes for the convenience of the researcher. The pupils were also assured of confidentiality as the information given was going to be used for academic purposes only. All the pupils in the study gave verbal informed consent.

CHAPTER FOUR

PRESENTATION OF RESULTS

This chapter presents the research findings according to the three main objectives. Firstly, the challenges faced by the teachers of visually impaired pupils in teaching mathematics and the challenges that the visually impaired pupils encounter in learning mathematics. Secondly, the compounding factors in the challenges faced by the teachers and also the compounding factors in the challenges pupils face. Thirdly, the coping strategies that both the teachers and the pupils use shall be presented.

4.1 CHALLENGES FACED BY VISUALLY IMPAIRED PUPILS IN MATHEMATICS

Data from Focused Group Discussions

In order to obtain first hand information on the challenges the visually impaired pupils face in mathematics, focused group discussions were held. At each school pupils mentioned the challenges that they face in learning mathematics. By using this method of data collection pupils were able to give in-depth experiences in mathematics. The following are some of the challenges visually impaired pupils encounter in mathematics.

Table 1: Pupils Learning Mathematics or Not

When asked whether they were learning mathematics, the pupils gave the responses indicated in the table below.

LEARNING MATHEMATICS	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
YES	8	80	10	100	10	100	1	10	29	72.5
NO	2	20	0	0	0	0	9	90	11	27.5
TOTAL	10	100	10	100	10	100	10	100	40	100

According to Table 1 above, the majority of pupils or 72.5 percent of the pupils in the study said that they were learning mathematics while 27.5 percent said that they were not learning mathematics.

The syllabus is not favorable

Pupils at the four schools in the study stated that some topics in mathematics are difficult for the visually impaired pupils to understand. At School D, 90 percent of the pupils unanimously agreed that mathematics is highly visual and abstract. Topics such as coordinates and integers pose a lot of challenges. At School A, pupils strongly felt that mathematics topics become more difficult as they moved from one grade to another.

“Madam, some topics just need sight, so we the visually impaired cannot do those topics.”

Teachers are inadequately trained in Braille Mathematics

The pupils at Schools A and D reported that most of their teachers portrayed ignorance on the use of certain mathematical concepts. At School A, the pupils said that some teachers do not know most of the mathematics signs in Braille and this affected the way the teachers taught.

"Teachers do not explain things properly. They should have enough knowledge to be able to teach mathematics."

At school D, the pupils pointed out that most teacher complain about teaching mathematics to visually impaired pupils.

"Actually most teachers just walk into the classroom, talk and leave. They do not know what to do with us who are visually impaired."

Poor Tactile Skills

The results from the focused group discussions (FGD) revealed that most pupils have poor tactile skills. The pupils at School A reported that as mathematics become complicated they have difficulties to read diagrams because the tactile skills are poor. At School D, 90 percent of the pupils attributed poor tactile skills to lacking of training on reading mathematical diagrams.

Inconsistency in Braille Notations

Pupils reported that the Braille notations that they learn in mathematic in most cases differ with those used in the examinations prepared by the Examinations Council of Zambia where a computer is used to print the examinations.

4.2 CHALLENGES TEACHERS FACE IN TEACHING MATHEMATICS

Data from the teacher questionnaire

Table 2: Training of Teachers to Teach Mathematics to the Visually Impaired Pupils

In a question to find out if they were trained to teach mathematics to visually impaired pupils, the teachers' responses were as follows.

Teachers trained or not	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
Yes	2	50	3	75	4	100	1	25	10	62.5
No	2	50	1	25	0	0	3	75	6	37.5
Total	4	100	4	100	4	100	4	100	16	100

In Table 2 above, 62.5 percent most of the teachers reported that they were trained to teach mathematics to the visually impaired pupils while 37.5 percent were not trained.

Table 3: Duration of Training of Teachers

When asked how long they were trained at the college, the teachers gave the following responses.

Duration of Training	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
12 months	0	0	2	50	4	100	4	100	10	62.5
24 months	3	75	1	25	0	0	0	0	4	25.0
Non	1	25	1	25	0	0	0	0	2	12.5
Total	4	100	4	100	4	100	4	100	16	100

In Table 3 on page 28, 62.5 percent or the majority of the teachers in the school were trained only for twelve months, 25 percent were trained for twenty-four months and 12.5 percent were not trained in special education.

Table 4: Competence of Teachers in Teaching Mathematics to the Visually Impaired Pupils

In a question to find out how competent the teachers were in teaching mathematics to the visually impaired, the following were the responses.

Competence in Math	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
Very competent	2	50	2	50	2	50	0	0	6	37.5
Quite competent	2	50	1	25	2	50	2	50	7	43.7
Not competent	0	0	1	25	0	0	2	50	3	18.8
Total	4	100	4	100	4	100	4	100	16	100

According to Table 4 above, 43.7 percent of the teachers felt that they were quite competent in teaching mathematics. 37.5 percent of the teachers reported being very competent and 18.8 percent said that they were not competent at all.

