JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF INFORMATION SCIENCE

IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN ENHANCING QUALITY OF EDUCATION FOR STUDENTS WITH VISUAL AND HEARING PROBLEMS IN SELECTED HIGHER EDUCATIONAL INSTITUTIONS OF ETHIOPIA

By

Solomon Alemu

Jimma, Ethiopia

November, 2018

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF INFORMATION SCIENCE

Impact of Information Communication Technology (ICT) in enhancing quality of education for students with visual and hearing problems in selected higher educational institutions of Ethiopia

By

Solomon Alemu

Principal Advisor: - Amanuel Ayde (Assistant professor, PhD candidate)

Co-Advisor: - Deonasios Deresa (MSc)

A THESIS SUBMITTED TO THE DEPARTMENT OF INFORMATION SCIENCE, COLLEGE OF NATURAL SCIENCES, JIMMA UNIVERSITY, IN MEETING THE PARTIAL FULFILLMENT FOR THE AWARD OF DEGREE OF MASTER OF SCIENCE IN INFORMATION AND KNOWLEDGE MANAGEMENT

Jimma, Ethiopia

November, 2018

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

DEPARTMENT OF INFORMATION SCIENCE

Impact of Information Communication Technology (ICT) in enhancing quality of education for students with visual and hearing problems in selected higher educational institutions of Ethiopia

By

Solomon Alemu

This thesis entitled "**Impact of Information Communication Technology (ICT) in enhancing quality of education for students with visual and hearing problems in selected higher educational institutions of Ethiopia**" has been read and approved as meeting the requirements of department of Information Science in partial fulfillment for the award of the degree of Master of Science in Information Science (Information and Knowledge Management), Jimma University, Jimma, Ethiopia**.**

Name and Signature of Members of the Examining Board

<u>Name</u>	<u>Title</u>	<u>Signature</u>	<u>Date</u>
……………………..	Chairperson	………………..	………
Amanuel Ayde (PhD candidate)	Principal Advisor	……………….	………
Deonasios Deresa (MSc)	Co-Advisor	……………….	……….
…………………………	Internal Examiner	………………..	………
…………………………	External Examiner	………………….	………

Dedication

I dedicate this research for my lovely daughter Mitik Solomon and my wife Elfinesh Badenga.

Declaration

This thesis is original work and has not been submitted as a partial requirement for a degree in any University.

_____

Solomon Alemu

November, 2018

This thesis is submitted for examination with our approval as University advisors.

_____

Amanuel Ayde

_____

Deonasios Deresa

November, 2018

Acknowledgement

Table of Contents

List of Tables

List of Figures

Abstract

The aim of this study was to identify the role of Information Communication Technology for students with visual and hearing problems, as well as to explore the factors that hinder these students not to be effective as it is expected. The research design for this study was cross sectional survey. Addis Ababa, Jimma and Hawasa Universities were study areas. The respondents were undergraduate students with visual and hearing problems, lab assistants and instructors who teach these students. Total population of this study was 374. Sample size was determined by using both purposive and stratified random sampling. Qualitative and quantitative methods were used to collect data from total of 167 respondents. Data collection instruments were questionnaire, interview and observation. The researcher used both descriptive way of statistical methods like measures of central tendencies to analyze the collected data and inferential method to see the relationships between variables. The result obtained from the study indicate that ICT help the students to access relevant information independently. For students who have experience to use technology, there is a problem of being dependent on it. Also the experience of students with visual and hearing problems in using computer, internet and Assistive technologies is at minimum level. 52.9% of the respondent have no experience of using computer and 58.2% of them do not know how to use internet. Majority of them have mainly limitation of awareness to use technology, digital divide and interpersonal relationship with others. Even though technological tools are effective in giving the information for the user, all students with visual and hearing problems could not use them properly. The main reasons for this challenge are complexity of technology and shortage of computer and Assistive technologies in number and kind. The students who use computer and Assistive technologies have good information seeking behavior; i.e. most of them use the technology for educational purposes. To indicate the strategy that should be implemented in order to solve the problems of quality of education for these students, Technology Acceptance Model (TAM) is adopted. Generally, students with visual and hearing problems have gap of getting relevant and timely information because of barriers from organizational structure, digital divide, lack of awareness how to use technology and complexity of technology. Therefore, students with visual and hearing problems, lab assistants, universities, Ministry of education and FDRE government should actively participate in order to implement the inclusion policies and enhance quality of education for these students.

