Investigating Mathematics Learning and Achievement of Students with Hearing Impairment: The Case of Menelik II Preparatory School

Ananiya Abebe

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This is to certify that the thesis prepared by Ananiya Abebe, entitled: Investigating Mathematics Learning and Achievement of Students with Hearing Impairment and Submitted in partial fulfillment of the requirements for the degree of master of education complies with the regulations of the university and meets the accepted Standards with respect to originality and quality.

Signed by the Examining Committee:

Examiner Dr. Sewalem T Signature _____ Date 15/12/14

(External)

Examiner Solomon Areaya Signature _____ Date 18/12/14

(Internal)

Advisor Kassa Michael Signature _____ Date 18/12/2014

Chair of Department or Graduate Program Coordinator

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ACRONYMS AND ABBREVIATIONS

dB – decibel

EGSECE – Ethiopian General Secondary Education Certification Examination

FDRE – Federal Democratic Republic of Ethiopia

GRI- Gallaudet Research Institute

HI – Hearing Impaired /Impairment

LSC- Listening and Spoken language Method of Communication

MOE – Ministry of Education

NCTM - National Council of Teachers of Mathematics

SC - Simultaneous Communication

SL- Sign language

SD = Standard Deviation

Sig – Significant

TGE – Transitional Government of Ethiopia

UNESCO – United Nations, Education, Science & Cultural Organization.

Abstract

Investigating Mathematics Learning and Achievement of Students with Hearing Impairment: The case Menelik II Preparatory School.

Ananiya Abebe

Addis Ababa University, 2014

The purpose of this study was to assess mathematics learning and achievement of students with hearing impairment. Descriptive survey research design was used for this study. The study was carried out in Menelik II preparatory school. The study sample comprised 4 mathematics teachers, 4 interpreters and 40 students with hearing impairment. Data was collected by use of questionnaires, observation and document analysis. It was analyzed and presented using descriptive statistics (frequency distribution, mean score, percentages and standard deviation) and t-test and multiple regressions. This study found out that :- most of the respondents were a profound hearing impaired without other family members with hearing impairment, some of the respondents/students hear conversation very slightly and a few of them hear sound very slightly, most of the respondents' parents were with no formal education except for some who were certificate or diploma and degree holders, teachers do not use an appropriate methods of teaching, time on task was found to be inadequate, teachers are in trouble to use sign language, teachers never covered the syllabus content in the stipulated time and students with hearing impairment had low mathematics achievement. This study recommends: to give training on methods of teaching, to use tutorial program, to use more instructional time and to give sign language training.

CHAPTER ONE

1. INTRODUCTION

1.1. Back ground of the Study

Education is the main way to build up the future of the child and the society (United Nation, 1994 as cited in Fikrte, 2006). Formal education is becoming accessible to increase the numbers of children. But school attendance does not necessary mean that effective learning is taking place or education that schools provide is relevant to the needs of their students. Education has not always been seen as a right of the child, especially for children with disabilities (United Nation, 1992).

Education is one of the vital components in the life of every social group. Every member of the society should have proper education in their respective settings. Students with hearing impairment have their limitations in learning in regular classrooms. To students with hearing impairment the loss of the important sensory capacity affects their education.

Sometime between the ages of 12 and 24 months as a result of previous language experiences, the child begins to learn to speak and to develop language skills. Obviously, if the child is hearing impaired, speech and language development may be delayed. Under developed speech and language skills are the greatest limitations that occur as a result of hearing impairment. Delayed speech and language acquisition influence a child's ability to develop communication skills such as reading, writing, listening and speaking. As a result these skills develop at a slower rate than those of the normally hearing child (Gear heart et al, 1992 as cited in Felkech, 2000).

As a group children with significant hearing loss are at greater risk than other children below their potential despite the institution of various educational approaches of increasingly earlier ages (Calderon and Low, 1998 as cited in Ibid). The most important factor that affect education of Students with hearing impairment as mentioned above is their problem in communication that comes due to their hearing loss.

Since children with hearing impairment and youth are unable to hear the continuously repeated flow of language spoken around them, they need to be exposed to special and unique communication systems. They are not automatically exposed to the very wide series of language stimulation experienced by hearing people. Hence for children with hearing impairment, early constant and continuous use of visual communication models such as sign language, finger spelling and cued speech together with amplification and above all aural / oral training can help to reduce the risk of language delay and develop skills in communicating and integrating them with the community around (Alemayehu, 1995).

Traditionally students who are hearing impaired are taught in the listening and spoken language (LSC) method of communication receives intensive speech and language therapy when they are young. The language delay due to the hearing loss for these students was a main focus for the teacher of the students with hearing impairment. The students hearing losses were what were hindering their abilities to be successful in the main stream environment.

Research shows that student's hearing loss may no longer be the only obstacle, they may need to overcome. According to Gallaudet Research Institute (GRI) it is estimated that approximately 39% of children who are hearing impaired have an additional disability of these 39% of children with additional disabilities, 13.4% of children have other learning disabilities (GRI, 2011) as cited in Bush (2012).

According to Soukup and Feinstein (2007) as cited in Bush (2012), a child who is hearing impaired is more likely to have a learning disability than their hearing counter parts.

According to the individuals with disabilities education Act (2004) as cited in Bush (2012), a specific learning disability is defined as: a disorder in one or more of the basic psychological processes involved in understanding or using language, spoken or written which the disorder may manifest itself in the imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations (Cortiella, Candace, 2010) as cited in Bush (2012).

Being able to do mathematics is a necessary and valuable life skill. Whether you are shopping for groceries, paying a bill, or cooking from a recipe, mathematics skills are important. However, it is the process of learning which can be affected by different abilities and disabilities.

According to Ndurumo (1993) and Adoyo (1995) as cited in KIE (2006) students with hearing impairment lag behind their hearing counter parts in mathematics. Here also according to Adoyo (2004), there is increasing dissatisfaction with low achievement in schools for the students with hearing impairment. Wood and Howarth (1983) found that students with hearing impairment were approximately 3.4 years behind in mathematics achievement tests when compared to their hearing counter parts. The low achievement is attributed to inappropriate teaching methods, lack of commitment by teachers and communication problems across the curriculum Ogutu (1996).

Adoyo (2004) indicated that the failure seemed to occur because teachers are not presenting the curriculum materials in a linguistic form that is accessible to hearing impaired students. These problems forced to take place a reform in mathematics for students with hearing impairment.

Calls for reform in mathematics for Students with hearing impairment have targeted mathematics word problem solving and general reasoning skills as critical areas of emphasis (Daniele, 1993; Dietz, 1994). Educators have encouraged programs serving Students with hearing impairment to adopt the recommendations included in the standards advocated by the National Council of Teachers of Mathematics (NCTM). In particular, these standards emphasize that problem solving more than applying specific strategies when solving different classes of word problems. In the view of the NCTM, problem solving is "not only a goal of learning mathematics, but also a major means of doing so" (NCTM, 2000).

Other studies show that students with hearing impairment don't perform well in problem solving tasks, achieving well below hearing students (Traxler, 2000). The low achievement of students with hearing impairment in this area has been attributed to a combination of linguistic, cognitive, and experiential factors. Linguistic content of the problems or the English language abilities of the students have been considered the

primary contributing factors to students with hearing impairment difficulties with mathematics in general, as well as with word problems in particular (Barham and Bishop,1991).

Students with hearing impairment in Menelik II preparatory school have faced obstacles in learning mathematics. Students with hearing impairment show passive participation in mathematics class. They seem to show a less interest to attend their mathematics lesson.

Hearing impairment is a disability that can affect students' ability to learn mathematics, and understanding this issue is essential to overcome the difficulties which faced students with hearing impairment.

On these bases this study focused to investigate mathematics learning and achievement of Students with hearing impairment.

1.2. Statement of the Problem

Students with hearing impairment tend to have slower learning processes because they cannot pick up various concepts and vocabulary incidentally like students who do not have a hearing impairment. This can be problematic in the mathematics class room.

Studies show that students with hearing impairment do not perform well in problem solving tasks, achieving well below hearing students (Traxler, 2000). The low achievement of students with hearing impairment in this area has been attributed to inappropriate teaching methods, inadequate content coverage and time on task, lack of commitment by teachers and communication problems across the curriculum (Ogutu, 1996).

Having a hearing impairment can adversely affect a student's ability to learn. Not only is it difficult to communicate, but since most teaching is done through speaking, the barrier for impaired studies can seem insurmountable. In particular, mathematics is a subject with abstract ideas that cannot always be communicated with words (stein, 2012).

Moreover deaf children are less educationally retarded in more mechanical skills such as arithmetic computation and spelling. The spelling ability of deaf children has been studied. It does appear however that of deaf children may be superior in spelling performance. Mathematics computation is an area in which deaf children also seem to

achieve well. They are less successful at mathematical problem solving which is predicted on a language base (Tesfaye, 2004).

Students with hearing impairment in Menelik II preparatory school seem to have a low achievement in mathematics and a less participation in mathematics classroom than their hearing counter parts.

Mathematics is a compulsory subject in Ethiopian schools (Fikrte, 2006) which is also true in most parts of the world. Fuchs and Fuchs (2002) as cited in Fikrte (2006). Fikrte said that currently the world is becoming more and more technical and the study of mathematics and the resulting skills have become increasing valuable.

Although, mathematics is a key subject no more research was conducted on mathematics learning and achievement of students with hearing impairment in Ethiopia. Attempts which were made by other researchers were not beyond the general academic learning and achievement of students with hearing impairment. Furthermore, no research conducted on this issue in the study site.

Because of this there is a need to conduct studies in Menlik II Preparatory School to investigate mathematics learning and achievement of hearing impaired students.

1.3. Research Questions

This study was guided by the following basic research questions.

- What is the way of mathematics learning in hearing impaired classes?
- What is the achievement of hearing impaired students in mathematics?
- What is the way of communication between teachers and students with hearing impairment in mathematics class?

1.4. Objectives of the Study

The study aimed at investigating mathematics learning and achievement of hearing impaired students. More specifically, the objectives of the study are:

- To investigate mathematics learning of hearing impaired students.
- To examine mathematics results of students with hearing impairment.
- To find out factors influencing mathematics achievement of students with hearing impairment.

- To assess the communication of students with hearing impairment and their teachers in mathematics class.

1.5. Significance of the Study

Research to investigate mathematics learning and achievement of students with hearing impairment that is Knowledge of mathematics problems faced by these students, the methods of teaching, time on task, medium of instruction and content coverage that were used in the past would help us to improve the system of educating the hearing impaired at the present situation. This study may contribute to the understanding of mathematics learning and achievement of students with hearing impairment locally and the country at large. The results of this study will contribute to some degree to the efforts of

a) Teachers who are in need to give real system of support to their students.
b) Other professionals who work in related areas that support students with hearing impairment.
c) Researchers who are interested in conducting studies related to the issue.
d) Provide the necessary assistance for teachers to understand their students with hearing impairment so that they can create conductive settings for healthy learning situation.
e) Provide basic information for the concerned bodies like policy makers, planners and interested groups to realize and overcome barriers, which operate against mathematics learning and achievement of students with hearing impairment.
f) Serve as a stepping- stone for further research in the field.

1.6. Scope of the Study

This study was done in Addis Ababa, Arada Subcity, Menelik II Preparatory School by taking Grade 11 students with hearing impairment. This study is used to investigate mathematics achievement of students with hearing impairment.

1.7. Limitation of the Study

Special Education, itself is a relatively new phenomenon in Ethiopia. Hence, locally written literature particularly on mathematics learning and achievement of students with hearing impairment were not available. The researcher, therefore, feels that additional evidences were not presented to supplement the study in the Ethiopian context.

The study was focused on the influence of socio demographic characteristics of the respondents and curriculum factors on mathematics achievement of students with hearing impairment. But this study did not investigate the influence of psychological problems and economic status of the participants on mathematics achievement.

1.8. Definition of key Terms

Academic achievement:- knowledge obtained or skills developed in the school subject, usually designed by test scores, by mark assigned by teachers or by both (Schulze, carpenter and Turnbull, 1991).

Disability:- any restriction or lack (resulting from an impairment) of ability to perform any activity in the manner or within the range considered normal for a human being (Miron, 1994).

Hearing Impairment:- Any hearing loss from mild to severe. A hearing problem that can adversely affect a student's educational performance (Yosseldyke and Algozzine, 1995).

Interpreter:- A person who uses sign language and/or finger spelling to translate spoken communication so deaf individuals can understood it (Vergason and Alenn, 1990).

Mathematics achievement test:- After a lot of study and exercise students' success and performance in mathematics as seen by scores on test conducted by the investigator and by subject teacher on basis of content on the text book for each grade.

Mathematics learning:- Mathematics learning should include abroad range of learning activities, exposition, discussion, practical work, practice, problem solving and investigation and particular elements that should be presented in successful mathematics learning to pupils of all age (Krantz, 1999).

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Historical Development of Special Needs Education

History tells us that "prior to the late 1700s the fate of disabled individuals was likely to be a cruel one and the Greeks, Romans and other early cultures are often cited by their practices of killing the unwanted children" (Tibebu, 1995, p.13).

As time went on, there came conviction, which considered children with special needs as different from the rest of children with a sense to develop separate educational system (Hegarty & packligton, 1988 as cited in Tesfaye, 2004).

Moreover, some professionals imitated the concern for the educational rights of children with disability and as a result residential schools, special-day schools and special classes were opended respectively (Moore, 1996 as cited in Ibid).

At the beginning, although opinions may differ on reasons for establishing segregated schools for special needs students, it was assumed that such educational models could serve for proper utilization of instructional equipment and for maintaining a one to one attention such a model was also assumed to encourage a feeling of security among special needs children by avoiding unfair compassion with those who are believed to be more competent students (Jenkison,1997 as cited in Ibid).

Particularly in 1950s and 1960s , people came to be aware of a continuous history and practices of segregation in their own societies with acknowledgement that had " strong value implication". This condition, in turn has brought the idea of the integration of special needs children with their natural peers with " a wish to move away" from segregated educational practices (Millward and Dyson, 1995, p.44).

According to Fish (1985) (as cited in Tibubu, 1995) it was in 1980s that revolutionary changes took place in special needs education with the aim to educate children with special needs. Similarly, it was indicated that one of the 1960s significant achievements in area of specials education was" the conceptualization of the delivery of special needs education services as a continuous of services known as "cascade model", viewing the regular school classroom as the most natural and the least restrictive option.

Hegarty and packlington (1988) noted that the historical development of special needs education seems to differ from country to country. For example, special needs education for pupils with special needs was a relatively recent development in Great Britain. In the United States it was at the beginning of the nine teeth century (Meijer and Hegarty, 1994).

Regarding the historical development of special needs education in Ethiopia, it has a relatively closer point of time reference with the establishment of the first regular school in the country. It was within time gap of less than a decade since the establishment of the first regular school (Menelik II school) that special education for the disabled was opened in its modern form in Ethiopia (Tibebu , 1995).