Table 5: Ability to Use Braille Mathematics and Nemeth Code

When asked whether they were able to use Braille Mathematics and the Nemeth Code, the teachers responded as follows.

Ability to use BM/NC	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
BM	2	50	3	75	0	0	0	0	5	31.3
BM/NC	1	25	0	0	4	100	2	50	7	43.7
None	1	25	1	25	0	0	2	50	4	25.0
Total	4	100	4	100	4	100	4	100	16	100

BM=Braille Mathematics

NC=Nemeth Code

Table 5 shows that 43.7 percent of the respondents were able to use the Nemeth Code and Braille Mathematics, 31.3 percent could use Braille Mathematics and 25 percent could not use either Nemeth Code or Braille mathematics.

Table 6: Teachers Trained or Not in Braille Mathematics and the Nemeth Code

Asked if they were trained in Braille Mathematics and the Nemeth Code, the teachers' responses were as follows.

Training in BM/NC	SCHOOL A		SCHOOL B		SCHOOL C		SCHOOL D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
BM	2	50	1	15	0	0	0	0	3	18.8
BM/NC	1	25	0	0	3	75	3	75	7	43.7
None	1	25	3	75	1	25	1	25	6	37.5
Total	4	100	4	100	4	100	4	100	16	100

BM=Braille Mathematics

NC=Nemeth Code

In Table 6, 43.7 percent of the teachers said that they were trained in the Nemeth Code and Braille mathematics, 18.8 percent reported training in Braille Mathematics only while 37.5 percent were trained in neither Braille mathematics nor Nemeth Code.

Making Tactile Teaching Aids

Teachers face the challenge of making teaching aids. At one school all the teachers, both the sighted and the visually impaired agreed that making teaching aids was very challenging. This was worsened by other factors such as the lack of materials used in making tactile aids.

Changing Teaching Staff between Classes

Some teacher reported that changing from one class to the other caused difficulties. At School A, 3 or 75 percent of the teachers reported that they did not teach one class for the whole year but were given new ones almost every term. The lack of consistence brought problems because teaching styles and approaches vary hence both teachers and pupils have difficulties adjusting. A visually impaired teacher at one school said that he was being underutilized because he was given new classes to teach every year and has not been given a class at secondary school level.

Use of Mathematics Tools

Most of the teachers in the study reported facing challenges in the use of equipment found in the schools. A teacher at one school said that some tools used in mathematics are available in the school but was unable to use them because she does not have the knowledge to use the tools.

“The tools were not explained to us at the college. The lecturer just stood in front of the class, held up an abacus and told us that it was a tool for teaching mathematics to the visually impaired pupils.”

Inconsistency in Braille Notations

There was lack of consistence in Braille notations used in the computer printed examinations in mathematics by the Examinations Council of Zambia and the Braille notations used in schools.

4.3 DATA FROM THE TRAINER’S QUESTIONNAIRES

The trainers of special education teachers at the Zambia Institute of Special Education (ZAMISE) were part of the study. This was done so that they give their views on the training of the teachers of the visually impaired pupils. The information from the trainers was meant to shed light on or help us understand some of the challenges teachers mentioned.

Table 7: Adequacy of Teaching Staff at the College

In a question to find out if the college had staff to train teachers in mathematics for the visually impaired, the trainers gave the following responses

Teaching Staff			TOTAL	
	No	%	No	%
Adequate	1	25	1	25
Not Adequate	3	75	3	75
Total	4	100	4	100

Table 7 above shows that 1 or 25 percent of the trainers at the college felt that there was enough staff to train teachers of visually impaired pupils while 3 or 75percent reported that there was a shortage of staff.

Table 8: Training of Teachers in Mathematics for the Visually Impaired Pupils

In a question to find out if teachers were trained in mathematics for the visually impaired pupils, the trainers gave the following responses

Training of Teachers in Math			Total	
	No	%	No	%
Yes	3	75	3	75
Not At All	1	25	1	25
Total	4	100	4	100

In Table 8 above, 3 or 75 percent of the trainers at ZAMISE reported that they train teachers how to teach mathematics to the visually impaired pupils while 1 or 25 percent said that the College does not train teachers to teach mathematics to visually impaired pupils.

Table 9: Competence of Students in Teaching Mathematics to the Visually Impaired Pupils

The trainer gave the following response when asked about the competence of the students in teaching mathematics to the visually impaired pupils.

Competence of Student to Teach Math			TOTAL	
	No	%	No	%
Competent	3	75	3	75
Not competent	1	25	1	25
TOTAL	4	100	4	100

Table 9 above shows that 3 or 75 percent of the trainers agreed that by the end of the training or at graduation from the college teachers were competent to teach mathematics to the visually impaired pupils. 1 or 25 percent said that the teachers were not competent to teach mathematics to the visually impaired pupils.

Teaching Practice

In a question to find out if the lecturers observed students teaching mathematics during teaching practice, all the lecturers agreed that they do observe students in order to ascertain their level of competence in teaching mathematics to the visually impaired pupils.