Acronyms and Abbreviations

AAU= Addis Ababa University

AT= Assistive technologies

DOI= Diffusion of Innovation

FB= Faculty of Business

FDRE= Federal Democratic Republic of Ethiopia

FM system= Frequency Modulation System

GTP= Growth and Transformation Plan

HU= Hawasa University

ICT= Information Communication Technology

JU= Jimma University

MoE= Ministry of Education

MOLSA= Ministry Of Labor and Social Affairs

NPAPD= National Plan of Action of Persons with Disabilities

PDF= Portable Document Format

SPSS= Statistical Package for Social Science

TAM= Technology Acceptance Model

TOE= Technology-Organization-Environment

TPB= Theory of Planned Behavior

UTAUT= Unified Theory of Acceptance and Use of Technology

WB= World Bank

WHO= World Health Organization

CHAPTER ONE

Introduction

Disability is the condition or function limited because of impairment relative to standard function of other individuals. The problem can be impairments like physical, sensory, cognitive, intellectual, mental illness or others [1]. Disability is one of the societies' problem in both developed and developing countries. The disabled societies have a limitation to perform what they want due to their environmental factors. There are different factors affecting these communities; i.e. being disabled person, socio/psychological challenges, economic challenges, physical challenges and others can be mentioned. These problems have negative impacts which obligate the victims of the problem not to be successful in their life and hinder the country's development as well [2].

The problem of being disabled society can be a cause to influence them not to have better self-esteem for themselves. This is also true for students with disabilities who are attending their primary, secondary and tertiary schools [2]. Based on the report of World Bank (WB) and World Health Organization (WHO), out of the total population of Ethiopia, 17.6% (15 million) children, adults and elderly persons are individuals with disabilities [3].

To help and motivate 15 million individuals with disabilities, Ethiopia proposed and signed different policies and regulations. The proposed and signed agreements are mainly contain inclusion policies for individuals with disabilities [3]. Inclusion policy is prepared to incorporate societies with disabilities into different services to ensure that they have equal opportunity with other individuals to achieve their maximum potential [4].

Some of the inclusion policies Ethiopia proposed and signed are the following: - 1) Constitution of Federal Democratic Republic of Ethiopia (FDRE) article 41(5) which is adopted in 1995; 2) Proclamation concerning the Rights to Employment for Persons with Disabilities, No. 568/2008; 3) The Federal Civil Servant Proclamation No. 515/2007; 4) Labor Proclamation, No. 377/2003, amended by Labor Proclamation No. 494/2006; 5) Proclamation on definition of Powers of duties of the Executive Organs of the Federal Democratic Republic of Ethiopia, No. 691/2010; 6) Growth and Transformation Plan (GTP) 2010-2015; and 7) National Plan of Action of Persons with

Disabilities (2012-2021) [5]. These programs and policies are designed to help Ethiopian societies with disabilities in areas of disability prevention, medical rehabilitation, educational rehabilitation, awareness raising, personal security and others [6].

According to report from the Ethiopian Ministry of Education [7], only small portion out of the disabled societies (4%) are on the way of leading their life through education. In others words, out of 15 million individuals with disabilities, only 4% (about 600,000) of them are getting chance of formal education. Parallel to this, growth of the given country is not imagined without considering the contributions of all citizens in it [2]. It is not possible to determine the development of the given country without considering the participation of each citizens within it. This is also true for students with disabilities attending primary, secondary and tertiary schools in Ethiopia. To get contributions of the students with disabilities, it is believed that there should be affirmative actions that motivate them.

National Plan of Action of Persons with Disabilities (NPAPD) is one of the plans Ethiopia proposed to enhance the participation of individual with disabilities including students with disabilities who attend their programs at different educational levels [6]. This plan is proposed to be implemented from 2012-2021 and supervised by Ministry Of Labor and Social Affairs (MOLSA). This plan has about nine main programs like awareness raising, accessibility, religion, education, culture, recreation, medical rehabilitation and disability prevention. Even though one of NPAPD's goals is enhancing the participation of students with disabilities, majority of the individuals with disabilities cannot get chance of formal education. Also the participation of students with disabilities is less especially in tertiary schools. Even their field choice is limited mostly to social science areas [8].