Like in the case of other countries, the first special school was began by missionaries from Europe, the first special school being opened for the blind in 1917 (MOE, 1994). Unfortunately, the educational system that had just begun to emerge was seriously disrupted by the brief Italian invasion Tekeste (1990) as cited in Tesfaye (2004). Thus, the first special school was closed and reopened in 1955 in Addis Ababa. Additionally other special schools were opened for children with other disability in 1960s and 1970s (Tibebu, 1995). As indicated by Tibebu, it was in the 1980s that the Ethiopian government, through Ministry of Education, began to take part in the provision of special education. The education and training policy of Ethiopia 1994 has considered the provision of education to special needs children. Under its specific objectives, it is stated as "to enable both the handicapped and the gifted learn in accordance with their potentials and need" as (TGE, 1994, p. 9). The educational policy further confirmed "special education and training will be provided for people with special needs" (TGE, 1994).

Furthermore, what has been stated in the Ethiopian constitution Article 41 declares that "every Ethiopian national has the right to equal access to publicly funded social services" (FDRE, 1995, p: 15). Moreover Article 90, states as follows "to the extent the country's resources permit, policies shall aim to provide all Ethiopian access to public health and education" (FDRE, 1995, p. 13).

2.2. Hearing Impairment

Researchers usually agree that listening is an important tool for the child to learn and acquire information from his /her environment through the auditory channel. It is through hearing that the child "learns to discriminate between loud and soft, high and low, and distracting and pleasant sounds". Additionally, "hearing is instrumental for the child to determine the direction, distance and meaning of sounds" by analyzing the human voice (Gear heart, Weishan & Gearheart , 1992, p:40 as cited in Tesfaye, 2004).

It is believed that hearing impairment can negatively affect the normal pattern of speech and language development there by arresting the child's ability to develop such as communication skills reading, writing, listening and speaking.

With this brief information in mind, the meaning, classification and cause of hearing impairment will be treated shortly under the following sub- headings.

2.2.1. Meaning / Definition of Hearing Impairment

In defining hearing impairment, two extreme points of view are represented by professionals adhering to different philosophical orientations, namely the physiological and educational approach. According to Hallahan and Kauffman (1991, p.266), persons who strictly maintain physiological view points are "interested primarily in the measurable educators degree of hearing loss" whereas educators who favor educational view point are concerned with " how much the hearing loss is likely to affect the child ability to speak and develop language". The most commonly used and accepted set of definitions related to educational orientations are presented as follows.

Hearing impairment:- is defined as a " generic term indicating a hearing disability which may range in severity from mild to profound" (Pasonella and cara, 1981, p. 299) including the subsets of deaf and hard of hearing.

Deafness:- is understood as a condition when a person's hearing disability precludes successful of linguistic information through audition, with or without a hearing aid, which adversely affects educational performance (Schulze et al, 1991).

Hard of hearing:- is a person who, "generally with the use of hearing aid has residual hearing sufficient to enable successful processing of linguistic information through audition (Hallahan and Kauffman, 1991,p. 266).

According to Reynolds and Janzen (1990, p. 300) due to "the interference of deafness with language acquisition, pre lingual deaf children and adults markedly differ from the post lingual deaf child". It is further noted that the post lingual deaf/ students with hearing impairment have "a sensory-impairment that interferes with their ability to receive speech and other sounds", but having "normally and completely developed language function" which is not possessed by the prelingual deaf children.

It is reported that in most cases, hard of hearing children can acquire language skills efficiently without too much difficulty and hence "most of the post lingual deaf who possess language do not join the deaf community". In other words, they can easily be integrated with their hearing peers. Most importantly, educators are highly concerned about the age of onset of hearing impairment and its relationship with language development.

2.2.2. Causes of Hearing Impairment

As noted Hallahan and Kauffman (1991), ottitis media, malformation of outer ear, malformation of ear channel, foreign object in the external ear, excessive build up of ear wax, and perforation of the ear drum due to excessive pressure are some common causes of conductive hearing loss.

On the other hand, the type of hearing loss that affects "frequency, intelligibility and clarity of the sounds that a person hears" is known as sensory neural hearing loss (Gear heart et al., 1992). Heredity (which is the most frequent cause of child hood deafness), bacterial infection such as meningitis), Premature birth, viral infection (such as measles and mumps) and deprivation of oxygen at birth are frequently observed causes. Additionally, prenatal infection of the mother such as rubella, congenital syphilis, RH incompatibility, blows to the head, some antibiotic drugs and excessive noise levels are identified as causes for sensor neural hearing loss (Hallahan & Kauffman, 1991). Other than the type of hearing loss, the age at which the hearing loss takes place is taken as

a critical factor, particularly due to the influence of hearing on the acquisition of language (Schulze and carpenter, 1991).

2.2.3. Functional Hearing in Relation to Language and Behavior

Most students with hearing loss in regular class room have enough residual hearing to process language through hearing with appropriate amplification. Knowing exactly what kind of assistance is required for the teacher of his students in a variety of class room situation helps the students to benefit from these experiences. Hearing loss has been organized traditionally into five categories, which consider the range of sounds used in speech; it may be helpful for the regular teacher to know which category best describes his particular (Moores, 1996).

1. **Normal hearing**

   Students can detect all speech sounds even at a soft conversations level. The student's hearing would be plotted in the -10 to 15 decibel range on a diagram.

2. **Minimal loss**

   Students may have difficulty of hearing faint or distant speech. Peer conversation and teacher instructions presented too rapidly, particularly in noisy class rooms are likely to result in missed information. Loss is between 16 to 25 decibels.

3. **Mild**

   Students may miss up to 50% of class discussions especially if voices are soft or the environment is noisy. Students will require the use of a hearing aid or personal FM system. Loss is between 26 to 40 decibels.

4. **Moderate**

   Class room conversation from 3 to 5 feet away can be understood if the structure and vocabulary is controlled. Hearing aids and /or personal FM systems are essential. Specific attention will need to be directed to language development, reading and written language. Loss is between 41to 55 decibels.

5. **Moderate to severe**

   Without amplification students with this degree of loss can miss up to 100% of speech information. Full time use of amplification is essential. They will probably require additional help in language based academic subjects. Loss is between 56 to 70 decibels.

6. **Severe**

Students can only hear loud noises at close distances. They require individual hearing aids, intensive auditory training and specialized instructional techniques in reading, language and speech development. Loss is between 71 to 90 decibels.

7. **Profound**

For all practical purposes these students' rely on vision rather than hearing for processing information. If you have a student in this category, he or she is usually a candidate for signing systems and specialized instructional techniques in reading, speech and language development. A loss is 91 decibels or more is described as profound.

2.3. Education of Hearing Impaired

In early times, Greek philosophers, like Aristotle considered the ear as our organ of instruction and hearing was taken as a major factor contributing to intelligence (Moores, 1996).

As a result owing to misconceptions attached to hearing impairment, students with hearing impairment had been denied of their educational rights for many years (Moores, 1996).

Initially, the major concerns were centered on defining the legal and religious rights of the hearing impaired and " Education for the hearing impaired was not a consideration in societies in which the majority of the population was illiterate" (Moores ,1996,p.32).

In the long run, educators and other professionals began to have an insight into the possibility of educating the students with hearing impairment. As noted by Goldstein (1989), in the 16th century, there was a renewed interest in Europe and institutions were opened to educate even the profoundly deaf children. As a result, most students with hearing impairment began to attend their education separately "either in residential schools or in day school for the deaf" (Moores , 1996, p .8).

However, around the beginning of 1968, there came a reaction against increasingly segregated educational provisions for students with hearing impairment (Moores, 1996). In fact, referring to its historical back ground "for more than three hundred years, the

primary emphasis among educators of the hearing impaired has been communication" by giving attention to academic achievement.

Today, the majority of students with hearing impairment are educated in schools were hearing students are attending as well (Moores, 1996). Currently, legislation, technological advances, improved educational services, and the growing public awareness have brought a remarkable progress in the area of deaf education (Moores, 1996).

However, in spite of the achieved progress, the field of deaf education has been full of "bitter controversy and conflict" and the education is said to be a below what it should be (Moores, 1996). Furthermore, Smith and Luckasson (1995, p: 478), on their part stated, "The best educational methods for students who are hearing impaired are still matters for debate by those who are deaf and by professional educators". It is believed that students with hearing impairment deserve to be placed in an environment where they can communicate with peers, and meet their academic, social, emotional and cultural needs. "They deserve to be in an environment where they are truly included in every aspect of the school" (Smith and Luckasson, 1995, p. 483).

On the other hand, Smith and Luckasson (1995) noted that for students who use sign language as their primary means of communication, "the regular school environment where administrators, teachers, and classmates are not fluent in sign language can result in considerable isolation."

A side from the existing constraints, depending upon the severity and type of disability, regular education classrooms, resource rooms, special classes, special day schools and residential schools were use as placement options to educate children with special needs (Smith and Luckasson, 1995). In addition, while discussing about this same issue, researchers informed, "along with acquiring educational benefits, students with hearing impairment acquired social skills in regular class rooms".

In the case of hearing impaired education in Ethiopia, special schools for the hearing impaired were first opened by the nongovernmental organization, in 1963 E.C(in Addis Ababa-Mekanisa) and 1967 E.C (in Addis Ababa round Bole) by the church of Christ Mission and the American Mission respectively (Berta, 2000).

Recent evidence as mentioned by Tilahun (1991 E.C) as cited in Tesfaye (2004) shows that residential schools, special day school, special classes and regular classes are forms of educational provision available for students with hearing impairment in Ethiopia. Currently, it appears that the opening of special classes, and some integrated classes for hearing impaired students is at a growing rate bringing students into closer physical proximity for a possibly better social interaction.

Even though as stainback and stainback (1990, p: 19) indicated, "care must be exercised to ensure that any organized grouping of people does not violet, their interest, needs and basic rights". Hence, to ensure better educational provision, it will be highly pertinent to examine the attitudes of teachers and students in order to make fair integrated educational placement.

Integration is a matter of providing appropriate, high quality education for pupils with special needs in regular schools (Hegarty, Jan and W., 1994). Integration is a process of increasing the participation of children with impairments and disabilities in the education programs and social life for regular schools in which their peers without disabilities participate (potts, P., Armstrong, F. and Matsterton, M., 1995).

2.4. Historical Perspectives of Sign language

Sing language is the earliest and the most important means of communication. Before language developed, sign language played a great role.

In ancient times people didn't systematically formulate sign language as we have today. Because of the lack of such a device in those days, their communication was not as effective as it is today. However the ancient people used simple and natural signs. The aim of this was to express their desires and feelings among the people in the community. William D.Brooks (1964: P. 117)as cited in Tsegu (1988) notes that, signal language includes all those forms of communication in which words, numbers and punctuation have been supplanted by gestures. Examples of range from the simplest gestures of the hitch hiker to the complete sign language of the deaf.

For instance, in the earliest times the North American, Indians used this language to communicate among themselves and as well as with other tribes. According to

Thomas & sebeok (1979: 132) the early warriors, traders and travelers used this means of communication till any common meaning could be expressed. He also stated that sign language did not remain as it was but developed and took shape by different scholars for better means of communication.

In addition scholars stated that the dot was the origin of sign and made man to express his feelings by drawing different pictures in the cave. Rudolf knock (1979) say "the dot is the origin from which all signs start and is their inner most essence." Taking this dot as a source man drew different forms like vertical and horizontal lines to represent something. Thus, this sign developed into various signs which represent various things in the society. Therefore we can confidently conclude that the origin of sign language initially emerged from the simple sign and gradually developed into sophisticated sign of communication.

After wards, sign language becomes the tool of the deaf community and it was gradually developed and designed for their effective means of communication.

According to Lionel Evans (1982: p.1) in the sixteen century a man called pedro ponce de Leon gathered the deaf children of important families in order to teach them sign language as a communication tool. He tried to teach those students by creating some signs in addition to natural signs. He also shaped some objects and related them to the spoken form. In addition Juanpable Bonnet, published a one-handed manual alphabet used to teach deaf students. He gave advice to the deaf family to use finger spelling to exchange ideas among themselves. Furthermore, Evans (1982: P.1) states "Bonnet believed that finger spelling should be used by members of the family to the young deaf child."

According to Harlon Lane (1971: p. 197) sign language was studied with effort by Michel del' Epee'. He made Bonnet's publication of manual alphabet as the base and considered sign language as a natural language for the deaf. One the other hand, his effort of studying sign language became the beginning of the modern system of education formulated in Europe and America. That is why; many people from different countries would like to go to France and England to study better means of educating the deaf.

2.5. The Role of Sign Language in the Deaf Community.

Sign language plays a great role in a deaf community. It is the most important tool to make communication more effective and successful. Such a type of communication is realized in a community where the people lack the ability to hear and speak. Effective communication in a deaf community is possible mainly through the use of sign language. To be more explicit, the mother of a deaf child successfully communicated with her child just as the mother of a child in any hearing community. In order to succeed, the frequently uses natural sign language such as gestures, facial expressions, the movement of the hands and the like. In addition, a mother employees different practical methods to communicate with her deaf child. For instance, a mother shows a smile on her face when she wants the child to do something. Making the child play is another concrete factor which she uses to communicate. Agatha H. Bowley & Leslie Gardner (1980: p. 141) state that, " there are many ways in which a mother communicates to her child, by her facial expressions or her gestures, by touching him, by picking him up, by curdling him and so on." Thus one may say that in a deaf community successful communication is possible.

Moreover, deaf children successfully develop using sign language with their peers rather than their hearing parents. Peers in a deaf community have various interesting activities. That always occupies themselves in useful things. When deaf children participate indifferent games such as playing foot ball, drawing pictures and the like, they effectively communicate among themselves. To achieve such things, they depend upon their sight. For example when they play games, they express their feelings by looking at each other. Melvin carter (1981: p.23) confirms that;

> In spoken language, hearing is necessary for listening and one uses the voice to Speak. In sign language, seeing is necessary for listening and moving One's arms hands face and body is necessary for speaking.

Therefore, looking at each other in a deaf community among the peers of the same age level carries equal message just as in the hearing community. Concerning eye contact Brooks (1971: P.120) also states that "the most readily observed of all gestures or action

language are facial expression. We focus on the face more often than on any other part of the body. Especially, we focus on the eyes."

Sign language is the root of deaf communication. This type of communication is used mainly in a deaf community. This is so because people in such community cannot use natural language to express their views. They do not have the opportunity neither to hear nor to speak. They depend upon their ability to see. That is why different scholars have repeatedly stressed the importance of sign language for the deaf as the proper vehicle for intellectual development.

2.6. Manual Alphabet

It has been said that sign language is the basis for the invention of better means of communication. Among the new inventions in this particular field of study manual alphabet is one of the most important methods of communication developed for the deaf community. This system stresses the use of manual alphabet and the language of signs as forms of communication in the deaf community. Using such a device the deaf can easily exchange their thoughts and feelings with their fellow men just as in the hearing community.

There are different forms of finger spelling or manual alphabet which are designed for communication purposes in the deaf community. The two types of manual alphabet are known as one handed manual alphabet and two-handed manual alphabet- North America, Scandinavia and the Soviet Union use the former type of manual alphabet. The two-handed system is used in the United Kingdom and Australia and parts of the British common wealth.

According to Freeman, et.al (1981:28) manual alphabet or finger spelling may not be taken as language in itself. But it must be considered as a code which represents the letters.

Especially in schools, most deaf students are instructed to communicate in manual method and are provided with enough practice for further education. Thus the invention of manual alphabet has helped the deaf not only to express their thoughts and feeling without any difficulty, but also to develop their ability of communication. Evans (1982: P.102) states that:

> Finger spelling has a special potential in this transitional process. Being alive medium, it can interact with signing having reversibility with orthographic spelling, it can represent written language ... this might reinforce the subsequent learning of the written language.