Training of teachers in Braille mathematics and the Nemeth Code

3 or 75percent of the trainers reported that the teachers of visually impaired pupils were trained in Braille mathematics and the Nemeth Code while 1 or 25 percent said that the teachers were not trained in the Nemeth code and Braille mathematics.

Challenges Faced in Training

- *Duration of training*

The trainers reported that the duration of training in mathematics was short. Mathematics for the visually impaired was given six hours of training in the entire academic year.

- *Lack of equipment and materials*

The trainers indicated that the college had obsolete equipment. Most of the basic materials such as Braille primer are not available. As a result teachers are not adequately prepared to use the equipment that they find in schools.

- *Poor mathematics background*

One or 25 percent of the trainers stated that trainers lack a good background in Braille Mathematics. As a result they have challenges in training teachers in the subject.

- *Curriculum*

The trainers stated that mathematics for the visually impaired was imbedded in the part of the curriculum where teachers learn Braille. It is not taught as subject. Consequently, mathematics is only taught as part of teaching the basics of Braille.

4.4 COMPOUNDING FACTORS FOR THE PUPILS.

Teachers and Pupils Attitudes

11 or 27.5 percent of the pupils in the study said that they were not learning mathematics because the subject was tough and the teachers told them that they could be educated without mathematics. The pupils in a grade nine class reported that they were not going to sit for examinations in mathematics because they want to concentrate on other subjects. The attitudes of both teachers and pupils either negative or positive impacted on the teaching and learning of mathematics.

“Am difficult teach mathematics. In term 1, I was performing well but now I cannot.”

“If a blind pupil at school X is learning mathematics in grade 10, I can also do well.”

Lack of Materials

In all the four schools in the study, pupils reported that they lacked materials to use in mathematics.

“Madam, we have nothing to use. Even the simple writing frames and stylus we have to buy ourselves. There are no tools. That is why we do not learn mathematics”.

Poor Background in Mathematics

Pupils in the study indicated that they did not learn mathematics at lower grades. As a result they had a poor foundation in mathematics for further learning. 2 or 12 percent of the pupils at school D stated that they did not learn mathematics in grades 1 -5 and it was difficult to begin learning the subject in grade 8.

Large Classes

The pupils at school A felt that they were unable to concentrate in mathematics because within one classroom, there were three classes.

“Teacher M speaks very loud. We fail to concentrate during mathematics lessons because we end up listening to what he is teaching and forget the calculations.”

At school B, one class had 10 visually impaired pupils and the pupils felt that the class was too large.

“We need individual attention but we are too many. The teacher is not managing.”

Negligence by the School

At school D the pupils are integrated in the mainstream. The pupils unanimously agreed that they were neglected and discriminated against.

“This school has a lot of money but they do not buy materials for us the visually impaired. The school would rather buy material for the sighted.”

“Teachers treat us equal, they use chalk board and leave. This school is highly disorganized because there is nothing in place for us who are visually impaired. Here we are not considered as human beings.”

4.5 COMPOUNDING FACTORS FOR THE TEACHERS

Cognitive Immaturity of the Pupils

Mathematics requires cognitive maturity especially for the visually impaired pupils.

Teachers reported that most of the pupils are not mature enough to learn mathematics.

Tactile aids for topics such as coordinates are difficult for the visually impaired to follow and Braille mathematics codes involving indices are cumbersome. Braille diagrams are

complicated and the visually impaired should be developed in cognition in order to be able to learn.

Lack of Materials and Equipment

The schools have limited materials and tools for teaching mathematics. In all the four schools, there were no mathematics textbooks in Braille for both the teachers and the pupils.

Table 10: Adequacy of Training of Teachers

Asked whether they were adequately trained in mathematics for the visually impaired pupils, the teachers gave the following responses.

Adequacy of Training	School A		School B		School C		School D		TOTAL	
	No	%	No	%	No	%	No	%	No	%
Adequate	2	50	3	75	4	100	0	0	9	56.2
Not Adequate	1	25	1	25	0	0	4	100	6	37.5
No response	1	25	0	0	0	0	0	0	1	6.3
TOTAL	4	100	4	100	4	100	4	100	16	100

Table 10 above, shows 56.2 percent of the teachers felt that they were adequately trained to teach mathematics to the visually impaired pupils while 37.5 percent did not agree that their training was adequate.

Lack of Transcription Services

1 out of the 4 schools under study had a transcription facility working. Lack of this facility made transcription of books from ink into Braille very difficult.

Attitudes

The poor attitude of teachers towards mathematics affected the pupils because they do not motivate pupils to have interest in mathematics. At school D one teacher reported that the school administration had bad attitude toward the education of the visually impaired pupils.

“Generally, there is lack of seriousness because even writing frames and Braille paper are difficult to purchase. Materials for the visually impaired are expensive but there is need to set priorities.”

A teacher at one school attributed the negative attitude to lack of incentives to boost the morale of teachers.

9 or 56 percent of the teachers reported that teaching mathematics to the visually impaired pupils was good and they just needed material and tools so that they can teach better.

Large Classes

Large numbers of pupils in one class, especially in the integrated setting disadvantages the visually impaired pupils. Teachers have difficulties giving individualized attention to the visually impaired pupils. One teacher said that...