1.1. Background of the study

ICT is one of the enablers that plays great role in today's digital era. Mainly this technology enables communication between individuals, information access to satisfy information need, learning through different mechanisms, facilitate social connection and participation in different real life experiences. It means that ICT has great impact that obligates every individuals of the digital era directly or indirectly. Currently, the interactivity of the technological products and the influence of globalization bring each of daily activities under the influence of this enabler [9].

According to Hasselbring & Glaser, over past two or three decades, the number of students with disabilities have been steadily increasing at all levels of education. This is opportunity that create the way for undermined and discriminated societies (individuals with disabilities) to show the ability they have like individuals who are not disabled. Also if individuals with disabilities get chance to learn, they can update themselves by having better information seeking behavior. This in return help them to get valuable experiences for their future life. This means that students with disabilities are one member of learners that should get important information from their colleges or universities and that can help them to contribute something for the community around them [10].

As a principle, every school has objective or goal to give some experiences for the students [10]. And students with disabilities are individuals who need to get some affirmative actions. This means that these students want someone who can identify their problem clearly and treat them based on their interest. In other dimension, the progress of Higher Educational Institutions is the sum of total contribution of communities within it. Students with disabilities are one of the contributors for the growth of educational institutions. If responsible bodies are working properly to motivate the participation level of these students, they have abilities that can reshape the attitude of every individual. However, there is limitation to know how to motivate these students to do their best and there is a gap from society to accept groups with disabilities. There is ignorant or discrimination of disabilities in real life. Also in developing countries, their interaction of students with disabilities with dynamic assistive technological product is limited [11].

Tertiary educational institutions are the key role players in order to produce qualified professionals that are responsible in their daily activities. To achieve such kind of vital objective, universities and colleges should improve their teaching and learning activities. In other words, the quality of education is currently the issue that should get applicable answer [9]. One of the way in which quality of education enhanced in tertiary school and colleges is having a culture of disseminating the right information at the right time for the right users [12]. Thinking how to deliver relevant and updated information for students with disabilities is every individual; especially, it should be the prioritized assignment of colleges and tertiary educational institutions.

There are researchers who are trying to indicate issues which can be related with the students with disabilities who are attending school in different fields. Some of the researches indicated that students with disabilities are not considered in the implementation of current technologies for teaching and learning. This is major problems for higher educational institutions found within developing countries [9]. Additionally, there is a gap of identifying the advantages and impacts of the current technological products and services for students with disabilities in educational areas. The main research gaps that currently observed are the following: 1) the research gap which clearly shows the information seeking behavior of students with disabilities which is/are mostly dominated by ICT (Information Communication Technology) [9] [13] [14]; 2) shortage of study in identifying the digital divide between students with disabilities and challenges that can face them [15]; 3) lack of exploring the status of assistive technologies [9] [12] and 4) shortage of researches which explore the role of digital technologies like social media and mobile devices in order to bring quality of education specially for students with disabilities [9].

1.2. Statement of the problem

According to Beyene & Tizazu, most of the time poor people born with or acquire an impairment or condition that can limit them to do something due to high exposure to number of diseases and injuries. This problem is true for developing countries like Ethiopia. However, the reason to be disabled person is not only being poor person. There might be several factors that should be considered. For instance, accidents, genetic causes, environmental/life events, unknown causes and technological factors can be the majors. While students with disabilities are at school, they might have different information seeking behavior. However, their interest can be hindered by different factors and this in return can limit the quality of education [13].

According to Mutanga, in relation to students with disabilities, societies in higher educational institutions have three main problems. First, the problem of understanding the perception of students with disabilities towards services given. This is the problem of both non-disabled societies and students with disabilities themselves. These students mostly do not know what they want and how to get it. Secondly, there is the problem of deeply understanding the information seeking behavior of these students. Thirdly, some individuals or organizations know the information behavior of students with disabilities; but, there is lack of experience to know the best way to help these students [14].