It is known that manual method of communication is effective use of facial expression and hand movements. Nevertheless, the deaf are also different in their finger spelling understanding as the hearing people vary in their talent of speaking, understanding and the like some deaf people are good at communicating in finger spelling and some of them are active in lip reading and oral communication.

The difference lies on the type and degree of the hearing loss. For example, when we examine the difference between the deaf and hard of hearing their talent of communication is not the same, students with hearing impairment can acquire language and develop speech with or without hearing aid. But a deaf child can communicate in finger spelling or in lip- reading method. Therefore, manual alphabet is the most perfectly formed and shaped sign language used in the deaf community.

2.6.1. Sign language (SL) or Finger spelling

The prominent scholars, Thomas H. Gllaudet and Laurent Glerc who opened deaf school in 1817 in America, made invaluable contribution to the study of deaf communication.

Lionel Evans, who studied about deaf communication, said that the American Sign Language was accepted internationally by the world Federation of the deaf which was held in stockhom in 1963. During that time, except the letter [T] all the letters were accepted and taken as part of an international manual alphabet. Later on , [T] was modified and taken with the rest of the letters, the reason for the selection of this alphabet is not mentioned. However, a lot of research was made by different scholars concerning the structure of the American Sign Language. This system of communication belongs to one-handed manual alphabet. So it employs hand configuration which represents, the written letter in manual alphabet. Thus Stephen P. Quigly and Robert E. Kretschemer (1982:11) as cited in Tsegu (1988) state that "American sign language is a manual communication in the forms of signs used as language."

This manual alphabet has twenty six hand shapes which represent the twenty six letters of the English alphabet. These hard shapes may help us to spell the English words just as the written alphabet concerning the Evans (1982: P.45) says.

> It is possible to transmit the written language on the hands. This is done by finger spelling which uses hand and finger shapes to represent the alphabetic letters of written language. As there is one - to - one equivalence between the manual symbols and the graphic symbols, finger spelling has word-for-word correspondence with reading and writing.

Thus, the use of finger spelling might reinforce the reading and writing communication skill of the deaf within a short period. If someone wants to say something the deaf, simple words and short sentences must be used. Concerning conversation with the deaf Sutcliffe (1969: 14) as cited in Tsegu (1988) who studied about deaf communication states, "the golden rule is in conversing with the deaf, leave out all unnecessary words and use the simplest words you can."

In short, if the rules of deaf communication are studied, one can certainly share the information without such difficulty.

In addition making the ASL meaningful, facial expression, eyes, body movement and the like play an important role to transmit or to communicate ideas effectively. Thus the movement of the body, arms, hands and finger or the signer will help one to notice the ability of the deaf and willingness to communicate with his friends.

Therefore, Evans (1982: P.68) says "the general location of signs is the space in front of a circular area from the top of the head to just below the waist line."

Different scholars planned a short method of teaching manual alphabet to the deaf children. Among them Sutcliffe (1969: P.3) stated:

> In learning the letters one or two little points should be noticed. The five vowels are signaled by touching, with the right for finger, the tip of the left thumb for A, the little finger for E, the middle one for I, the next for O and the little finger for U.

Similarly, there are also some methods which help the deaf to familiarize himself within a short period of time. In addition, some formation of finger spelling process might be given by associating with something that is easily handled.

Sign language carries a lot of meaning more than the spoken language. The ASL can be taken as an example. Barbara Fink (1962:7) as cited in Ibid records that "ASL is very economical; what might taken ten words to say in English is communicated in ASL by two sings and some facial expression."

2.6.2. The National Finger Spelling of Ethiopia and the Numerical Sign

Deaf people live in our country just as elsewhere in the world. In the developed countries different means of deaf communication is designed to be used as an independent language for the deaf. However, for many years in the past such useful device was unknown in Ethiopia. Later the American missionaries who came here to teach began to learn the problem of the deaf people. Soon among these, interested educators took the initiative to establish the new device. Accordingly, they introduced the American sign language is the school of the deaf in Ethiopia.

The National finger spelling of Ethiopia was introduced in 1965 E.C. The experts who developed this new idea were deaf Ethiopians. They were Minase Abera, Teklehaimanot Derso and Hailu Yesuneh. The uniqueness of the newly developed finger spelling is that it is quite similar to that of the Amharic alphabet and respond accordingly. This method has enabled the deaf community to communicate with their friends in the hearing community. Regarding this point, the Ethiopian National Association for the Deaf in the first edition of its magazine, courage explained what was done actually when the National Finger Spelling of Ethiopia was drafted the formation of the thirty-three finger spelling is very similar to the hearing community's alphabet and it is easily handled with the right hand only. Concerning the development of finger spelling a French writer Harlen Lane (1971: 235) says "finger spelling is a means of replacing signs and a way of forming words with that of spoken language." Therefore, the development of finger spelling of Ethiopia not only has made communication effective but it has also based itself on the corresponding letters in Amharic alphabet.

The numerical sign is not developed in our language. Moreover, no further information is given by those who have developed the National Finger spelling of Ethiopia regarding numerical signs. In the mean time the English numerical sign is used.

2.7. Different Methods of Communication

Many people assume that the use of sign language may solve the problem of the deaf community in every field of knowledge. But when emphasis is given to such assumption, it is found out that sign language does not solve all the difficulties of the deaf community. It is also known that sign language has both advantages and disadvantages like any means of communication. When it is dark and the movements of the fingers are not visible. Sign language becomes useless in communicating among the deaf. Such problems motivate people to try to invent other means of communication that could be useful during the day and at night. Rogger Freeman,et. al (1981: 154) says "... signing reinforces speech reading and speech reading reinforces signing and better communication the result."

As human beings use different means of communication, the deaf also developed manual alphabet (finger spelling) speech reading (lip-reading), oral and total communication. The above medium of communication has its own method to facilitate understanding among the deaf. The following are the methods which enable the deaf to communicate easily.

2.7.1. Lip Reading or Speech Reading

Among the methods known to facilitate communication in the deaf community is lip reading (speech reading). This helps the deaf people to perceive the spoken language through visual perception while some body moves his lips to speak. If a child is good enough to try to practice some words with his peers, he will be successful in using lip reading. As a matter of fact, this means of communication will develop if the child is especially helped by his family to learn some words. Otherwise, it is difficult to take it as a means of communication for a child whose speech intelligibility, when someone makes a speech or a talk. Until his guess work ability develops, he will not be able to communicate.

In order to acquire this medium of communication children should have good eye sight that could help to read the movements of the lips.

Thus, cued speech is defined by Lee Katz, et.al (1974:17) as follows.

> Cued speech is a procedure designed to reduce the degree to which the deaf child differs from the hearing child in acquiring and using language. Sounds which cannot be perceived upon the lips are recognized through cued that are formed by positions of the hand, near the lips, neck and shoulder.

It is possible to say that, cued speech is used to clarify speech reading or lip reading if it is studied carefully. It is along with cued speech that the use of lip reading (speech reading) is magnified among the deaf community. Thus, knowledge of lip reading along with finger spelling (manual alphabet) will facilitate deaf communication.

However, speech reading or lip reading has some limitation that is due to the problem of articulation one cannot understand what is said by some body. Lip reading is an extremely difficult skill to master by the deaf community. It is hard to make a distinction between 'p' and 'b' , 't' and 'd', 'k' and 'g' and the like by looking at the movement of some one's lips. Even words like pat', 'bat', 'mat' and the like are not readily distinguished. This is because, the vocal organs that produce certain sounds do not function normally, so the deaf cannot make distinction between the voiced and voiceless sound. The above such unidentifiable letters and words can be explained as follows (Sutcliffe, 1969: P.5):

> .... Let him stand in front of a mirror and without voicing the words, let him silently move his lips to form the words. Tip, Dip and Nip. He will see that the lip movements are almost identical and therefore, these three words looking just the same, the letter't','d' and 'n' are indistinguishable.

At large, different scholars invent certain methods to solve the above difficulty of lip reading is the cued speech. Evans (1982: P.40) says that to clarify the above ambiguities Dr. Orin Cornett developed a system called cued speech. It has twelve different hand shapes which helps to facilitate lip reading while some one speaks.

Therefore, for making speech reading effective Daniel and Anges H. Ling (1980:138) as cited in Tsegu (1988) state that,

> First the child must become aware that speech communication is an important and meaningful activity and that response for speech have positive and direct advantages for his which affect his needs and happiness .... Second, the child should learn and store vocabulary relating to his experience ... third the child should develop speech skills.

2.7.2. Aural /oral/ Communication

It is clear that a child who has normal hearing ability develops the language through which the limitation of the speech hears from his family. A deaf child must be encouraged to look especially at the movements of his mother's lips. Like a game he must be taught orally words like father, mother, ball, bread and the like when he practices such words orally, his voice is strange and unusual to understand. Thus when he is taught the above word, his father should associate whatever she says with the movements of her lips. According to Katz et al (1974: P.15)

> Oralism is a point of view which requires that all communication with deaf children, both in and out of the class room and among the deaf themselves, be done exclusively by means of speech and speech reading.

The above point of view is modified by different scholars such that oral communication will be successful if it is used with manual and lip reading means of communication. So in order to teach the oral means of communication, the child must be trained in lip reading or speech reading skill. The skill may help him to achieve various ways of pronouncing words. Similarly a combination of oral and manual alphabet could be helpful for a child to develop the oral communication skill. Especially for the partially deaf child, with the help of manual communication a teacher can teach oral communication by increasing his voice to the maximum. Bowely and Gardner (1980: P.168) state,

> .... The oralist maintain that the introduction of manual methods in deaf schools sight, as it were, derive out oral methods, which are known to be a slow, long term process of learning ....

Manual methods, if properly used as part of a wider programmed of developing communication skills, may actually encourage oral skill.

Bowely and Gardner (1980: P.170) also say that hearing aids also provide effective means of communication along with lip reading for partially deaf child. It is helpful to teach some sounds by indicating the source of the sound, for example the barking of a dog. Thus, this method creates full meaning and encourages the deaf to learn more words than ever before.

2.7.3. Total Communication

This form of communication uses all available means to develop language ability in a deaf community. As Freeman, et al (1980: P.147) state total communication was first used by a deaf teacher, Roy Holcom in California to develop the knowledge of any subject in a deaf community within a short period. So, total communication is likely to be needed for the deaf community in any field of activity. Any deaf student who registers for further education is primarily well accustomed to total communication. That is why; it is considered the most appropriate media for the deaf to communicate.

Evans (1982: P.13) says "Total communication involves the use of all means of communication with the deaf people and by the deaf people. It requires that a hearing person use his speech, signs, finger spelling and English syntax. Total communication is a gradual development which takes time to master by the deaf community. This is because; a deaf person must pass through learning different means of communication, i.e. sign language, manual alphabet (finger spelling), lip reading (speech reading), oral communication and the like. That is why, the influence of total communication has spread all over the deaf students to participate in any field that almost equals to the hearing community.

2.8. Academic Achievement of Students with Hearing Impairment

Many academic skills draw on students' general awareness of language. Individuals who are hearing impaired are at risk for reading and writing difficulties because the hearing loss affects their ability to construct accurate representations of sound letter correspondences (Anastasiow, 1993). Because of their learning limitations, they may have problems of interpreting the language of others and expressing themselves in oral

and written modes. Lasass and Davey (1987) as cited in Winzer (1990) added that many deaf students demonstrate restricted vocabulary.

Most cannot comprehend even the most commonly used words. This is probably due to syntactic deficits rather than inadequate word recognition or knowledge of word meanings. Other researchers also stress that children with limited vocabularies may experience great difficulties in language and reading.

A hearing impairment that delays language development seriously limits association between sounds and written symbols. Therefore, reading may be an area of considerable difficulty for such a student, particularly, for a young child who is in the process of acquiring reading skills while simultaneously developing language. This is in addition to academic difficulties that may result from a hearing loss (Gearheart et al, 1992).

2.9. Mathematics Teaching and Learning of Students with Hearing Impairment

From our experience, in school and in our daily life, we understand that mathematics is the subject that serves as a tool and basic for other subject matters or social interaction. Although it is not the purpose of the researcher at this time to discuss on what mathematics is, it is better to mention some issues raised by scholars. Many have discussed specially on its function. Nevertheless, most fail in giving the clear meaning of what mathematics is. There are some who tried to give the picture of mathematics. Sindhu (1981:1) explained it as the numerical and calculation part of man's life and knowledge that means it helps man to give an interpretation of his idea and conclusion. It enables man to study various phenomenons in space and establish various relationships between them. He also viewed it as a science of abstract form and logical reasoning.

Rosskopf and Fey (1972:20) described mathematics as the hand median and servant of the science. This is to mean that it is a subject matter of great application and is a means to understand other subject and activities, which are happening in the world. Portman and Richardson (1993: P.105) supported the idea of them by explaining mathematics as a way of organizing our experience of the world. This means it is the subject that enriches our understanding and enables us to communicate and make sense of our experiences.

All the ideas that have been discussed so far show that the function of most of the disciplines is based on mathematics. That means the teaching and learning process of mathematics has great contribution not only for developing the knowledge of mathematics but also for the enhancement of other subject matters and even for daily life application. Considering these facts proper attention should be given on the teaching and learning process of mathematics in all levels of schools.

Most scholars discussed on mathematics teaching and learning that traditional approach has little effect in the learning of mathematics and they gave emphasizes on modern way of teaching.

Krantz (1999: 103-104) explained that mathematics learning should include a broad range of learning activities, exposition, discussion, practical work, practice, problem solving and investigation and particular elements that should be presented in successful mathematics learning to pupils of all age.

McCormick and pressly (1997:301) discussed cooperative learning could be used for many content areas, it is especially appropriate for mathematics education, since contemporary mathematics educators emphasize social collaboration in problem solving.

As to Davidson (1985) cited in Assefa (2005) noted studies have demonstrated that students become problem solvers as a function of participating in cooperative learning experience.

Davidson and his colleagues believe that cooperatively interacting to solve problems can be a transformative experience for many students with advantage that include;

- Students come to value the process of problem solving rather than production of process.
- Mathematics anxiety is reduced when students work in cooperative group.
- Cooperative instruction permits move challenging and less conventional problems to be presented to students.
- Multiple representation of problem situation is offered in discussion.

2.10. Mathematics Achievement of Students with Hearing Impairment

Students with hearing impairment are not being sufficiently engaged in cognitively challenging word problem situations. They lag behind their hearing counter parts in mathematics. According to Adoyo (2004) there is increasing dissatisfaction with low mathematics achievement in schools for the students with hearing impairment.

Barham and Bishsop (1991) noted that teachers of students with hearing impairment, "when asked about the problems their pupils are having with mathematics, seem to have an intuitive feeling that language is at the heart of their difficulties".

Pagliaro and Ansel (2000) asked primary level teachers about the difficulty of word problems presented to their students with hearing impairment. Concerns included language related issues primarily within problem content and problem representation, and to a lesser degree within student proficiency and teacher abilities. Others have also discussed the potential language related factors , noting that students with hearing impairment generally have great difficulty with English, graduating well below grade level in reading (Traxler,2000). Runder (1978) identified English language structures used in both written and verbal instructions for mathematics that cause special difficulty for students with hearing impairment. These language structures include conditionals (if, when), comparatives (greater than, the most), negatives (not, without), inferential (should, could, because, since,) low information pronouns (it, something), and lengthy passages. More recently kidd, Lam and Madsen (1993) identified additional English language difficulties that hearing impaired students experience in learning mathematics. Their findings included words that have different meanings within mathematics than they do outside mathematics, multiple ways of expressing a single concept and varied forms abbreviations and symbols.