“Teachers do not make use of the resource room in the school because there are no materials used in giving remedial lessons to the visually impaired pupils.”

4.6 COPING STRATEGIES BY THE PUPILS

Working in Pairs

The totally blind pupils and those with low vision are put in pairs so that they can help one another in schoolwork. This strategy was reported in all the four schools in the study.

"If am to learn mathematics I ask my friend to read for me from ink print while I transcribe into Braille."

Copying Notes

Pupils reported that one way of learning mathematics was by copying notes from the teachers during the lesson since there were no textbooks. The pupils use these notes to study in their free time after lessons.

Use of Primitive Devices to Count

"I use very old methods of counting. I mean using stones and sticks to work mathematics because the cubes and the cuberithm boards are not enough."

Use of the Intellect

"I use the computer in my head to do the mathematics. I have put a lot of calculations in my brain."

Sharing Learning Aids

At school B, pupils reported that in order for them to learn mathematics the timetables were set in such a way that mathematics lessons took place at different times. This way all classes at varying times used the few tools available in the school.

Abandoning Mathematics

11 or 27.5 percent of the pupils in the study reported that they were not learning mathematics due to the challenges and other factors mentioned. These pupils have stopped learning mathematics and they do not sit for national examinations in the subject. 9 or 22.5 percent of the pupils were from school D, where the visually impaired pupils are integrated in the mainstream at high school level while 2 or 5 percent were from school A.

4.7 COPING STRATEGIES BY THE TEACHERS

Conducting Workshops

2 or 50 percent of the schools reported that one way of improving their teaching in mathematics was by conducting workshops on capacity building in mathematics within the schools. At one school, the administration sent a teacher for training in mathematics for the visually impaired and the teacher has become a resource person on the workshops the school conducted.

Making Teaching Aids

Teachers reported that they made teaching aids using resources that are available in the schools.

"We are struggling to make some aids but somehow we manage. We use initiative especially when making diagrams."

Transcription of Work

In all the four schools under the study, teachers said that in order to continue teaching mathematics they transcribed textbooks that were in ink print into Braille.

"We transcribe our work and also the work for the pupils. We do not have Braille text books, so we have no choice but to transcribe, though the school has only one Perkins Brailier which the teachers use."

Modification of Work

The teachers reported that they made modifications to topics in the syllabus to suit the visually impaired pupils. A visually impaired teacher at one school stated that modification to topics were inevitable if the visually impaired pupils were going to learn mathematics. Teachers made modifications to examinations as well especially where the Braille notations in the mathematics examinations paper were inconsistency with the ones that were taught in the schools

Teach at Pupils' Pace

One way of overcoming some of the challenges was to teach at a slower pace. The visually impaired pupils learn slowly and they complained when teachers rushed through the work.

Set the Time Table Strategically

At school B, teachers reported that one way of overcoming the challenge of lack of learning and teaching aids was by setting the time table in such a way that at any given time one class was using the mathematics tools and aids.

Giving Notes to the Pupils

In the four schools under study, teachers said that due to lack of text books in Braille, they gave notes to the pupils during lessons and they tried as much as possible to explain the examples given to the pupils.

Abandoning Mathematics Lessons

4 or 25 percent of the teachers reported that due to the challenges that they were facing in teaching mathematics they decided to stop teaching mathematics. At the time of the study the visually impaired pupils who were learning in the mainstream were not taught mathematics and also not sitting for the national examination in mathematics.

Figure 1: Data from Lesson Observations

In order to obtain a picture of what is happening during mathematics lessons, observations were done in 3 out of 4 schools in the study. The following were the challenges and coping strategies observed.

TOPIC	CHALLENGES	COPING STRATEGIES
Percentages	Lack of equipment to use in the calculation.	Teacher explained the given examples.
Fractions	There were no teaching and learning aids. Pupils could not easily make mental images.	Teacher explained the given examples.
Perimeter	Inadequate rulers	Teacher took individual pupils around the class to take measurements.
Integers	Pupils had difficulties moving on the brailed number line.	Teacher helped the pupils to move their fingers between the positive and negative numbers on the number line.
Algebra	Pupils did not have the required learning aids. Teacher had difficulties explaining the algebraic expressions	Teacher spent more time explaining the examples he dictated to the pupils.
Addition	Teacher did not have tactile teaching aids hence used the chalkboard. Pupils could not read the work on the board.	Teacher dictated the examples and took time to assist the pupils individually.

CHAPTER FIVE

DISCUSSION

In this section the challenges pupils and teachers face in mathematics are discussed. The factors that make the challenges more difficult as well as the coping strategies are also discussed.

Osterhaus (2002) stated that both teachers trained in special education and the ordinary teachers face a lot of challenges in teaching mathematics to the visually impaired pupils. This finding is in line with the findings teachers both trained and those not trained in special education agreed that they were facing challenges in teaching mathematics. In this study only 62.5 percent of the teachers said that they were trained in mathematics for the visually impaired and 37.5 percent were not trained. Both the trained and non-trained teacher faced challenged in teaching mathematics to the visually impaired pupils.