Researchers indicates that ICT has both positive and negative impacts on the routine activities of information society. Their finding is general which did not include the societies who need affirmative action [16] [17] [18]. Still there is limitation of study which identify whether students with disabilities are effective in using the complex technology or not.

ICT is the broad term and difficult to describe it properly [18]. Mostly, ICT includes issues of products, services and infrastructures within it. In this study, it is aimed to include the roles and status of products like assistive technologies, impacts of internet services, digital technologies like social Medias and mobile technologies with relation to quality of education.

Most papers agreed that students with disabilities have different information seeking behavior [9] [18] [19] [20] [21]. However, they have a limitation to put which information seeking behavior is mostly dominated by ICT and needs more attention. The papers did not clearly show how often these students use ICT products and for what purpose they search information online. Even most of the papers assume that for students with disabilities searching information from the internet is enough. Additionally, students with disabilities have the gap in considering the roles and disadvantages of other offline and e-resources accessed by different technological tools.

Digital divide is the difference in using the technological products in the given area [15]. This concept was started in 1990s before two and half decades. Papers tried to indicate the existence of digital divide. However, the factors they use for this case are mainly economic difference of nations, gender, age, geographical area and considering all populations generally [22] [23] [24]. Still there is a gap of identifying the digital divide between students with disabilities and other students; as well as there is a shortage in identifying the digital divide between students with disabilities themselves.

Assistive technologies are the technologies that can facilitate the quality of education [12]. They are good role players in disseminating information for the user or accessing information by the user. Especially, they are the most important tools for students with disabilities. Researches currently indicated that the importance and disadvantage of these assistive technologies. However, they are limited to evaluate the status of the technological products (effectiveness and efficiency Assistive technologies) which are available to assist students with disabilities [9].

Due to inclusion policy and the availability of volumes of information, today students with disabilities are more informed and competent than previous times [9]. However, these students have limitation in accessing the right information at the right time. Also there is a gap in identifying the role of digital technologies such as social Medias in sharing knowledge and the role of mobile devices for flexible learning.

The aim of this research were the following: -

- To clearly identify the impacts of ICT on teaching learning process
- To identify digital divide which is currently observed between students with visual and hearing problems,
- To explore challenges of students with visual and hearing problems to access information sources compared to non-disabled students,
- To identify the roles and status of digital technologies and finally propose the strategies for identified problems in the study.

1.3. Research questions

The following research questions were designed to conduct the study.

1. What are the information seeking behaviors of students with visual and hearing problems influenced by ICT?
2. What is the digital divide currently observed between students with visual and hearing problems?
3. What is the current status (effectiveness and efficiency) of assistive technologies in enhancing quality of education for students with visual and hearing problems?
4. What are the challenges of students with visual and hearing problems to access different information sources?
5. What are the roles of digital technologies and mobile devices in order to manage knowledge and bring quality of education for students with visual and hearing problems?

1.4. Objectives

1.4.1. General objective

To explore the impact of ICT in enhancing quality of education for students with visual and hearing problems in selected higher educational institutions of Ethiopia.

1.4.2. Specific objectives

- To investigate the influence of ICT on students with visual and hearing problems.
- To identify the key information seeking behavior of students with visual and hearing problems towards ICT.
- To identify the available services, technologies and the digital divide which is currently observed between students with visual and hearing problems.
- To explore the status of the assistive technology for students with visual and hearing problems.
- To investigate the role of digital technologies and mobile devices in order to manage the quality of education.
- To design a conceptual framework based on the result of the study.

1.5. Significance of the study

This study provides benefits related to the teaching learning process to increase the quality of education for higher educational institutions of Ethiopia. It is helpful in identifying information seeking behaviors of students with visual and hearing problems which are mostly influenced by ICT. It can also help interested and responsible bodies to examine the digital divide currently hinder students with visual and hearing problems not to be effective as it is expected. This study is helpful to select and design (adopt and adapt) the right assistive technology for higher educational institutions' students with visual and hearing problems. In addition to this it can be input to give better information about interactive digital technologies and mobile devices in order to manage knowledge and enhance the culture of flexible learning for the above mentioned students. This study provides information for policy makers, future researchers and Ethiopia Ministry of Education (MoE) in order to bring quality of education and select the right digital and assistive technologies.