Kelly and Mousley (2001) reported that college students with hearing impairment problem-solving performance decreased on word problems as the computational information increased.

Nunes and Moreno (1998) have argued that hearing loss cannot be treated as a cause of difficulties in mathematics but as a risk factor.

Several findings in the literature suggest that hearing loss is not a direct cause of difficulties in mathematics. First, not all deaf pupils are weaker than in mathematics than their hearing counter parts:- approximately 15% of the profoundly deaf pupils perform at average or above average levels in standard tests (Wood, Wood and Howarth, 1983).

If hearing loss were a direct cause of difficulties in mathematics, there should be no deaf pupils displaying achievements adequate for their age level.

Furth (1966) and Rapin (1986) as cited in Tesfaye (2004) who suggested that students with hearing impairment in low results in reasoning tasks and educational assessments can be explained by an "information deprivation". Students with hearing impairment lack access to many sources of information (e.g. radio, conversations around the dinner table) and their incidental learning may suffer from this lack of opportunity.

2.11. Factors Influencing Mathematics Learning and Achievement of Students with Hearing Impairment

2.11.1. Socio Demographic Characteristics of the Respondents

Gender, the severity of hearing loss, the age of its onset, the academic background of the students' family, and the hearing status of the students' parents are related to the academic success experienced by the students with hearing impairments (Yosseldyke, James and Algozzine, 1995).

Regarding to Ethiopian contexts, study on secondary school students (9-12) in Bahirdar, the investigators (Ademe & Gebre, 1990) boys perform better than girls and Fennema & Sherman (1978) had reported that boys perceived both their parents as more positive towards as learner of mathematics than did girls. Beside differential treatments and reinforcements by parents, teachers, peers, and considers together with perceived usefulness of mathematics tend to account for the gender gap in attitude towards mathematics (sileshi, 1995). He noted that even if performance does not depend on sex difference, due to different factors at secondary school level boys perform better than girls and girls make many mistakes than boys at secondary level. Researchers frequently reported that female students have lower perception of competence and lower performances than male students in mathematics (Hannula M. 2002).

Other researchers revealed that children and young adults who have mild hearing losses generally perform better academically than those with severe losses.

Students who are deaf from birth tend to have more difficult acquiring academic skills than those who later loss their hearing. Students with hearing impairments from families of high socio economic status and those who have hearing parents tend to experience fewer academic difficulties than students from families of low socio economic status or those whose parents are hearing impaired (Tirussew, 2000).

Eatshope (1975) and kangan (1978) as cited in Adamu (2004) Pointed out that students who came from families of higher level of education tend to achieve higher than those from uneducated ones. Thus, more success in education takes place in educated families than their counter parts.

The education level of the parents has its own importance in children's education. Simmon (1981) revealed that socio economic status such as parents' education level is significant predictor of cognitive achievement. Regarding this idea Harbison and Hanvshek (1992) studied the effects of mothers' education and fathers' education on mathematics and Portuguese achievement. They found that the level of both mothers' and fathers' education exerted a positive influence on achievement. In contrast to fathers' education, local investigator Adamu (2004) explained that mothers' educational level show a significant impact on their children's achievement whereas fathers' educational level did not show a significant impact.

The academic back ground of the students' family influence students' success. In this regard, Grissmer (1994) reviewed that students with parents who were both college educated tended to attain better at the college education.

In relation to this, Laosa (1982) elaborated that children from more educated families excel at schools because the teaching-learning and assessment processes in schools are like those they have learned to master at home.

Furthermore, Tirussew suggested that we couldn't make firm generalizations about the ways in which students that are deaf and hard of hearing function academically. They do not perform as well as hearing students on standardized tests of reading and writing, and

research suggested that children who are deaf have much more difficulty acquiring reading skills. Nevertheless, differences in language ability that result from deafness affect a student's ability to perform in traditional academic areas.

To put it more simply, three factors are related to the academic achievement of children with hearing impairments; the degree of hearing loss, the presence of language and experiences in the environment with people and things.

On the other hand, the academic achievement levels of students who are deaf are substantially lower than those of their peers without disabilities (Jensema, karchemer and Trybus, 1977). By age of 20, half of the students tested read below the mid-fourth grade level. They stated, "at best, only 10 percent of hearing impaired eighteen year-olds nationally can read at or above an eighth grade level"

The reason for such academic difficulties varies, but most researches point to two interactive theories or possibilities. The first is that students with hearing impairments have some type of cognitive deficit, which in itself, contributes to problems in language development and academic performance. The second is the inverse of the first; that is, because of the language deficits of students with hearing impairments, their academic abilities are somewhat diminished. Most research indicates that the second possibility is more accurate and most often involves specific deficits in the language related areas of reading and writing (Tylor et al, 1995).

2.11.2. Methods of Teaching

Students with hearing impairment tend to have slower learning processes because they cannot pickup various concepts and vocabulary incidentally like children who do not have a hearing impairment. This can be problematic in the mathematics class room. Additionally, students with hearing impairment can have delayed learning as a result of receiving differential treatment from teachers and classmates. students with hearing impairment are often treated differently because people do not understand that hearing impairment is not linked to intelligence or ability to learn.

Students with hearing impairment can have trouble understanding verbal and mathematics problems because they might not be able to pick up new vocabulary and

concepts without being directly taught. These students do not have the general vocabulary or the basic mathematics vocabulary needed to fully understand verbal and written mathematics problems and understand mathematics concepts and processes. Furthermore, if the child struggles with reading, then the child might also struggle with word problems in mathematics. students with hearing impairment often have trouble communicating with others. These children with explaining their thought processes in a way that makes sense to the teacher and classmates.

Elizabeth Ray (2001) as cited in stein (2012) states "The make-up of the learning environment is particularly crucial for students with hearing impairment as compared to their hearing peers; they are always at a disadvantage because information is generally received via the spoken word"). Students with hearing impairment have difficulty with verbal information because they often either misunderstand or do not hear what is being said. Also students with hearing impairment tend to struggle in busy and noisy environments because they have trouble focusing on the teacher's voice and the task at hand.

Finding the right accommodations for students with hearing impairment in the class room can be difficult as each student needs his/her own individualized set of accommodations? There are various ways to help students with hearing impairment do well in school. For students who have a "severe lack of vocabulary and simple syntax knowledge, work using pictures and picture symbols to support speech and/or signs" (Pollock, 1997) as cited in stein (2012). This can be done by the teacher or by another student in the same class room using the child's preferred mode of communication. The most obvious way to help students with hearing impairment is to use a variety of visual representations for each concept being taught. If explaining things verbally, the class room should be quiet and the student should be able to see the teacher's face and lips. Often students with hearing impairment speech or lip read, therefore seeing teacher's face and lips is crucial. Additionally, teaching new concepts using visuals and allowing students time to observe the visual is crucial. Students with hearing impairment need to watch the explanation within a quiet classroom and then have time to think about the process before allowing the class to offer its responses. With a quiet environment students can focus on what he/she is doing without being distracted by other sounds.

Other accommodations include abbreviated assignments, assignment sheets, modified test formats, a note-taker, preferential seating, specific environments, captioned videos, and peer tutoring.

Having a hearing impairment can adversely affect a student's ability to learn. Not only is it difficult to communicate, but since most teaching is done through speaking, the barrier for impaired studies can seem insurmountable. In particular, mathematics is a subject with abstract ideas that cannot always be communicated with words. Accommodations that address both the environment and the teaching/learning styles can bridge the gap and enable students with hearing impairment to be successful.

Teachers can incorporate each of the different methods of learning into their lessons since they "work quite well as a means to develop specific attention grabbing techniques" (Armstrong,1995) as cited in stein (2012). Having the students know about the differentiated styles of learning helps them to understand why they learn in the way they do and what style of learning the student might prefer. Together, the teacher and student can come up with different ways to teach/learn mathematical topics and ideas.

Helping students with hearing impairment learn through incidental learning is one of the best ways to make sure the student has a full and complete understanding of each mathematics topic. In addition to using manipulative, teachers can introduce new vocabulary a week early by putting the words and definitions in clear view on the walls. Through this method students whose minds tend to wander, will read the definitions and possibly recall the words the following week. Students will feel more confident about learning new material because they already recognize some words and definitions. Furthermore, teachers can use drama as a means to promote incidental learning. Students can be asked to create or modify a song about a certain topic that helps them remember how to do those types of problems and present their song to the class.

Technology is commonly used in our society today. Incorporating technology such as computer programs and smart boards in the classroom is considered beneficial by some. Teachers can use programs such as Geometer's sketch pad or GeoGebra to teach students with hearing impairment about geometry and about graphing functions. These programs

allow students to manipulate the shapes and graphs in ways they cannot on paper and discover properties in a more individualized method.

The educational philosophy and methods of instruction are dynamic and hence, change from time to time. Instructional methods are usually of two types. These are the teacher centered method and the learner centered method. Learner centered and teacher centered practices are often viewed as representing opposite ends of philosophy spectrum, the constructivist and positivist philosophy. The student centered practices are said to have an underlying constructivist philosophy while teacher centered approach is grouped in the positivist philosophy.

These two philosophical views have their own understanding of how learning takes place (Lejeune, 2001: P. 3) as cited in Lemma (2006).

As indicated by many scholars the teacher centered method is the oldest approach, which probably lived for more than thousand years. This approach according to plass (1998: P.30) as cited in Lemma (2006), makes sharners passive receivers of knowledge, while teachers and texts are the source of authority. In this approach lecture format dominates and students learn by rote fashion, reproducing the subject matter in set exercises in easy form and in examination. In the teacher centered method, most of the time the teacher talks while the students are passive learners. According to silberman (1996:P.1), it is hard to keep up with a teacher who is talking for a long time. In such situation students usually lack concentration for a sustained period of time even, when a teacher talks slowly.

The process of teaching- learning in learner centered method is different from teacher centered method in the activities of teachers, students, and in the way learning takes place. According to Gredler (1997:P.54), learning in the learner centered approach is the product of interactions among the learners knowledge, information in the environment and the learners activities.

Many educators believed that the learner centered method of teaching gives more emphasis to the learner and how to learn than what is taught. For example, Temechegn (2001: P.31) as cited in Lemma (2006) indicated that learner centered methodology stresses the need for taking care of the child, its growth and

development. This is possible by using number of teaching techniques and strategies to study the child carefully and observes over period of time, his growth and development in intellectual, sensory motor and emotional concepts.

Regarding students' role in learner centered class room, plass (1998: P.30) indicated that the learners are active participants in the process of teaching –learning. They are actively involved in the learning process and their prior knowledge and experience is an integral part of the process. In this method according to him the learners are encouraged to articulate their ideas and opinions. Since the learning styles of learners vary, no one style of teaching dominates, a variety of approaches, catering for different learning styles is used. In this method, students actively work in groups collaborating share their own ideas, benefit from each other's individual styles strategies and skills. Much of learning is task based. Task is defined as a learner centered activity that has clear learning to an outcome. This approach is considered as the most appropriate in teaching mathematics. However the methods may change depending on the learners' ability and nature of the topics.

Findings from research studies about learners with hearing impairment have supported the argument that mathematics should not be taught to students with hearing impairment as discrete series of computational skills. The national council of teachers of mathematics of America (NCTM), 2000) recommends an approach that emphasizes reasoning based on understanding of the content and follows a constructivist view of learning mathematics. Educating students with hearing impairment should therefore incorporate instructional strategies that promote the construction of knowledge through mental connections/schemata. Teaching new mathematics concepts and vocabulary, for example, should include making use of pedagogy that builds on prior knowledge and context and relates the new concept to a pictorial representation (Pagliaro & Lang, 2007). According to kelin and Merrit (1994) as cited in KIE (2006) a constructivist teaching approach leads to improved student achievement because it develops critical thinking, interpretation and analytical skills.

2.11.3. Time on Task

Research shows consistent positive correlations between instructional time and student achievement at both primary and secondary level. Significantly this relationship appears stronger in developing countries (UNEESCO, 2005).

Cooper and Valentine (2001) also indicated that in general, students who spend more time on home work tend to show higher level of academic achievement.

2.11.4. Medium of Instruction

Learning to speak is difficult if one cannot hear. Hearing impairment is primarily a communication problem (Webster and Ellwood, 1985). The degree and kind of impairment greatly affect the ability to communicate. Hearing children typically acquire a large vocabulary and knowledge of grammar, word order, idiomatic expressions, fine shades of meaning ,and many other aspects of verbal expressions by listening to others and to themselves from early infancy. A child with a hearing impairment, however, is exposed to verbal communication only partially or not at all.

As a rule, students with hearing impairments experience a lag in vocabulary skills when compared with hearing students of comparable age. Once again children who are deaf show a more noticeable lag than do children who are hard of hearing. This lag in vocabulary development worsens as the child with hearing impairment grows older (Tylor & Sternberg, 1995).

Furthermore, problems with general vocabulary lead to problems associated with more specific vocabulary demands (Tylor et al., 1995). For example, students with hearing impairment often have problems with abstractions because they are frequently taught in a one-word-one meaning way. Also apparent are difficulties associated with syntax and morphology, children who are hard of hearing appear to experience developmental delays in syntactic and morphological development when compared to children without hearing impairments of the same age.

On the other hand, yosseldyke and Algozzine (1995) indicated that the vocabulary deficiency affects the communication. These communication problems can also seriously interfere with interpersonal relationships for students with hearing impairments who

receive all or part of their education in general education class room. Their inability to communicate with other students can delay their language development. Moreover, that they communicate in ways that are different from those around them can inhibit their social interaction and development. It is argued that the effects of hearing loss are pervasive and can create psychological stress (Moores, 1996). Children who are deaf are often passive participants in communication, as their parents, care givers tend to deprive them from any type of interpersonal relationships. As a result, the vocabulary and syntax of children who are deaf develop slowly.

Education of the hearing impaired worldwide has been one of the most controversially discussed topics. The issue has been the difficulty in finding an appropriate classroom communication system that effectively provides access to curriculum content. Subsequently there have been changes in search for a better teaching methodology from pure oralism to total communication and now towards sign bilingualism (Gallimore, 1993).

According to Johnson, Liddell and Erting (1989), the education of students with hearing impairment worldwide has been a failure. The failure is attributed to the use of artificial codes such as simultaneous communication (Sc) development by committees. Exposure to such artificial codes results into an impoverished, idiosyncratic and incomplete language system.

Irokaba (2006) as cited in KIE (2011) noted that because SC is the 'official' method of instruction in most African countries there is the danger of hearing impaired child's limited knowledge in the second language, disrupting comprehension. Studies indicate that in a school where the student's first language is different from the predominant language of instruction, students tend to be benefit more if mathematics is taught in their first language (Ellerton and Clarkson, 1996; Setari, 2003). On the other hand, intensive research has been done on" code switching" in mathematics class room. "Code-switching" with therefore to be bilingual or multilingual settings means to switch between the language of teaching and the learners first language. The approach enables learners to harness the local language as a learning resource as well as to increase their participation in class room discourse. Studies have supported the use of the learner's first language as "support" in the teaching and learning of mathematics. This enables the

learner to continue to develop proficiency in the new language and at the same time learn mathematics (Alder & Setari 2003).