The finding of this study revealed that most teachers found challenges in topics such as geometry, time and distance and calculus. The findings are in line with those found by the College of State Island (2002) where it was revealed that teachers had problems in teaching drawing related topics such as geometry. The topics are highly visual and teachers are unable to present drawings and pictures into tactile modes.

The visually impaired pupils face the obvious challenge that mathematics is highly visual. Pupils felt that it is difficult to master most mathematical concepts because they are abstract. Bowers (2001) stated that this challenge is obvious because much of the

expositions of mathematics techniques rely on the use of verbs such as 'look for ' and 'identify. '

An equally challenging matter in teaching mathematics is determining the content. The syllabus which the visually impaired pupils and the sighted pupils are exposed to is the same. It is therefore a challenge for the teachers to determine the level of modification to the subject while remembering not to disadvantage the visually impaired pupil.

The Nemeth Code and Braille mathematics are important tools that teachers should be acquainted with. In this study 43.7 percent of the teachers reported being proficient in Nemeth Code and Braille mathematics. As a result the teachers have challenges in teaching mathematics because most of them do not know the use of the Nemeth Code and Braille mathematics. Although the trainers of teachers in special education stated that teachers were adequately trained to teach mathematics, the challenges trainers face in the college such as lack of equipment and the undetailed curriculum point to the fact that teachers are not adequately prepared to teach mathematics to the visually impaired pupils. The trainers said that teachers were adequately trained probably to protect the face of the College and to avoid giving an impression of being failures in the training of teachers of visually impaired pupils. However the fact that the trainers acknowledged that there was need to review the curriculum suggests that they are aware that their graduates are not well trained.

This finding identifies with that found by Kapperman (1994) where 76 percent teachers were not proficient in Nemeth Code and Braille mathematics and Wittenstein (1993) where only 50 percent of the teachers reported being proficient in Nemeth Code and Braille mathematics. These studies demonstrate that one serious challenge teachers face was lack of knowledge in Nemeth Code and Braille mathematics.

The lack of knowledge and competence in Nemeth Code and Braille mathematics was attributed to inadequacy in training. 62.5 percent of the teachers were trained for only twelve months. This period of training is not enough to give the teachers the skills needed. Only 56 percent agreed that they were adequately trained and only 37.5 percent said that they were very competent in teaching mathematics. In other words, the majority of the teachers are not competent in teaching mathematics to visually impaired pupils. Inadequate training in the Nemeth Code means that teachers will not be able to teach mathematics at upper levels. This probably explains the trend found in schools where the visually impaired are not learning mathematics at high school level. The Nemeth Code is supposed to provide skills in integrals, trigonometric functions and matrices. Since teachers have less knowledge about the concepts, they face challenges in high-level mathematics.

Teachers have challenges in using mathematics tools found in schools. This was attributed to inadequate exposure to the tools during training. The trainers also agreed that teachers were not exposed to the tools required and that the college had outdated tools. At one school, teachers faced the challenge of inconsistency in teaching classes.

Teachers have new classes almost every term. The challenge came about because teaching styles and approaches vary hence both teachers and pupils have difficulties adjusting.

Mason (1997) stated that visually impaired pupils learn differently. This means that visually impaired pupils, especially the blind would not use sight to learn mathematics but other senses such as touch and hearing. The fact that pupils lack sight is a challenge in itself. As a result visually impaired pupils have challenges in grasping the concepts and properties of number. The study found that besides lack of sight being a challenge, visually impaired pupils also have very poor tactile skills. Tactile skills are necessary for the pupils to be able to read mathematical diagrams and numbers. The poor tactile skills entail that reading complicated diagrams is difficult. The poor tactile skills have been attributed to poor training in tactile use to the pupils by the teachers.

Teachers and pupils have brought out some factors that are compounding to the challenges. The attitudes of both teachers and pupils affected the desire to teach and learn mathematics.

The study revealed that 44 percent of teachers had negative attitudes toward the subject and these teachers did not put in a lot of effort to learn from their colleagues how to teach or make teaching aids. Pupils also have negative attitudes towards mathematics and this was attributed to the discouraging remarks from the teachers. Teachers with a negative attitude do not encourage visually impaired pupils to learn mathematics but advise pupils

to take other subjects that do not have many mathematical calculations. The negative attitude of the teachers was attributed to lack of knowledge in mathematics and the methods of teaching the subject to the visually impaired.

The study also revealed that pupils' career choices were influenced by their teachers. The teachers who had negative attitudes towards mathematics encouraged pupils to take up careers that did not demand that they have good knowledge in mathematics. Similarly, pupils who have received positive remarks about mathematics seemed not to have limitations in choosing careers and were hopeful that they could choose jobs such as accountancy and engineering which demand mathematical knowledge. This finding suggests that the choice of careers by the visually impaired pupils was to a certain extent influenced by the school environment and not necessarily by the labour market.

Spungin (1989) also found that a combination of inadequate knowledge and lack of confidence in the teachers themselves and their pupils brings about problems in mathematics for the visually impaired persons. The teachers with a positive attitude encourage pupils to learn mathematics and use available resources to make teaching and learning aids.