1.6. Scope and limitation

This study is limited to only topics related to impacts of ICT in enhancing quality of education for students with visual and hearing problems. It is performed within the selected Ethiopian universities; i.e. Jimma, Addis Ababa and Hawasa Universities starting from December to June in 2017/18. These three universities are selected purposely to get better response from target population in order to identify the current challenges and progress of students with disabilities in higher educational institutions of Ethiopia. In this study undergraduate students with hearing and visual problem are considered. The study covered technologies like assistive technologies for students with hearing and visual problem, digital technologies like social media and mobile devices. Also the term ICT was used in this study to indicate only the impact of the current technological products and services which have direct relation with quality of education.

1.7. Ethical issues

The data collection regarding students with visual and hearing problems in the form of interviews, questionnaire and observation usually generates specific ethical issues. The researcher took the consent of each participant before conducting the data collection. After acquiring the consent, a copy of form is given to the participant. A consent form is filled up by the participant. For the visually impaired and for several students with hearing problems. The informed consent form is completed by a sighted person on the student's behalf. In addition to filling the consent form, actual names of participants are not mentioned while reporting the study. Recordings of interviews are also kept confidentially. A permission to conduct the study obtained from the higher responsible bodies like post graduate coordination office and managers of students with disabilities office.

1.8. Operational definitions

Assistive Technology: - it is a tool or service which can enhance the skill and abilities of individuals with disabilities to fully participate in their routine activities.

Digital Divide: - "The gap between individuals, households, businesses, and geographic areas at different socioeconomic levels with regard both to their opportunities to access ICT and to their use of the Internet for a wide variety of activities" [25].

Disability: - "Disability is the loss or limitation of opportunities to take part in society on an equal level with others due to social and environmental barriers" [26].

Education: - is a tool which can give formal lessons for learners and can be motivator to bring economic and social development for individuals who are informed (learned).

ICT: - "The Information and Communication Technology (ICT) is an umbrella term that includes any communication device or application" [27].

Information Seeking Behavior: - it is the concept which indicates the set of actions which can be performed by individuals and used to identify their information need, seek information based on their interest, evaluate the sources and select the right information.

CHAPTER TWO

Literature review and related works

2.1. Literature review

2.1.1. Disability

Disability is the loss or limitation of opportunities to take part in society on an equal level with others due to social and environmental barriers. It is complex, dynamic, multidimensional, and contested [26]. Disability is part of the human condition. Almost everyone will be temporarily or permanently impaired at some point in life, and those who survive to old age will experience increasing difficulties in functioning. Most extended families have a disabled member, and many non-disabled people take responsibility for supporting and caring for their relatives and friends with disabilities [28].

This does not mean that disabled societies cannot be part of the solution for the global challenges. For instance, Jacob, Leah, Miriam, Saul, Moses and Isaac were the religious leaders who had had different kinds of disabilities. And Abraham Lincoln, Franklin Delano Roosevelt, Wilma Rudolph, Astrophysicist Stephen Hawking, Chuck Close, Artist Frida Kahlo, Actor Danny Glover, Marlee Matlin, Walt Disney, Albert Einstein and others were Artists, Athletes, Political Leaders, & Scientists with Disabilities who were unique persons in reshaping the minds of citizens of the world [29].

2.1.2. Types of disability

There are number of disability types. Visual, hearing, mental, physical and other kinds of disability problem can be the majors [30]. According to [31], human beings can have number of disability types. Some of them are vision Impairment, deaf or hard of hearing, mental health conditions, intellectual disability, acquired brain injury, autism spectrum disorder and physical disability.

Visual problem is the problem of being blind person or having partial vision. The individuals with visual problem can use personal assistants or devices like eye glasses, talking book player, jaws or others. Hearing problem is the problem which ranges from mild to profound. Individuals with

hearing problems can use different mechanisms or equipment like speech, lip-reading, writing notes, hearing aids or sign language interpreters [31].