2.11.5. Content Coverage

According to KIE (2006) a teacher can take less or more time depending on the ability of the learner. According to Ogembo (2002), the allocated time for mathematics has proved to be inadequate in covering the wide syllabus effectively. No coverage of the syllabus has lead to poor performance of deaf students in class room examination because students with hearing impairment end up being tested on uncovered topics.

Chitwa and Njunge (2004) and Ouko (2004) carried out studies on the content coverage in secondary schools and found that content was poorly covered while teaching was not up to students' level leading to poor performance of students.

CHAPTER TEREE

3. METHODOLOGY

3.1. Research Design

Even though the selection of research design depends on the nature of the study, the research problems being addressed the resources available for the study, there is an increasing attention of using both quantitative and qualitative methods as a research strategy. According to creswell (2009) as cited in Abdisa (2013), for mixed research, the overall strength of the study is greater than either qualitative or quantitative methods. Similarly, Abdisa (2013) recommended that employing both qualitative and quantitative methods is preferable because using both enable the researcher to verify and substantiate the data ; and discover something that would have been missed either quantitative and qualitative techniques were employed to meet the above stated objectives of this study. Quantitative techniques were used to analyze the data gathered through questionnaire. The data that had obtained through open ended questions, document analysis and lesson observation had analyzed, organized and summarized by qualitative methods. The result of quantitative analysis was confirmed by qualitative results for effective achievement of the study objective. Even if both qualitative and quantitative methods were used to assess the problem more deeply. The researcher used more of quantitative methods. From the different quantitative methods descriptive survey research design was used to investigate the problem more deeply because descriptive survey research design was used to collect data from every unit of population to determine the current status of that population with respect to one or more variables (Mugenda & Mugenda, 1999).

3.2. Research Participants

The populations of the study have included students with hearing impairment who are currently attending in grade 11; and also mathematics teachers and interpreters who are assigned in Menelik II preparatory school. Grade 11 students with hearing impairment were selected as participants of the study for it was believed that they may better understand questionnaires and elicit dependable information than students with hearing impairment at a lower grade level and in addition to this grade 11

students were new to the environment (preparatory school) and they faced to different problems.

But grade 12 students with hearing impairment were not selected as participants of the study even if it was believed that they might better understand questionnaires and elicit dependable information because these students were not new to the environment and did not face to different problems.

Students with hearing impairment enrolled in the study were 40, 25 male students and 15 female students. Similarly all mathematics teachers (4) and interpreters (4) assigned to teach hearing impaired students were also participants in the study.

The researcher took all population and data were collected from all population to get reliable information about the problem and of the population.

3.3. Study Site

The main objective of this study is to investigate mathematics learning and achievement of students with hearing impairment. When the researcher set his goal to asses mathematics learning and achievement of students with hearing impairment, he looked the problem at different dimensions, and finally the researcher was initiated to investigate mathematics learning and achievement of students with hearing impairment at preparatory level. Due to this the researcher was inspired to conduct a study at Menelik II preparatory school because the availability of students with hearing impairment at preparatory level was the reason for selecting this school as a study site.

3.4. Variables

The variables for this study were gender, age of onset of hearing loss, level of hearing, parents' educational status deaf family members, methods of teaching, time on task, medium of instruction, content coverage and mathematics achievement. From these variables: gender, age of onset of hearing loss, level of hearing, parents' educational status, deaf family members, methods of teaching, time on task, medium of instruction and content coverage are independent variables whereas mathematics achievement is dependent variable.

3.5. Instruments for Data Collection

Data were collected using questionnaires, document analysis and lesson observations. The questionnaires contain close ended questions about methods of teaching, time on task, medium of instruction, content coverage and achievement of students with hearing impairment. On the basis of this idea, a five point attitude scale with a continuum "strongly disagree", "disagree" "moderately agree", "agree" and "strongly agree" was constructed in Amharic language to examine the attitudes of students with hearing impairment towards methods of teaching, time on task, medium of instruction, content coverage and achievement. A clear written instruction was attached to the instrument. To understand the possible perceived factors that affect participants' attitudes, some open-ended items were also included in the instrument.

The attitude scale consists of 28 items and the participants were asked to indicate the extent of their agreement with each statement using a five point attitude scale. The given scale values were, 1 = strongly disagree, 2= disagree, 3= moderately agree, 4 = agree, 5= strongly agree.

In addition to this the questionnaires administered to students, teachers and interpreters consisted of two sets of items. The first set of items was related to demographic characteristics of the respondents. The second set of items was used to obtain information about methods of teaching, time on task, medium of instruction, content coverage and mathematics achievement. The close ended questions were responded by students with hearing impairment. The total numbers of open ended questions was four and these questions were responded by interpreters and mathematics teachers.

Document analysis was conducted to see mathematics achievement of students with hearing impairment in relation to hearing students. The researcher had seen one year EGSECE result and one year class room results to compare mathematics results of students with hearing impairment to that of their hearing counter parts.

Lesson observation (a total of 3 classes) was carried out in class room by using observation check list. The observation check list consist 12 items. Each item was prepared for the purpose of evaluating mathematics' methods of teaching, time on

task of teachers and students, mathematics vocabulary knowledge of interpreters and participation of students with hearing impairment in the class room.

3.6. Ethical Consideration

Questions of ethics are embedded in every aspect of the process of research. To carry out this study the entire necessary requirements for data collection process were done. A formal letter was given to Menelik II preparatory school principal from Addis Ababa University, Department of science and mathematics education. Therefore to do this research, contacts have been made with the school principals and unit coordinators in order to establish a smooth relationship to achieve the purpose of the study and the researcher asked permission from the responsible body of the school to conduct the study and discussed the importance of the research with them. Preliminary information was also secured from the school to determine the number of participants to be included in the study from the school. The participants were informed the objective of the study and were protected from any kinds of psychological and physical harm. Moreover, their responses were kept confidentially and there was no any obligation to participants in the study.

3.7. Validity and Reliability of the Instrument

3.7.1. Validity of the Instrument

Kothari (2004) notes that validity is the extent to which a measuring instrument provides adequate coverage of the topic under study; if the measurements contain a representative sample, then the content validity is good. In order to establish content validity all the developed data collection instruments (questionnaires, documents analysis and classroom observation) were judged by seven professionals of whom three of them from special need education, two of them from mathematics and the rest two were from language professionals. All the data collection instruments (questionnaires, document analysis and classroom observation) were improved but none of the item was discarded that means some items were modified

3.7.2. Reliability of the Instrument

Reliability deals with the consistency with which an instrument of evaluation measures whatever it is made to measure.

Before applying the instrument to the main study, a pilot study was conducted in Menelik II preparatory school to check and improve the validity and reliability of the instrument.

3.8. The Pilot Study

A pilot study was carried out on grade twelve students. The total number of participants in the tryout study was 10(m = 7, f= 3). The participants were selected using simple random sampling. In simple random sampling, the units of the population are not selected as the discretion of the researcher, but by means of certain procedures which ensure that every unit of a population has one fixed probability of being included in the sample.

The objectives of the pilot study are:-

1. To evaluate the technical adequacy of the instrument (that is reliability)
2. To check whether or not the wordings are appropriated for reading at student's level.
3. To check whether or not the items are fair with regard to their culture.

Pilot was conducted to improve the clarity of items to determine time needed for administration and also to check inter-items reliability to discard when the items are very low relation within items and prove which needed to be modified since all the items were developed by the researcher with professional consultation, checking the reliability of the items was very important. By doing so questionnaires were distributed for ten (10) students with hearing impairment in Menelik II preparatory school. The data obtained were analyzed using spss version 20. All the five scale items were correlated.

Table 1. Reliability Indices

No	Items	Cronbach's alpha	No of items
1	Methods of teaching	0.757	6
2	Time on task	0.773	6
3	Medium of instruction	0.625	5
4	Content coverage	0.611	5
5	Achievement	0.68	6

After a pilot study the instrument was found valuable to collect the data for the main study and hence it was administered as scheduled. The obtained data in the main study was tabulated and organized for further analysis.

3.9. Procedures for Data Collection

To administer the constructed questionnaires with some additional open ended items, all grade 11 students with hearing impairment (40), mathematics teachers (4) and interpreters (4) were included in the study. Those mathematics teachers and interpreters who taught students with hearing impairment were selected as participants.

Questionnaires were not discarded and the total numbers of population that were participated in the actual study were 48 of which 40 students with hearing impairment, 4 mathematics teachers and 4 interpreters.

Referring to the characteristics of the participants in the groups and experiences gained from a pilot study, it was found necessary to use relatively different approaches in the administration of the instrument to the participants.

Firstly, after explaining the objectives of the study, the constructed instrument (Prepared in Amharic language) was distributed to 40 students with hearing impairment and the constructed instrument (prepared in English language) was distributed to 4 mathematics teachers and 4 interpreters as scheduled for the school. For convenience, a page written instruction was attached to all questionnaires so that the participants can easily understand how to make it. All questionnaires were collected within one day.

Regarding mathematics teachers and interpreters, a classroom was arranged and they filled the questionnaires in the presence of the researcher. The researcher gave the necessary clarification whenever needed by the respondents. All the questionnaires were collected as soon as the session (which took almost an hour) was over.

As to the students with hearing impairment owing to the possible problems that may have in written communication and in reading skills, it was found preferable to complete the questionnaires through the help of sign language interpreters. The sign language interpreters, using a total communication method, explained the idea in each item to the students with hearing impairment in an understandable manner and then some questionnaires marked by the interpreters themselves on basis of the given responses by the respondents.

The researcher closely attended the whole process. The expressed ideas through total communication in addressing the meaning of items to the students with hearing impairment were also checked. Since total communication involves oral expression, it was possible to attend the interpretation process.

After collecting all the completed questionnaires, lesson observations (a total of three classes) were taken place in the classroom by using class room observation checklist and document analysis (one year EGSECE result and one year class room result) were conducted to see mathematics achievement of students with hearing impairment in relation to hearing students.

3.10. Plan of Data Analysis

All data were organized and processed for each item in a way appropriate for analysis. Various techniques were used in dealing with different variables.

To asses mathematics learning and achievement of students with hearing impairment and to see the relationship of some demographic variables with mathematics achievement and methods of teaching, time on task, medium of instruction, content coverage and with mathematics achievement some statistical methods were employed. Descriptive data analysis (by using mean score, percentages, frequency

distribution, and standard deviation) had been used to describe the data on the basis of the reaction of the respondents to the items.

Data related to open ended questions, document analysis and lesson observations were analyzed using qualitative methods.

Multiple regression analysis was used to see the relation of some predictor variables to students with hearing impairment on mathematics achievement.

t-test was used to see whether there are mean differences or not between the male and female students with hearing impairment. The statistical software that was used in the study was spss computer program.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Results

This result section present the major findings beginning with socio-demographic variables that were used for comparative purposes latter on and followed a presentation of the five study variables i.e. methodology of teaching, time on task, medium of instruction, content coverage and mathematics achievement.

4.1.1. Socio Demographic Characteristics of the Respondents/Students

The major socio-demographic characteristics of the respondents are presented on table 2. Included in this group is gender, age of onset of hearing loss, level of hearing, parents' education status and deaf family members.

Table 2: Socio-Demographic Variables of the Respondents/Students

Variables	Groups	Frequency	Percent
Sex	male	25	62.5
	female	15	37.5
Age of onset of hearing loss	Pre lingual	19	47.5
	Post lingual	21	52.5
Level of hearing	Hear conversation very slightly	14	35.00
	Hear sound very slightly	9	22.5
	Deaf	17	42.5
Parents' educational status	cannot read and write	16	40.00
	can read and write	13	32.5
	Certificate and diploma	4	10.00
	Degree and above	7	17.5
Deaf family members	Yes	6	15.00
	No	34	85.00

The data summarized in table 2 indicates that about 62.5% of the respondents were males, 37.5% of the respondents were females. 52.5% and 47.5% of the respondents were post and pre lingual deaf respectively. Similarly, 42.5%, 22.5 % and 35% of the participants were a profound hearing impaired, hear sound and hear conversation very slightly respectively.

Nearly 72.5% of respondents' parents were with no formal education, except for some who were certificate or diploma and degree holders (27.5 %), and 85 % of the respondents were without other family members with hearing impairment. This implying the study participants were composed of deaf communities without other family members with hearing impairment.

Table 3. Socio Demographic Characteristics of Teachers and Interpreters

Variables	Groups	Frequency	Percent
Sex	Male	6	75
	Female	2	25
Qualification	Certificate	1	12.5
	Diploma		
	Degree	7	87.5
Total Service	1-15 yrs	5	62.5
	16-32 yrs	2	25
	Above 30 yrs	1	12.5

In terms of qualification status, all mathematics teachers have a qualification level of degree (12+4).

Regarding total years of experience for mathematics teachers it ranges from 15 years to 34 years.

In terms of qualification status, out of 4 interpreters 1 interpreter has a qualification level of certificate (12+1). Similarly 3 interpreters were with a qualification level of degree (12+4).

Regarding total years of experience for interpreters it ranges from 1 year to 2 years.

As a whole teachers have higher years of experience than interpreters.

4.1.2. Methods of Teaching Mathematics

Attempts were made to measure the mathematics achievement of respondents firstly focusing on the methodology dimension and followed a presentation of time on task, medium of instruction, content coverage and achievement. The responses are summarized in table 4. Note that they were required to respond to the items saying "strongly agree", "agree", "moderately agree", "and disagree" and "strongly disagree". Responses were scored in such a way that high score means good method of teaching mathematics. Notice that correct or keyed responses are given score of 5 and 4 followed by a score of 3 for average response and 2 & 1 for incorrect/low scores.

Table 4: Mean Comparison of Male and female Students on Methods of Teaching

No	Items	Male		Female		t-value	SIG
		Mean	SD	Mean	SD		
1	Teachers use teaching aids which are useful for students with HI	2.56	1.08	2.4	1.24	.426	.671
2	Teachers teach students with HI by using play and dramatization method	3.24	1.16	3.2	1.52	.94	.926
3	Teachers employ active learning methods	2.76	1.23	2.93	1.03	-.456	.651
4	Teachers teach students with HI by using problem solving method	2.8	1.15	2.87	1.59	-.153	.879
5	Teachers arrange the class room setting in favor of students with HI	2.32	1.03	3.1	1.12	-2.336	.025
6	Teachers use demonstration method	2.76	1.09	3.3	1.48	-1.24	0.223

As shown in table 4 grand mean on item one for both male and female students was 2.56 and 2.4 respectively thus indicated low score and the obtained t-value df(38), t(0.426) and p=0.671>.05. It could be said that there was no difference on response of male and female students on teachers' use of teaching aids. Grand mean on item two for both male and female Students was 3.24 and 3.2 respectively thus indicated average score and the obtained t-value df (34) t (0.94) and P= 0.926 >.05 indicated that no difference on

response of male and female students on teachers use of play and dramatization method. Grand mean on item three for both male and female students was 2.76 and 2.93 respectively thus indicated low score and the obtained t-value df (38), t (-.456) and p=0.651 >.05 shows that no difference on response of male and female students on teachers use of active learning methods.