Lack of materials and tools to use make teaching mathematics more complicated. The lesson observations revealed that there are few tools for teaching mathematics. Tools that are available include styluses and slates, cuberithm boards, and Perkins Brailier. The visually impaired pupils have challenges in keeping up with the latest advances in the

mathematics technology. Tools such as the talking calculator and Braille computers are lacking in schools. The non availability of such technology in schools brings problems, as seen when Braille mathematics notations used in computer prepared examinations are inconsistent with those taught in schools.

Poor mathematics background for both the teachers and the pupils has been another contributing factor to the challenges. Some visually impaired pupils are not learning mathematics at elementary level and learning mathematics at higher grades was a challenge. This finding tally with that by the Department of Education and Skills in England (2001), which showed that visually impaired pupils lack the necessary experience that supports estimation. The trainers and the teachers also lacked mathematical skills necessary to impart knowledge in the learners.

Another compounding factor in 50 percent of the schools in the study was the large classes. School B has an arrangement where three grades were accommodated in one classroom and all running at the same time. Pupils and teachers are unable to concentrate. Large classes were evident in integrated settings where a class had sixty pupils. Teachers were unable to give individualized attention to the pupils and the resource room was not well equipped to give remedial lessons to visually impaired pupils.

Negligence by school authority is another compounding factor. Evidence from school D showed that school authorities neglected the education of the visually impaired pupils in

the sense that materials for the sighted pupils were purchased while the visually impaired pupils did not have learning materials.

It was revealed that visually impaired pupils were not learning mathematics mainly because teachers and pupils lacked material to use.

Another factor that makes teaching mathematics challenging is the slow cognitive development of the visually impaired pupils. Mathematics requires cognitive maturity, which is usually lacking in visually impaired pupils. The visually impaired pupils develop slowly in cognition. This is due to lack of visual experiences and early language development in mathematics that is gained through hearing counting and joining in counting (Napier, 1974). Cognitive immaturity makes it difficult for the pupils to follow tactile aids for difficult topics and Braille mathematics codes involving diagrams. Braille diagrams are complicated and the visually impaired pupils need to be cognitively mature in order to be able to learn to read.

The study revealed that lack of transcription services in the schools makes the teaching of mathematics more challenging. Since there are no Braille mathematics textbooks in the schools, teachers transcribe ink printed books into Braille. The non-availability of transcription equipment makes lesson preparations more challenging. All the schools but one in the study did not have transcription facilities.

In this study the teachers and the pupils revealed that teachers are not well trained to teach mathematics to visually impaired pupils. The majority of the teachers agreed that

they were not well prepared to teach mathematics to visually impaired pupils. The poor training of the teachers meant that their knowledge and skills in Braille mathematics, Nemeth Code and the use of tools and equipment were not proficient. The pupils noticed that teachers were not conversant with teaching during lessons when they failed to explain concepts properly and were unable to use tools such as the abacus. The negative attitude was also attributed to lack of training because teachers do not know what to do.

The above finding is inconsistent with the view of the trainers of teachers where 75 percent said that the teachers were well trained to teach mathematics to the visually impaired pupils. This assertion by the trainers contradicts with the challenges that they face during training such as undetailed curriculum, lack of equipment and the short duration of training. The challenges that trainers face suggest that teachers were not adequately trained to teach mathematics to the visually impaired pupils.

Although teachers and pupils encounter challenges in mathematics, mathematics is still taught and learnt. Some coping strategies have been put in place or used to overcome the challenges. The pupils are paired up to help one another in mathematics. This method works in that pupils who have residual vision can read ink print while their blind friends transcribe what is read for them into Braille. This strategy was arrived at due to lack of mathematics textbooks in Braille. Another way of overcoming the challenge of lacking in textbooks was to give notes to the pupils. The pupils copied notes that were dictated to them by the teachers. The pupils used the notes to study.

The study revealed that pupils use the intellect to do calculations. Pupils memorize concepts. Osterhaus (2002) stated that visually impaired pupils were good at rote learning and memorizing concepts was good for them.

At school B, the lack of material was overcome by classes sharing the available tools. The timetable was set in such a way that at any given time one class was learning mathematics thereafter the materials were taken to the next class. This way each class had the chance to use the available tools and aids.

Some pupils and teachers have abandoned mathematics because of the challenges faced, coupled with compounding factors in the subject. 27.5 percent of the pupils abandoned mathematics and opted to concentrate on other subjects. 22.5 percent of the pupils not learning mathematics were at a high school. 3 percent of the pupils were in grade nine. This finding showed that visually impaired pupils were not learning mathematics at high school level due to the challenges mentioned earlier. It should be remembered that as pupils progress in school, mathematics becomes complicated and the challenges and compounding factors increase.

One way of overcoming challenges of lack of knowledge in Nemeth Code and Braille mathematics was by conducting capacity building workshops for the teachers. Two schools in the study had already started conducting workshops. The idea of conducting workshops was initiated by the schools. The workshops aim at empowering teachers with skill in teaching mathematics to the visually impaired, giving practice and

knowledge on the use of certain tools and also help teachers to develop interest in the subject.