2.1.3. Disabilities and Ethiopian higher educational institutions

The history of Ethiopia and students with disabilities started before 50 years ago [32]. This story was started from primary schools which had primary aim of teaching bible. Later, this teaching process got progress and transformed to higher educational institutions to teach the students with disabilities about the product of science and its environment. However, usually these students used to have different information seeking behavior which could not get better solution. They want to update themselves as much as possible, but still there is limitation of getting suitable mechanism in order to help these students. Students with disabilities mainly have problem related to self-esteem, perception, ignorant from the society and adaptation of current updated technologies for their information need [32]. The way individuals and institutions give solutions for students with disabilities' problem is the way to which they enhance the quality of education in order to make them competent locally, nationally and internationally.

2.1.4. Factors affecting students with visual and hearing problems

There are different factors that can limit students with visual and hearing problems from accessing and utilizing of resources to achieve their goal. These problems can be personal, institutional or country level. In other words, the factors for these problems might be individuals (including students with disabilities), institutional (most of the time not having well-structured organizational culture within universities) and absence of policy or regulations which can be implemented properly in order to help students with visual and hearing problems [33]. The main problems that can affect the quality of education for students with visual and hearing problems in higher educational institutions are geographical location, socioeconomic factors, domestic policy within the country and the perspectives of students with disabilities towards the resources available for them or the service given for them [32] [33]. By itself the type of resource available for students with visual and hearing problems have also impact. If the assistive technological products available are not interactive and easy to understand, it is difficult to think about the success of these students.

2.1.5. ICT as enabler

ICT stands for Information Communication Technology [9]. It got its popularity with the progress of the internet. Especially in this globalization and digital era, ICT plays great role by acting as enabler and source of information. Every activity in our environment is directly or indirectly influenced by the technological product [12].

ICT has several benefits, i.e. helping for the effective communication between citizens of our planet, for accessing of multiple information sources with different formats, for enhancing quality of education through different mechanisms including flexible learning and for social connections [9].

Because of its enabling capacity ICT is essential for quality of education [9]. In addition to enabling capacity, today citizens of the world are influenced to consider ICT when they adopt and evaluate the right inclusion policy for students with visual and hearing problems [34]. In other words, the strategy or inclusion policy which is proposed for students with visual and hearing problems should consider the impact of technology too.

ICT has capacity to help students with visual and hearing problems to access online courses easily, working on one's own pace, learning at home, communicating with peers easily, availability of information anywhere and at any time, feeling more independent, confident and less stressed, the ability to keep up with the rest of the class, and to use materials in alternate formats [34].

2.1.6. ICT and digital divide

Digital divide is the difference of using the technological products in the given area [15]. This concept was started in 1990s before two and half decades. According to [15], there should be primary question that can identify the main cause of digital divide. This question is that which one is the primary responsible problem? ICT or Digital divide? It is clear that ICT plays a great role in order to change the living condition of society, economic growth, thinking ability, attitude and perception of individuals. However, the negative impact of ICT brought the digital divide. "ICT is not a panacea for all the problems of developing countries. However, digital divide has important implications for these countries as the uneven distribution of ICTs access may mean that segments or groups who have no or limited accessibility to these technologies may be denied of socioeconomic opportunities" [35].

2.1.7. Assistive technologies and quality of education

Assistive technologies are defined as "any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" [36]. These technologies can be ranged from personal assistive technology such as speech and braille output to advanced technologies like screen magnificent system, speech synthesizer, mobile aided technologies and others.

Assistive technologies are the main role players for students with visual and hearing problems to assist them in order to get quality of information with minimum effort and time [15]. This is an input to bring the quality of education in tertiary schools (universities) [9]. By using the technological products, institutions can help students with visual and hearing problems to participate in different field of specialization, assess current and real information, communicate with other individuals easily and learn anywhere anytime [15] [9].

According to Pacheco, Yoong and Lips [9], most of researchers focus on assistive technology to show the role of ICT for individuals with disabilities. These assistive technologies are mainly computer, devices like hearing aid, screen readers, braille system and others. To show the maximum capacity of ICT, Pacheco, Yoong and Lips studied the role of digital technologies like social media and mobile technologies to help students with disabilities to select the right field of specialization when they become freshman of tertiary school. Still their study is limited only to application of ICT to field choice.