Grand mean on item four both male and female students was 2.8 and 2.87 respectively thus indicated low score and the obtained t value df (38), t (-0.153) and P =0.879 >.05 indicated that no difference on response of male and female students on teachers use of problem solving method. Grand mean on item five both male and female students was 2.32 and 3.1 respectively thus indicated low score and the obtained t value df (38), t (-2.336) and P= 0.025 < .05 indicated that there is a difference on response of male and female students on arrangement of class room setting in favor of students with hearing impairment. Grand mean on item sixth both male and female students was 2.76 and 3.3 respectively thus indicated low score and the obtained t value df (38), t (-1.240) and P= 0.223 >.05 indicated no difference on response of male and female students on teachers use of demonstration method.

4.1.3. Time on Task

Attempts were made to measure the time on task response of respondents. The responses are summarized in table 5. Note that they were required to respond to the items saying "strongly agree", "agree", "moderately agree," "disagree" and "strongly disagree". Responses were scored in such a way that high score means proper use of time. Notice that correct or keyed responses are given score of 5 and 4 followed by a score of 3 for average response and 2 & 1 for incorrect/low scores.

Table 5: Mean Comparison of Male and Female Students on Time on Task

No	Items	Male		Female		t-value	SIG
		Mean	SD	Mean	SD		
1	Teachers use extra time	1.92	.996	2.3	1.5	-.884	.382
2	students with HI revise mathematics daily	2.28	.89	2.73	1.22	-1.353	.184
3	students with HI revise mathematics weekly	2.2	1.11	2.53	1.3	-.858	.396
4	students with HI revise mathematics monthly	2.2	1.19	2.53	1.5	-.776	.443
5	Teachers use their time effectively	2.44	1.12	2.4	.74	.123	.903
6	students with HI use their time effectively	2.4	1.0	2.53	1.18	-.381	.706

As shown in table 5 grand mean on item one for both male and female students was 1.92 and 2.3 respectively thus indicated low score and the obtained t-value df (38), t (-0.884) and P= 0.382 >.05 indicated that no difference on response of male and female students on teachers use of extra time to help students with hearing impairment. Grand mean on item two for both male and female students was 2.28 and 2.73 respectively thus indicated low score and the obtained t-value df (38), t (-.353) and P= 0.184 >.05 indicated that no difference on response of male and female students on revision of mathematics daily. Grand mean on item three for both male and female students were 2.2 and 2.53 respectively thus indicated low score and the obtained t-value df (38), t (-0.858) and P= 0.396 > .05 indicated that no difference on response of male and female students on revision of mathematics weekly.

Grand mean on item four for both male and female students was 2.2 and 2.53 respectively thus indicated low score and the obtained t-value df (38), t (-0.776) and P =0.443 >.05 indicated that no difference on response of male and female students on revision of mathematics monthly. Grand mean on item five for both male and female students was 2.44 and 2.4 respectively thus indicated low score and the obtained t-value df (38), t (.123) and P= 0.903 > .05 indicated that no difference on response of male and female students on teachers use of time effectively.

Grand mean on item six for both male and female students was 2.4 and 2.53 respectively thus indicated low score and the obtained t-value df (38), t (-0.381) and P= 0.706 >.05 indicated that no difference on response of male and female students on students with hearing impairment use of time effectively.

4.1.4. Medium of Instruction

Attempts were made to measure the mathematics medium of instruction of the respondents. The responses are summarized in table 6. Note that they were required to respond to the items saying "strongly agree", "agree", "moderately agree", "and disagree" and "strongly disagree". Responses were scored in such a way that high score means good communication. Notice that correct or keyed responses are given score of 5 and 4 followed by a score of 3 for average response and 2 & 1 for incorrect/low scores.

Table 6: Mean Comparison of Male and Female Students on Medium of Instruction

No	Items	Male		Female		t-value	SIG
		Mean	SD	Mean	SD		
1	Teachers use sign language	1.84	1.17	2.06	1.38	-.551	.858
2	Interpreters know signs of vocabularies of mathematics	2.64	.91	3.26	1.16	-1.9	.065
3	Teachers use lip reading	2	.95	2.7	1.38	-1.979	.55
4	students with HI understand the interpretations of interpreters	3.76	5.57	3	1.3	.517	.608
5	students with HI understand the instruction of teachers	2.6	1.04	2.8	1.2	-.554	.583

As shown in table 6 grand mean on item one for both male and female students was 1.84 and 2.06 respectively thus indicated low score and the obtained t-value df (38), t (-0.551) and P = 0.585 >.05 indicated that no difference on response of male and female students on teachers use of sign language. Grand mean on item two for both male and female students was 2.64 and 3.26 respectively thus indicated low score

and the obtained t-value df (38), t (-1.901) and P=0.065 >.05 indicated that no difference on response of male and female students on knowing of the signs of all vocabularies of mathematics. Grand mean on item three for both male and female students was 2.0 and 2.7 respectively thus indicated low score and the obtained t-value df (38), t (-1.98) and P= 0.55 > .05 indicated that no difference on response of male and female students on teachers use of lip-reading to help students with hearing impairment .

Grand mean on item four for both male and female students was 3.76 and 3.0 respectively thus indicated average score and the obtained t-value df (38), t (0.517) and P= 0.608 > .05 indicated that no difference on response of male and female students on students with hearing impairment understanding of interpreters interpretations. Grand mean on item five for both male and female students was 2.6 and 2.8 respectively thus indicated low score and the obtained t-value df (38), t (-0.554) and P= 0.583 > .05 indicated that no difference on response of male and female students on students with hearing impairment understanding of the instruction of teachers.

4.1.5. Content Coverage

Attempts were made to measure the content coverage response of respondents. The responses are summarized in table 7. Note that they were required to respond to the items saying "strongly agree", "agree", "moderately agree", "and disagree" and "strongly disagree". Responses were scored in such a way that high score means good content coverage. Notice that correct or keyed responses are given score of 5 and 4 followed by a score of 3 for average response and 2 & 1 for incorrect/low scores.

Table 7: Mean Comparison of Male and Female Student on Content Coverage

No	Items	Male		Female		t-value	SIG
		Mean	SD	Mean	SD		
1	Teachers cover all units in the text book without missing subtopics	2.12	1.12	2.7	1.23	-1.43	.16
2	Teachers cover some units by giving reading assignment to students with HI	2.6	1.12	2.53	1.35	.69	.867
3	Teachers use make up class to cover the text book	2.24	1.09	2.2	1.01	.115	.909
4	Teachers use tutorial class to cover the text book	2.44	1.04	2.26	1.38	.449	.656
5	Teachers do every exercise without missing some parts	2.12	1.23	2.13	1.06	-.035	.972

As shown in table 7 grand mean on item one for both male and female students was 2.12 and 2.7 respectively thus indicated low score and the obtained t-value df (38), t (-1.431) and P= 0.161 > .05 indicated that no difference on response of male and female students on teachers coverage of all units in the text book without missing sub topics. Grand mean on item two for both male and female students was 2.6 and 2.53 thus indicated low score and the obtained t-value df (38), t (0.69) and P= 0.867 >.05 indicated that no difference on response of male and female students on teachers coverage of some units by giving reading assignment to Students with hearing impairment. Grand mean on item three for both male and female students was 2.24 ad 2.2 respectively thus indicated low score and the obtained t-value df (38), t (0.115) and P=0.91 > .05 indicated that no difference on response of male and female students on teachers use of makeup class to cover the text book.

Grand mean on item four for both male and female students was 2.44 and 2.26 respectively thus indicated low score and the obtained t-value df (38), t(0.45) and P= 0.656 > .05 indicated that no difference on response of male and female students on teachers use of tutorial class to cover the text book. Grand on item five for both

male and female students was 2.12 and 2.13 respectively thus indicated low score and the obtained t-value df (38), t (-0.035) and P= 0.972 < .05 indicated that no difference on response of male and female students on teachers doing every exercise without missing some parts.

4.1.6. Mathematics Achievement

Attempts were made to measure the content coverage response of respondents. The responses are summarized in table 8. Note that they were required to respond to the items saying "strongly agree", "agree", "moderately agree", "and disagree" and "strongly disagree". Responses were scored in such a way that high score means good mathematics achievement. Notice that correct or keyed responses are given Score of 5 and 4 followed by a score of 3 for average response and 2 & 1 for incorrect/low scores.

Table 8: Mean Comparison of Male and Female Students on Mathematics Achievement

No	Items	Male		Female		t-value	SIG
		Mean	SD	Mean	SD		
1	students with HI perform well in mathematics	2.76	.96	2.46	1.06	.895	.377
2	students with HI have low mathematics results	2.36	1.11	2.46	1.35	-.27	.788
3	students with HI faced challenges in learning mathematics due to language limitation	2.44	1.04	2.33	1.23	.292	.772
4	students with HI are active participant in the class room	2.88	.73	2.4	.83	1.921	.062
5	students with HI understand all concepts in each unit	2.56	.92	2.7	1.2	-.320	.750
6	students with HI do the exercises given by teachers	3.16	.99	3.13	.83	.087	.931

As shown in table 8 grand mean on item one for both male and female students was 2.76 and 2.46 respectively thus indicated low score and the obtained t-value df (38), t(0.895) and P= 0.377>.05 indicated that no difference on response of male and female students on the good mathematics achievement of students with hearing

impairment . Grand mean on item two for both male and female students was 2.36 and 2.46 respectively thus indicated low score and the obtained t-value df (38), t (-0.270) and P= 0.788 > .05 indicated that no difference on response of male and female students on students with hearing impairment low result of mathematics. Grand mean on item three for both male and female students was 2.44 and 2.33 respectively thus indicated low score and the obtained t-value df (38), t (0.292) and P= 0.775 >.05 indicated that no difference on response of male and female students on challenges of students with hearing impairment in learning mathematics due to language limitation.

Grand mean on item four for both male and female students was 2.88 and 2.4 respectively thus indicated low score and the obtained t-value df (38), t (1.921) and P= 0.062 >.05 indicated that no difference on response of male and female students on the active participation of students with hearing impairment in the class room. Grand mean on item for both male and female students was 2.56 and 2.7 respectively thus indicated low score and the obtained t-value df (38), t (-0.320) and P= 0.750 > .05 indicated that no difference on response of male and female students on students with hearing impairment understanding of all concepts in each unit. Grand mean on item six for both male and female students was 3.16 and 3.13 respectively thus indicated average score and the obtained t-value df (38), t (0.087) and P= 0.931>.05 indicated that no difference on response of male and female students on students with hearing impairment doing the exercises given by teachers.

4.1.7. The Relation of some Predictor Variables to Students with Hearing Impairment on Mathematics Achievement.

Multiple regression analysis was used to see the relation of some predictor variables to students with hearing impairment on mathematics achievement.

Table 9. The Relation of Some Demographic Variables to Students with Hearing Impairment on Mathematics Achievement.

Variables	B	Std. error	t	Sig.	R	R^2	Adj.R^2
(constant)	17.477	4.020	4.348	.000	.359	.129	-.021
Sex	-.900	1.434	-.628	.535			
Level of hearing	-.246	.872	-.282	.780			
Age of onset of hearing loss	-.386	1.377	-.280	.781			
Parents' educational status	1.329	.903	1.472	.152			
Deaf family members	-1.115	1.713	-.651	.520			

Dependent variable: mathematics achievement

Let us focus on the five predictors, whether they are statistically significant or not. sex (b = -9.00, p = .535) is not significant. Level of hearing (b= -.246, p=.780) is not significant. Age of onset of hearing loss (b= -.386, p=.781) is not significant. Parents' educational status (b=1.329, p=.152) is not significant. Deaf family members (b= -1.115, p= .520) is not significant.

To see the significance of the overall contribution of demographic variables (sex, level of hearing, age of onset of hearing loss, parents' educational status, deaf family members) to the students with hearing impairment on mathematics achievement, it was checked by an F-test. The obtained result indicated that the overall contribution of the independent variables (12.9%) was not statistically significant to students with hearing impairment on mathematics achievement (F = .858, p= .521).

Table 10. The Relation of Methods of Teaching, Time on Task, Medium of Instruction and Content Coverage with Mathematics Achievement.

Variables	B	Std. error	t	Sig.	R	R^2	Adj.R^2
(constant)	7.553	2.330	3.241	.002	.527	.278	.204
Methods of teaching	.098	.119	.823	.416			
Time on task	.072	.134	.542	.591			
Medium of instruction	.103	.108	.953	.347			
Content coverage	.359	.155	2.322	.026			

Dependent variable: Mathematics achievement

Let us focus on the four predictors whether they are statistically significant or not. Methods of teaching (b = 0.098, p =.416) is not significant. Time on task (b= .072, p = .591) is not significant. Medium of instruction (b = .103, p= .347) is not significant. Content coverage (b = .359, p = .026) is significant.

To see the significance of the overall contribution of these variables (methods of teaching, time on task, medium of instruction, content coverage) to the students with hearing impairment on mathematics achievement it was checked by an F- test. Thee obtained result indicated that the overall contribution of the independent variables (27.8%) was statistically significant to students with hearing impairment on mathematics achievement (F = 3.755, p= .011).

4.2. Discussion

The major socio –demographic characteristics of the respondents such as sex, age of onset of hearing loss, level of hearing, parents' education status and deaf family members are briefly analyzed in table 2. The respondent of male students is twice that of female students. The post lingual and pre-lingual deaf were proportional in number that means they have almost equal in number. Most of the students were a profound hearing impaired, some of the students hear conversation very slightly and a few of them hear sound very slightly. 3/4th of the respondents' parents were with no formal education

except for some who were certificate or diploma and degree holders. Most of the respondents were without other family members with hearing impairment.

Regarding to Ethiopian contexts, study on secondary school students (9-12) in Bahirdar, the investigators (Ademe & Gebre, 1990) boys perform better than girls and Fennema & Sherman (1978) had reported that boys perceived both their parents as more positive towards as learner of mathematics than did girls. Beside differential treatments and reinforcements by parents, teachers, peers, and considers together with perceived usefulness of mathematics tend to account for the gender gap in attitude towards mathematics (sileshi, 1995). He noted that even if performance does not depend on sex difference, due to different factors at secondary school level boys perform better than girls and girls make many mistakes than boys at secondary level. Researchers frequently reported that female students have lower perception of competence and lower performances than male students in mathematics (Hannula M. 2002). The degree and kind of impairment greatly affect the ability to communicate. Hearing children typically acquire a large vocabulary and knowledge of grammar, word order, idiomatic expressions, fine shades of meaning, and many other aspects of verbal expressions to others and to themselves from early infancy. A child with a hearing impairment, however, is exposed to verbal communication only partially or not at all.

As a rule, students with hearing impairments experience a lag in vocabulary skills when compared with hearing students of compatible age. Once again children who are deaf show a more noticeable lag than do children who are hard of hearing. This lag in vocabulary development worsens as the child with hearing impairment grows older (Tylor & Sternberg, 1995).

Studies revealed that children and young adults who have mild hearing losses generally perform better academically than those with severe losses.

Since most of the students were profound hearing impaired they do not perform well in mathematics students who are deaf from birth tend to have more difficulty acquiring academic skills than those later loss their hearing. As indicated in table 2, 47.5% of the students are pre-lingual this implies that most students faced challenges in mathematics problems. Generally the above stated review literature supports the results of this study.