Teachers make teaching aids using the materials that are available in the schools so that they can teach mathematics. Although teachers find difficulties in making complicated diagrams they still make teaching aids from some materials that are meant to be used by sighted pupils. For example, teachers at one school have put Braille numbers on ordinary rulers so that visually impaired pupils can use the tool in mathematics.

Most school lack transcription facilities such Perkins Brailler and other machines such as thermoform and Braille printer, which are needed in preparations of work for the visually impaired pupils. Teachers have found ways of transcribing work in order for the pupils to learn. Teachers use Perkins Brailler and writing frames to transcribe pupils' work from ink print into Braille.

Teachers overcome the challenge of cognitive immaturity of pupils by modifying work given to the pupils. The modifications mean that teachers work at the pupils' pace of learning. The findings from the lesson observations showed that visually impaired pupils learn slowly and teachers were required to move slowly through the examples and repeat many times. Modifications were also made in the methods of teaching. Napier (1974) stated that the visually impaired pupils progress in learning mathematics in the same way as their sighted counterparts but the methods of teaching differ. Competent teachers use a variety of teaching approaches because concepts taught at different times differ.

A major finding from the lessons observed was that teachers had varying methods of teaching different topics. For example, teachers at one school reported that they were finding it almost impossible to teach integers, yet at another school a teacher successfully taught the same topics using learning aids that he made from simple materials that were available in the school. This finding shows that factors such as attitudes and creativity play a significant role on the coping strategies that teachers employ.

The lesson observations further showed that teachers who use exposition or lecture methods to teach mathematics to the visually impaired pupils had difficulties explaining concepts. Similarly the pupils had difficulties making mental picture of the concepts. At one school, a teacher engaged the pupils in finding the perimeter of objects around the classroom using tactile rulers and the lesson was successful. At another school where a teacher was using chalkboard to teach addition and another visually impaired teacher using lecture method to teach fractions, pupils had problems following the lessons. This finding shows that visually impaired pupils experience fewer difficulties in mathematics when teachers combine tactile methods and exposition methods in teaching mathematics.

CHAPTER SIX

6.1 CONCLUSION

The study showed that trained teachers in special education and ordinary teachers face challenges in teaching mathematics to visually impaired pupils. The visually impaired pupils also face challenges in learning mathematics. The challenges faced by teachers and pupils are similar and the variations among schools are not many.

The challenges teachers and pupils face do not change much as pupils progress to higher grades but the compounding factors become eminent. The challenges faced by teachers originate from the challenges the trainers face as they prepare teacher to teach visually impaired pupils and the challenges become complicated in schools where teachers are working.

There is a close link between the challenges teachers and pupils face. The challenges teachers encounter spill over to the pupils. The compounding factors manifested in the schools are many and they are related to the challenges.

Teachers and pupils have put strategies in place to overcome some of the challenges. The strategies seem to work but the teachers and pupils are struggling. The strategies work out when the school administrators, the teachers and pupils have positive attitudes.

Attitudes affect how the teachers and pupils devise strategies to overcome the challenges in mathematics.

6.2 RECOMMENDATIONS

The following recommendations are proposed in view of the issues that the study has revealed.

a) Pupils

- Pupils should be provided with learning materials in mathematics.
- Resource rooms in integrated settings where visually impaired pupils are learning must be refurbished with teaching and learning aids.
- Pupils must be given tactile skills in reading mathematic codes and Braille diagrams.

b) Teachers

- The schools must conduct capacity building workshops for teachers in methods of teaching mathematics to visually impaired pupils. This will help the teachers improve on the poor background in mathematics.
- The teachers should develop positive attitudes towards mathematics. This will help them devise methods of teaching mathematics and they will also be able to encourage pupils to learn mathematics.
- The number of visually impaired pupils in a class should be reduced to enable teachers to offer individualized attention to the pupils.

- The teachers should as much as possible use tactile learning and teaching aids rather than giving lectures in mathematics to visually impaired pupils.

b) Trainers

- In order for the teachers to be adequately trained in mathematical codes, teaching methods and the use of tools that they find in schools, the curriculum which is used in the training of teachers at the Zambia Institute of Special Education (ZAMISE) should be revised and strengthened.
- Specialization in training of teachers must be put in place. Specialist teachers in mathematics for the visually impaired pupils should be trained unlike a situation where teachers are exposed to all special educational needs in one year.
- The duration of training for the teachers must be increased from one year to two years during which the teachers specialize in teaching mathematics to visually impaired pupils.
- The College must employ well-trained and adequate teaching staff to train teachers.
- The college must be well equipped with tools used in mathematics and teachers must be exposed to these tools during training.

c) Ministry of Education

- Teacher training colleges should have a component of special education in training of all teachers so that all teachers have knowledge of special educational needs.
- The Ministry of education should mount termly sensitization workshops for teachers to foster positive attitudes towards mathematics.
- The ministry of education must put in place a policy on procurement and distribution of materials and equipment for the visually impaired pupils.
- The study found that there is inconsistency in Braille notations used in schools and that used by the Examinations Council of Zambia in preparations of examinations. Computer Braille used in examinations must be harmonized with that used in schools.
- Monitoring of schools where the visually impaired learn must be done. This will help control the attitude of neglecting visually impaired pupils by not buying teaching and learning materials.

d) Future research

- There is need to find out challenges in other subjects, especially sciences where visually impaired pupils reported facing challenges.