Eatshope (1975) and kangan (1978) as cited in Lemma (2006) Pointed out that students who came from families of higher level of education tend to achieve higher than those from uneducated ones. Thus, more success in education takes place in educated families than their counter parts.

The education level of the parents has its own importance in children's education. Simmon (1981) revealed that socio economic status such as parents' education level is significant predictor of cognitive achievement. Regarding this idea Harbison and Hanvshek (1992) studied the effects of mothers' education and fathers' education on mathematics and Portuguese achievement. They found that the level of both mothers' and fathers' education exerted a positive influence on achievement. In contrast to fathers' education, local investigator Adamu (2004) explained that mothers' educational level show a significant impact on their children's achievement whereas fathers' educational level did not show a significant impact.

The academic back ground of the students' family influence students' success. In this regard, Grissmer (1994) reviewed that students with parents who were both college educated tended to attain better at the college education.

In relation to this, Laosa (1982) elaborated that children from more educated families excel at schools because the teaching-learning and assessment processes in schools are like those they have learned to master at home.

With respect to parents' educational status, the majority of the students parents are grouped under cannot read and write. These have a significance effect on the mathematic achievement of students due to loss of communication and lack of awareness to the importance of education. As students with hearing impairment spent their time with their families, parents' educational status has its own effect on the knowledge of students.

The study participants were composed of deaf family communities without other family members without hearing impairment and the major of the respondents are losing their hearing by different causes. Only 15% of the respondents are coming from deaf family members.

Even though the above different studies shows that socio demographic variables (gender, age of onset of hearing loss, level of hearing, parents' educational status and deaf family members) have a significant effect on mathematics achievement of students with hearing impairment, the result of this study indicates the overall contribution of the socio demographic variables (12.9%) was not statistically significant to students with hearing impairment on mathematics achievement ($F= .818$, $p= .521$).

It is known that teaching methods play a great role in teaching learning process of the students at any education level. Although various teaching methods are used by different teachers, the application of methods would be different for different subjects. Mathematics is a compulsory subject in Ethiopian schools as well as in higher education, which is also true in most parts of the world. Thus, teaching mathematics for disabled students needs a great effort to make success students with hearing impairment in the course. Besides its algebraic and geometric nature of the course students with hearing impairment need additional methods of teaching to achieve their success in the course. And the analysis on the methods of teaching mathematics as indicated in table 4, most of the respondents agreed that mathematics teachers must use teaching aids which are useful for students with hearing impairment (pictures videos and other visual materials), employ active learning methods, teach students with hearing impairment by using problem solving methods, arrange the classroom setting in favor of students with hearing impairment and use demonstration method to make successful students with hearing impairment in the course. In addition to this some of the respondents agreed that teachers used play and dramatization method to teach students with hearing impairment in the class and to make them successful in the course.

Students with hearing impairment can have trouble understanding verbal and mathematics problems because they might not be able to pickup new vocabulary and concepts without being directly taught. These students do not have the general vocabulary or the basic mathematics vocabulary needed to fully understand verbal and written mathematics problems and understand mathematics concepts and processes.

Having a hearing impairment can adversely affect a student's ability to learn. Not only is it difficult to communicate, but the since most teaching is done through speaking the barrier for impaired students can seem insurmountable. In particular, mathematics is a

subject with abstract ideas that cannot always be communicated with words. Therefore teacher should incorporate each of the different methods of teaching into their lessons. These different literatures that are stated by different researchers support the results of this study.

Observations during mathematics lessons in a total of 3 class's shows that teachers never use teaching aids to teach students with hearing impairment. In addition to this, teachers give class work and check students response sometimes but not frequently.

As indicated in table 4, the independent group sample t-test for respondent participants between male and female students reveals there is no any significance difference between the respondents which means the above teaching methods for students with hearing impairment shows similar result by both respondents.

In this study time on task referred to time teachers spent in teaching mathematics and the time students spent in revising mathematics. With respect to time on task as indicated on table 5, most of the respondents agreed that teachers are not volunteer to use extra time to help students with hearing impairment. And also students agreed that they are not revise their mathematics lessons daily, weekly, and monthly. Similar to the lack of revision on mathematics lesson by students with hearing impairment and involuntary of teachers to use extra time, most of the respondents agreed that teachers and students with hearing impairment are not use their time effectively to achieve high mathematics scores in preparatory schools.

Research shows that consistent positive correlation between instructional time and student's achievement at both primary and secondary level and these studies also reveals the same results. Therefore students with hearing impairment do not perform well in mathematics due to the lack of revision on mathematics lesson and involuntary of teachers to use extra time to help students with hearing impairment.

Observations during mathematics lessons show that students with hearing impairment rarely complete their class work and homework. They are less interested to do their tasks. This may be brought from the poor methods of teaching mathematics.

Responses by teachers on time on task, students do not use their time effectively that means they do not complete different tasks such as class work, homework and assignment properly.

As indicated in table 5, male and female students do not give any statistical significance difference between them. This implies to teach mathematics lesson for students with hearing impairment needs extra time, revision of lessons and effective use of time by teachers and students to achieve their success in mathematics score (result) for preparatory students.

Instructional media plays a great role in the teaching-learning processes and students at any education level, particularly in high schools and preparatory schools level. The media of instruction for students with hearing impairment is a secondary language which needs a great effort to achieve communication skills through this language. Students with hearing impairment besides their hearing problem are supposed to develop this communication skills using sign language which is a difficult instructional media for a teacher too at preparatory schools currently. The great problem for hearing impaired students is the media of instruction of the mathematics lessons requires multi skills of language (which is not the mother tongue) and its algebraic and geometrical expressions.

With respect to media of instruction as shown in table 6, teachers are in trouble to use sign language in the class to teach mathematics for students with hearing impairment because they do not trained in sign language. In addition to this interpreters hardly understand teachers' instruction and vocabularies of mathematics and students with hearing impairment faced challenges to understand the interpretation of interpreters and the instruction of teachers.

Learning to speak is difficult if one cannot hear. Hearing impairment is primarily a communication problem (Webster and Ellwood, 1985).

The degree and kind of impairment greatly affect the ability to communicate. Hearing children typically acquire a large vocabulary and knowledge of grammar, word order, idiomatic expressions, fine shades of meaning, and many other aspects of verbal expression by listening to others and to themselves from early infancy. A child with a

hearing impairment, however, is exposed to verbal communication only partially or not at all.

As a rule, students with hearing impairments experience a lag in vocabulary skills when compared with hearing comparable age. Once again children who are deaf show a more noticeable lag than do children who are hard of hearing. This lag in vocabulary development worsens as the child with hearing impairment grows older (Tylor & Sternberg, 1995).

Education of the hearing impaired worldwide has been one of the most controversially discussed topics. The issue has been the difficulty in finding an appropriate classroom communication system that effectively provides access to curriculum content. Subsequently there have been changes in search for a better teaching methodology from pure oralism to total communication and now towards sign bilingualism (Gallimore, 1993). This is true about some of the different studies /researches conducted by different researchers and in addition to the above explanation, this study also shows there have been a great problem in communication between teachers and students with hearing impairment due to lack of sign language skills by teachers of students with hearing impairment.

Responses by teachers on medium of instruction used in mathematics indicated that none of the teachers used sign language to teach mathematics for students with hearing impairment. And in addition to this responses by interpreters on medium of instruction used in mathematics indicated that interpreters have their own limitation of knowing signs of some vocabularies (words) of mathematics due to this there would be a communication barrier between teachers, students and interpreters.

Observations during mathematics lessons shows that students with hearing impairment rarely communicated with their teachers, teachers never use sign language to teach mathematics, students with hearing impairment participate in the class passively due to the inability of teachers to use sign language and good interaction of students with hearing impairment with each other.

In general, most of the respondents agreed that teaching mathematics without skill of sign language is not understandable for students with hearing impairment. The results also

indicated that to teach mathematics for students with hearing impairment in preparatory schools needs the sign language skills of teachers.

As indicated in table 6, the independent group sample t-test also shows that the media of instruction (teachers' sign language ability) plays a great role on students with hearing impairment to achieve mathematics courses by both respondents.

Although coverage of contents is a similar problem for all students within the class, students with hearing impairment will suffer a great problem than that of their hearing counter parts. As indicated in table 7, most of the respondents agreed that teachers are not covering all topics and forwards their tasks to students by giving reading assignments without students with hearing impairment understanding of the contents and sub contents. content coverage in mathematics is not only dealing about the contents like any other subjects but also needs doing a lot of exercises for students with hearing impairment to achieve a higher mathematics score. Besides students with hearing impairment need the sign language to understand mathematics course they are also entitled to need a lot of time on mathematics course than their hearing counter parts. The result of table 7 shows, the need to cover all the contents of mathematics course without missing some parts for students with hearing impairment.

According to Ogembo (2002), the allocated time for mathematics has proved to be inadequate in covering the wide syllabus effectively. Chitwa and Njunge (2004) and ouko (2004) carried out studies on content coverage in secondary schools and found that content was poorly covered while teaching was not up to students' level leading to poor performance. Therefore the above literatures support the results of this study.

The independent group sample t-test also indicates there is no statistical difference between on the content coverage of mathematics course for both respondents. Thus content coverage has a significance effect on students with hearing impairment to achieve mathematics score at preparatory schools.

Although the main factors on the success of mathematics score by students with hearing impairment were analyzed and discussed in the earlier tables their achievement in table 8, indicates some of the respondents agreed that students with hearing impairment perform well mathematics slightly. Even if this result is shown by some students, most of the

respondents agreed that students with hearing impairment have low mathematics results, students with hearing impairment are passive participant in the classroom, students with hearing impairment faced challenges to understand all concepts in each unit and they are not interested to do exercises given by teachers due to language limitation.

Students with hearing impairment are not being sufficient engaged in cognitively challenging word problem situations. They lag being their hearing counter parts in mathematics. According to Adoyo (2004), there is increasing dissatisfaction with poor mathematics achievement in schools for the students with hearing impairment.

Barham and Bishop (1991) noted that teachers of students with hearing impairment, "when asked about the problems their pupils are having with mathematics, seem to have an intuitive feeling that language is at the heart of their difficulties. Thus the above literatures support the results of this study. Observations during mathematics lessons shows that students with hearing impairment passively participate in the class, they are not interested to help each other and with their hearing peers, teachers never use sign language to communicate with them and to enhance mathematics score, teachers never use teaching aids to help them and teachers have no initiatives to give class work and checking the responses of students with hearing impairment. Due to these students with hearing impairment are at risk to achieve good mathematics scores.

Responses by teachers and interpreters on mathematics achievement of students indicated that mathematics score of students with hearing impairment are very low. This is attributed by lack of sign language skills of teachers, lack of specially prepared supportive books, students with hearing impairment negative attitude towards the subject matter, the daily follow up needs of students with hearing impairment, absence of using additional class to help students with hearing impairment, lack of signs for some vocabularies (words) of mathematics, and low motives of students with hearing impairment to do class work, homework and assignments given by teachers. Document analysis (one year EGSECE result and one year class room result) shows that achievement of students with hearing impairment in mathematics in Ethiopian General Secondary Education Certification Examination and Classroom Examination has been low compared to their hearing counter parts. The students with hearing impairment on mathematics EGSECE result was 33% whereas their hearing peers' mathematics

EGSECE result was 44% and the students with hearing impairment mathematics class room average results were 46% whereas their hearing peers' mathematics classroom average results were 51%.

The independent group sample t-test also indicates there is no statistical significance difference between the group respondents.

UNIT FIVE

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary

The **intention** of the researcher in this study was to asses mathematics learning and achievement of students with hearing impairment and to identify factors influencing their achievement in relation to gender, the severity of the hearing loss, the age of its onset, the academic background of the students' family, the hearing status of the students' parents, methods of teaching, time on task, medium of instruction and content coverage. For this purpose, the following research questions were formulated.

- What is the way of mathematics learning in hearing impaired classes?
- What is the achievement of hearing impaired students in mathematics?
- What is the way of communication between teachers and students with hearing impairment in mathematics class?

In order to find out answer for the above questions Menelik II preparatory school students with hearing impairment were made subjects of the study. From this school, grade eleven students with hearing impairment were considered for it was believed that they may better understand questionnaires and elicit dependable information than students with hearing impairment at a lower grade level and in addition to this grade 11 students were new to the environment (preparatory school) and they were faced to different problems. But grade 12 students with hearing impairment were not selected as participants of the study even if it was believed that they might better understand questionnaires and elicit dependable information because these students were not new to the environment and did not face to different problems. And the researcher used descriptive survey research to investigate the problem more deeply.

Students with hearing impairment enrolled in the study were 40, 25 male students and 15 female students. Similarly all mathematics teachers (4) and interpreters (4) assigned to teach students with hearing impairment were also participants in the study.

The researcher took all population and data was collected from all population to get reliable information about the problem and of the population.

A pilot study was carried out on grade twelve (12) students with hearing impairment. The total number of participants in the tryout study was 10 (m=7,f=3) . the participants were selected using simple random sampling.

To collect the necessary information for this study, three measuring instruments were used (questionnaires, document analysis and lesson observations).

The attitude scale consists of 28 items and the participants were asked to indicate the extent of their agreement with each statement using a five point attitude scale. The given scale values were, 1= strongly disagree, 2= disagree, 3= moderately agree, 4= agree, 5= strongly agree. In addition to this the questionnaires administered to students, teachers and interpreters consisted of two sets of items. The first set of items was related to demographic characteristics of the respondents. The second set of items was used to obtain information about methods of teaching, time on task, medium of instruction, content coverage and mathematics achievement.

Document analyses were conducted to see mathematics achievement of students with hearing impairment in relation to hearing students. The researcher had seen one year EGSECE result and one year classroom result to compare mathematics results of students with hearing impairment to that of their hearing counterparts.

Lesson observation (a total of 3 classes) was carried out in classroom by using observation checklist and the researcher had seen one year classroom observation in his class. The observation checklist consist 12 items. Each item was prepared for the purpose of evaluating mathematics methods of teaching, time on task mathematics vocabulary signs knowledge of teachers and interpreters and participation of students with hearing impairment in the classroom.

To asses mathematics learning and achievement of students with hearing impairment and to see the relationship of some demographic variables with mathematics achievement and methods of teaching, time on task, medium of instruction and content coverage with mathematics achievement some statistical methods were

employed. Descriptive data analysis (by using mean score, percentages, frequency distribution, and standard deviation) has been used to describe the data on the basis of the reaction of the respondents to the items.

Data related to open ended questions, document analysis and lesson observations was analyzed using qualitative methods.

Multiple regression analysis was used to see the relation of some predictor variables to students with hearing impairment on mathematics achievement. t- test was used to see whether there are mean differences or not between the male and female students with hearing impairment. The statistical soft ware that was used in the study was spss computer program

Analysis of the collected data shows the following results

- The post lingual and pre lingual deaf were proportional in number
- Most of the respondents were a profound hearing impaired without other family members with hearing impairment.
- Some of the students hear conversation very slightly and a few of them hear sound very slightly.
- Most of the respondents' parents were with no formal education except for some who were certificate or diploma and degree holders.
- The overall contribution of socio demographic variables was not statistically significant to students with hearing impairment on mathematics achievement.
- The overall contribution of the variables (methods of teaching, time on task, medium of instruction and content coverage) was statistically significant to students with hearing impairment on mathematics achievement.
- Teachers do not use an appropriate methods of teaching
- Time on task was found to be inadequate.
- Teachers do not use sign language
- Interpreters have their own limitation of knowing signs of some vocabularies (words) of mathematics
- The syllabus were not covered in the stipulated time
- Students with hearing impairment are passive participant in the class room.
- Students with hearing impairment had low mathematics results.