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APPENDIX A

A QUESTIONNAIRE FOR THE TEACHERS OF VISUALLY IMPAIRED PUPILS

Dear Respondent

I am a student doing a master's degree at the University of Zambia, carrying out a study on the *challenges in teaching and learning mathematics by the visually impaired pupils*. You have been selected to participate in the study. The information that you will provide will be used for academic purposes only and will be treated with strict confidence.

Tick the appropriate answer or write in the provided space.

1. Are you trained to teach mathematics to the blind pupils?

YES _____ NO _____

2. Name the institution where you went for training

3. If your answer to question 1 is YES, how long did the course take?

3. If your answer to question 1 is NO, how are you able to teach mathematics despite being untrained?

5. How competent are you in teaching mathematics to the blind?

- a) Very competent
- b) Quite competent
- c) Not so competent

6. Which of the following tools are you able to use?

- a) Abacus
- b) Perkins Braille
- c) Taylor frames
- d) Talking calculator
- e) Brennan slate
- f) Any other _____

7. Where you trained in the Nemeth code and Braille mathematics?

8. Are you able to use Braille mathematics and the Nemeth code in teaching mathematics?

9. If your answer to question 8 is NO, give a reason.

10. Do you agree that your training was adequate?

- a) Adequate
- b) Not adequate

Part B

11. Do you have tools in the school for teaching mathematics to the visually impaired pupils?

Yes _____ No _____

12. List down the materials that you use to teach mathematics.

13. If there are no tools and materials, explain how you teach mathematics to visually impaired pupils?

14. What teaching tools do you think should be present for you to be able to teach mathematics to the pupils?

15. What are some of the topics that you find difficult to teach?

16. What makes the questions in 15 difficult to teach?

17. Do the pupils in your school sit for national examinations in mathematics?

YES _____

NO _____

18. If your answer to question 17 is NO, give reasons for your answer. _____

19. Mention any other problems that you are facing as you teach mathematics to the visually impaired pupils.

20. What measures have you put in place to overcome the challenges that are stated in question 19?

Thank you for your cooperation.

APPENDIX B

QUESTIONNAIRE FOR THE TRAINERS OF TEACHERS OF VISUALLY IMPAIRED PUPILS.

Dear Respondent

I am a student doing a master's degree at the University of Zambia, carrying out a study on the *challenges in teaching and learning mathematics by the visually impaired pupils*. You have been selected to participate in the study. The information that you will provide will be used for academic purposes only and will be treated with strict confidence.

Tick the appropriate answer or write in the provided space.

1. How long do you train the teachers of the visually impaired pupil?

2. Does the College have adequate staff to train teachers of the visually impaired pupils?

Yes _____ No _____

3. Do you train teachers to teach mathematics to blind pupils?

- a) Yes
- b) Not all

4. Name some of the aspects of training that the syllabus contain

5. Are teachers trained to teach mathematics using the Nemeth Code and Braille Mathematics?

6. What kind of tools for teaching mathematics do you have which students are acquainted with during training?

7. At the end of training, are the students competent to teach mathematics to the visually impaired pupils.

- a) Competent
- b) Not competent

8. How do you assess the competence of the student in using the Nemeth Code and Braille Mathematics?

9. Which areas of training do think are not adequately handled?

10. Do you observe the students during teaching practice as they teach mathematics to the visually impaired?

11. What difficulties do you face in training students to teach mathematics to visually impaired pupils?

12. What measures have you put in place to overcome the challenges that you face in training teachers of visually impaired pupils?

Thank you for your cooperation

APPENDIX C

FOCUSED GROUP DISCUSSION GUIDE FOR THE VISUALLY IMPAIRED PUPILS

1. Do you learn mathematics?
2. How do you learn mathematics?
3. What are some of the tools that you are using to learn mathematics?
4. How are the teachers of mathematics helping you to learn mathematics?
5. How is your performance in mathematics? Is it good or bad? Why is this so?
6. How do you think you can best learn mathematics?
7. What problem are you facing in this subject?
8. How do you overcome the problems that you face in this subject?
9. What do you think should be done to lessen the difficulties that you face in learning mathematics?

APPENDIX D

OBSERVATION SCHEDULE

1 Look at the lesson plan and check for the following

a) Preparation _____

b) The method of
teaching _____

c) Pupils'
participation _____

2 Check the availability of teaching aids.

a) What teaching aids is the teacher going to use?

b) Do the pupils have learning aids such as the abacus, slates and others?

3 In the absence of the required teaching aids.

a) What strategy is the teacher using?

b) Is the strategy being used helping the pupils to learn?