5.2. Conclusions

Based on the results of this study the following conclusions are presented

- Teachers do not use appropriate methods of teaching to help students with hearing impairment in the classroom.
- Time on task was found to be inadequate.
- Teachers are in trouble to use sign language in the class to teach mathematics for students with hearing impairment because they do not trained in sign language.
- Interpreters hardly understand teachers' instruction and vocabularies (words) of mathematics because interpreters have the own limitation of knowing signs of some vocabularies (words) of mathematics.
- Students with hearing impairment faced challenges to understand the interpretations and the instruction of interpreters and teachers respectively.
- Teachers never covered the syllabus in the stipulated time.
- Students with hearing impairment are passive participant in the classroom
- Students with hearing impairment faced challenges to understand all concepts in each unit and they are not interested to do exercises given by teachers.
- Students with hearing impairment have low mathematics results.

To sum up, the findings of this study are in line with the evidences found by other researchers in the field. The findings have important practical implication to the educational institutions specifically preparatory school program of Ethiopia. Thus, investigating mathematics learning and achievement of hearing impaired students call for suitable intervention strategies on the part of teachers, counselors, school administrators and curriculum designers.

5.3. Recommendations

In light of the finding that inappropriate methods of teaching, inadequate content coverage and time on task, and teachers' deficiency in sign language influenced mathematics achievement of hearing impaired students. This study recommends that:-

- Teachers need to training on methods of teaching mathematics for the students with hearing impairment.
- Menelik II preparatory school needs to prepare tutorial program for the students with hearing impairment.
- Students with hearing impairment need to more instructional time for mathematics in preparatory schools.
- Mathematics teachers need to sign language training.

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Appendix A

Addis Ababa University

School of Graduate studies

Department of science and Mathematics Education

Questionnaire for Students with Hearing Impairment

This questionnaire is prepared to investigate mathematics learning and achievement of students with hearing impairment and to suggest alternative solutions on the issue

Your assistance in providing information is highly valued. The information you provide will be kept confidential and be used only for the purpose of the study. Writing your name is not required

Part I. Background Information

Sex: 1. Male ☐ 2. Female ☐

Age: _____

Age of onset of the hearing impairment:

1. Pre lingual ☐
2. Post lingual ☐

Current status of hearing capacity:

1. Hear speech very slightly ☐
2. Hear sound very slightly ☐
3. Don't hear at all ☐

Academic background of parents:

1. can not read and write ☐
2. Read and write ☐
3. Certificate & Diploma ☐
4. Degree and above ☐
5. **Deaf family members:**

1. Yes ☐ 2. No ☐

Part II. Close ended questions

NB. Dear students please provide appropriate responses from the given five alternatives by making a tick mark (✓) to the corresponding item of the following attitude scales.

1=strongly disagree 2= disagree 3= moderately agree 4=agree

5= strongly agree

No	Items	Attitude Scales				
	A. In methods of teaching	**1**	**2**	**3**	**4**	**5**
1	Teachers use teaching aids which are useful for students with hearing impairment(pictures, videos and other visual materials)					
2	Teachers teach students with hearing impairment by using play and dramatization method					
3	Teachers employ active learning methods.					
4	Teachers teach students with hearing impairment by using problem solving method					
5	Teachers arrange the classroom setting in favor of students with hearing impairment					
6	Teachers use demonstration method					
	B. In time on task	**1**	**2**	**3**	**4**	**5**
1	Teachers use extra time to help students with hearing impairment.					
2	Students with hearing impairment revise mathematics daily.					
3	Students with hearing impairment revise mathematics weekly.					
4	Students with hearing impairment revise mathematics monthly.					
5	Teachers use their time effectively (give immediate feedback for students with hearing impairment work that is class work, homework, assignment, test etc and do not miss class.					
6	students with hearing impairment use their time effectively (do					

	their mathematics class work, homework and assignment on time and study mathematics based on schedule.					
	C. In medium of instruction	**1**	**2**	**3**	**4**	**5**
1	Teachers use sign language					
2	Interpreters understand teachers' instruction and vocabularies of mathematics.					
3	Teachers use lip reading to help students with hearing impairment					
4	Students with hearing impairment understand the interpretations of interpreters.					
5	students with hearing impairment understand the instruction of teachers					
	D. In content coverage	**1**	**2**	**3**	**4**	**5**
1	Teachers cover all units in the text book without missing subtopics					
2	Teachers cover some units by giving reading assignment to students with hearing impairment					
3	Teachers use make up class to cover the text book.					
4	Teachers use tutorial class to cover the text book					
5	Teachers do every exercise without missing some parts.					
	E. In achievement	**1**	**2**	**3**	**4**	**5**
1	Students with hearing impairment perform well in mathematics					
2	Students with hearing impairment mathematics result is low					
3	Students with hearing impairment faced challenges in learning mathematics due to language limitation.					
4	Students with hearing impairment are active participant in the class room					
5	Students with hearing impairment understand all concepts in each unit					
6	Students with hearing impairment do the exercises given by teachers					

አዲስ አበባ ዩኒቨርስቲ

ሥነ-ትምህርትና ጠባይ ጥናት ኮሌጅ

የሣይንስና ሂሳብ ትምህርት ክፍል

የተከበራችሁ ምላሽ ሰጪዎች

ይህ መጠይቅ የተዘጋጀው የመስማት ችግር ላለባቸው ተማሪዎች ሲሆን አላማውም የተማሪዎችን የሂሣብ ትምህርት የመማር ሁኔታ እና ውጤት ለማጥናት እና ለችግሩም መፍትሄ ለመጠቆም ነው። ለቀረበው መጠይቅ ትክክለኛ ምላሽ እንዲሰጡኝ በአክብሮት እጠይቃለሁ። የምትሰጡኝ ምላሽ ሚስጢራዊነቱ የተጠበቀ መሆኑን አረጋግጣለሁ። ስምዎን በመጠይቁ ላይ መፃፍ ስለማያስፈልግ የእርስዎ ማንነት ያለመታወቅ የተጠበቀ ነው።

በቅድሚያ አመሰግናለሁ!

ክፍል አንድ፡- መረጃ

ፆታ 1. ወንድ ☐ 2. ሴት ☐

ዕድሜ ----------

የመስማት ችግር የተከሰተበት ወቅት

1. ቋንቋ ከመቻል በፊት ☐ 2. ቋንቋ ከተቻለ በኋላ ☐

አሁን ያለው የመስማት ችሎታ ሁኔታ

1. በጣም በትንሹ ንግግር እሰማለሁ ☐
2. በጣም በትንሹ ድምፅ እሰማለሁ ☐
3. ምንም አልሰማማም ☐

የቤተሰብ የትምህርት ደረጃ

1. ማንበብና መፃፍ የማይችል/ትችል ☐
2. ማንበብና መፃፍ የሚችል/ትችል ☐
3. ሰርቲፊኬት እና ዲኘሎማ ☐
4. ዲግሪ እና ከዲግሪ በላይ ☐
5. በቤተሰብህ/ሽ የመስማት ችግር ያለበት ሰው አለ

1. አዎ ☐ 2. የለም ☐

<u>ማሳሰቢያ</u>፡- የተከበራችሁ ምላሽ ሰጪዎች ከተሰጡት አምስት የመለኪያ አማራጮች አንዱን በመምረጥ የ " √ " ምልክት ያድርጉ

መለኪያዎች፡-

1 = በጣም አልስማማም

2 = አልስማማም

3 = በመጠኑ እስማማለሁ

4 = እስማማለሁ

5 = በጣም እስማማለሁ

ክፍል 2፡- መጠይቅ

ተ.ቁ	መጠይቅ	መለኪያዎች				
	ሀ. የማስተማር ዘዴን በተመለከተ	1	2	3	4	5
1	መምህራን የመስማት ችግር ያለባቸውን ተማሪዎች ስዕልን በመጠቀም ያስተምራሉ፡፡					
2	መምህራን የመስማት ችግር ያለባቸውን ተማሪዎች በጨዋታና በድራማ ዘዴ ያስተምራሉ					
3	መምህራን አሳታፊ የማስተማር ዘዴን ይጠቀማሉ					
4	መምህራን የመስማት ችግር ያለባቸውን ተማሪዎች የተለያዩ ጥያቄዎችን በማሰራት ያስተምራሉ፡፡					
5	የተማሪዎች አቀማመጥ የመስማት ችግር ያለባቸውን ተማሪዎች በሚጠቅም ሁኔታ የተስተካከለ ነው፡፡					
6	መምህራን የመስማት ችግር ያለባቸውን ተማሪዎች በገለባ ዘዴ ያስተምራሉ					
	ለ. ተጨማሪ የትምህርት ሰዓትን በተመለከተ	1	2	3	4	5
1	መምህራን የመስማት ችግር ያለባቸውን ተማሪዎች ለመርዳት ተጨማሪ ሰዓት ይጠቀማሉ፡፡					
2	የመስማት ችግር ያለባቸው ተማሪዎች የተማሩትን ትምህርት በየቀኑ ይከልሳሉ፡፡					
3	የመስማት ችግር ያለባቸው ተማሪዎች የተማሩትን ትምህርት በሳምንት ይከልሳሉ፡፡					
4	የመስማት ችግር ያለባቸው ተማሪዎች የተማሩትን ትምህርት በወር ይከልሳሉ፡፡					
5	መምህራን ሰዓታቸውን በአግባቡ ይጠቀማሉ፡፡					
6	የመስማት ችግር ያለባቸው ተማሪዎች ሰዓታቸውን በአግባቡ ይጠቀማሉ፡፡					

	ሐ. የመግባቢያ ዘዴን በተመለከተ	1	2	3	4	5
1	መምህራን ለማስተማር የምልክት ቋንቋ ይጠቀማሉ፡፡					
2	አስተርጓሚዎች ሁሉንም የሂሣብ ቃላቶችን ያውቃሉ እንዲሁም ለመተርጎም አይቸገሩም፡፡					
3	ተማሪዎች ለመማር የከንፈር ንባብ ይጠቀማሉ፡፡					
4	የመስማት ችግር ያለባቸው ተማሪዎች የአስተርጓሚዎችን ገለፃ ይረዳሉ፡፡					
5	የመስማት ችግር ያለባቸው ተማሪዎች የመምህሩን ገለፃ ይረዳሉ፡፡					
	መ. የመፅሐፉን አጨራረስ በተመለከተ	1	2	3	4	5
1	መምህራን ሁሉንም ምዕራፍ ይሸፍናሉ፡፡					
2	መምህራን ሁሉንም ምዕራፍ የሚሸፍኑት ተማሪዎች እንዲያነቡት በማድረግ					
3	መፅሐፉን ለመጨረስ መምህራን የማካካሻ ሰዓት ይጠቀማሉ፡፡					
4	መፅሐፉን ለመጨረስ መምህራን ተጨማሪ ሰዓት ይጠቀማሉ					
5	መምህራን ሁሉንም የመፅሐፍ ጥያቄዎች ይሰራሉ፡፡					
	ሠ. የተማሪዎችን ብቃት በተመለከተ	1	2	3	4	5
1	የመስማት ችግር ያለባቸው ተማሪዎች ሂሣብን በጥሩ ሁኔታ ይሰራሉ፡፡					
2	የመስማት ችግር ያለባቸው ተማሪዎች ሂሣብ ውጤት ዝቅተኛ ነው፡፡					
3	የመስማት ችግር ያለባቸው ተማሪዎች የቋንቋ ብቃት ደካማ ነው፡፡					
4	የመስማት ችግር ያለባቸው ተማሪዎች በክፍል ውስጥ በጥሩ ሁኔታ ይሳተፋሉ					
5	የመስማት ችግር ያለባቸው ተማሪዎች በየምዕራፉ ያሉትን ፅንሰ ሃሣቦች ይረዳሉ፡፡					
6	የመስማት ችግር ያለባቸው ተማሪዎች በመምህሩ የሚሰጡትን ሁሉንም ጥያቄዎች ይሰራሉ፡፡					

Appendix B

Addis Ababa University

School of Graduate studies

Department of Science and Mathematics Education

Questionnaire for teachers & interpreters of the Students with Hearing Impairment

This questionnaire is prepared to investigate mathematics learning and achievement of students with hearing impairment and to suggest alternative solution on the issue. Your assistance in providing information is highly valued. The information you provide will be kept confidential and be used only for the purpose of the study. Writing your name is not required

Part I Background Information

Sex: *1.Male* ☐ *2.Female* ☐

Qualification: ----------

Experience in teaching students with hearing impairment: ----------

Part II. Open-ended questions

1. When teachers teach students with hearing impairment are they obedient? Do they attend class room seriously when they tell them to behave and follow up the lesson? Explain it

   _____

   _____

   _____

2. Do you know all signs of vocabularies of Mathematics? If not what do you do?

   _____

   _____

3. What is your opinion about mathematics learning and achievement of students with hearing impairment?

   _____

   _____

   _____

4. What are the main problems that are related in presenting your lesson to students with hearing impairment and in assessment them?

   _____

   _____

Appendix C

Addis Ababa University

School of Graduate studies

Department of Science and Mathematics Education

Classroom observation check list

Date _____grade_____

Subject_____ period _____

1. Encouraging and motivating students with hearing impairment learning

   Excellent ☐ V. Good ☐ Good ☐ Poor ☐

2. Teachers communication with students with hearing impairment

   Always ☐ sometimes ☐ rare ☐ Never ☐

3. Teachers use sign language

   Always ☐ sometimes ☐ rare ☐ Never ☐

4. Teachers use of teaching aids for students with hearing impairment

   Always ☐ sometimes ☐ rare ☐ Never ☐

5. Teacher's potency to help students with hearing impairment

   Excellent ☐ V. Good ☐ Good ☐ Poor ☐

6. Giving class work and checking

   Always ☐ sometimes ☐ rare ☐ Never ☐

7. Class room situation attracts attention of students with hearing impairment

   More available ☐ less available ☐ not available ☐

8. Students with hearing impairment completion of class works

   Always ☐ sometimes ☐ rare ☐ Never ☐

9. Students with hearing impairment participation in class room

   Always ☐ sometime ☐ rare ☐ Never ☐

10. Students with hearing impairment in helping each other and with their hearing peer in mathematics.

    Always ☐ sometimes ☐ rare ☐ Never ☐

11. Interaction of students with hearing impairment with a teacher in the class room

    Excellent ☐ V. Good ☐ Good ☐ Poor ☐

12. Students with hearing impairment interaction with each other

    Excellent ☐ V. Good ☐ Good ☐ Poor ☐

DECLARATION

I, Ananiya Abebe Gelaye hereby declare to Addis Ababa University School of Graduate Studies that this thesis is a product of my original research work, and it has not been submitted and presented to any other university for any academic degree and that all sources of material used for the thesis have been dully acknowledged.

Name: Ananiya Abebe Gelaye

Signature: _____

Date of Submission: October, 2014

Department of Science and Mathematics Education, Addis Ababa University

This thesis has been submitted for approval to my advisor

Kassa Michael

Signature: _____

Date of Submission: _____