On the above study, there is still the gap of showing how social Medias can help students with visual and hearing problems to process latest information and develop the culture of flexible learning. This study covered the roles of digital technologies like social media and mobile technologies in order to bring the quality of education by enhancing the culture of information sharing and flexible learning for students with visual and hearing problems.

2.1.8. Theoretical framework for adoption of technology

According to [37], theoretical frame work is the summary of the identified problems which is organized by following the results of the previous studies. It has two advantages; i.e. to plan what to do in the future and explanation of the findings. Most of the time, theoretical frame works have three attributes to consider. These are environment, organization and technology [38].

There are several types of technology adoption models. Some of them are technology acceptance model (TAM), theory of planned behavior (TPB), unified theory of acceptance and use of technology (UTAUT), diffusion of innovation (DOI) and technology-organization-environment framework (TOE) [52].

Diffusion of Innovation (DOI) model is aimed to show the perceived characteristics of technological innovations. These characteristics have impact on the attitude of the user to accept or reject technology [38]. However, DOI have limitation to consider the external factors that are termed as environmental contexts.

Technology-Organization-Environment (TOE) model is better in considering the three main attributes. Also it clearly shows the relationship between these three attributes (technology, organization and environment) [38]. However, the model still have the gap to consider issues raised from user side.

Theory of Planned Behavior (TPB) discusses mainly the attitude of the user towards using the innovation or technology. It relates the effectiveness of the technology with the attitude of the user [39]. However, this model has limitation to clearly put factors from external environment, organization and progress of the technology that can reshape the users' attitude.

Unified Theory of Acceptance and Use of Technology (UTAUT) is the model that has attributes of technology, user and environment [39]. These attributes are selective in adopting the technological innovations for the given system. However, organizational culture can influence the well functionality of the model.

Technology Acceptance Model (TAM) was designed for the first time in 1986 by Fred Davis [39]. This model passed through different modification until 2008. The selective aspect of versions of TAM is that they consider the external environment, users' perception and technology as well as organization culture. Because of this reason, this model is selected for this study.

The two frequently used versions of TAM are TAM 2 and Extending TAM 2 model [40]. Both of them consider technology, environment, organization and users' perception towards using technological tools and services. However, the degree of considering the above mentioned factors are different in both TAM models. Also the scope of the models are limited to adopt computer.
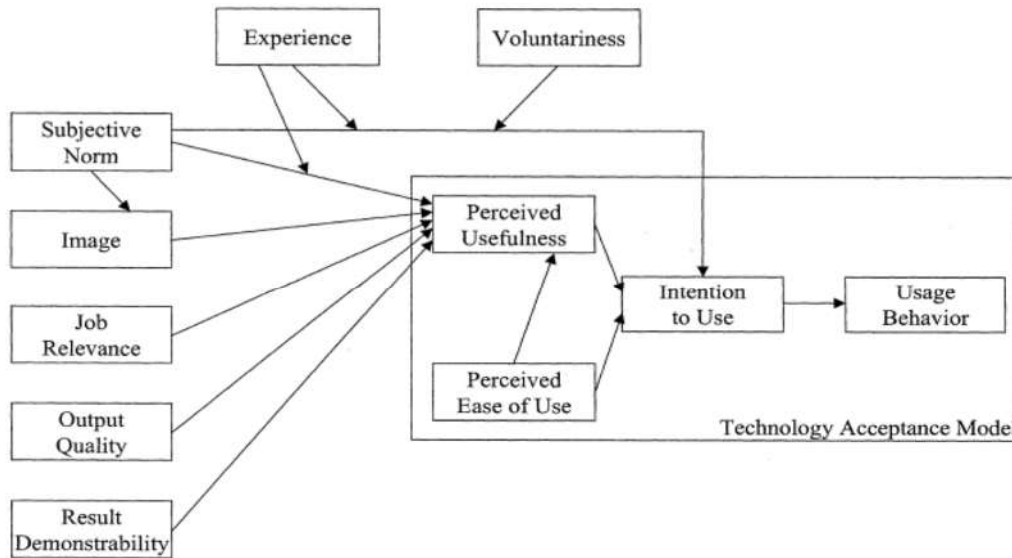
Figure 2.1. TAM 2 model adopted from Venkatesh [40]
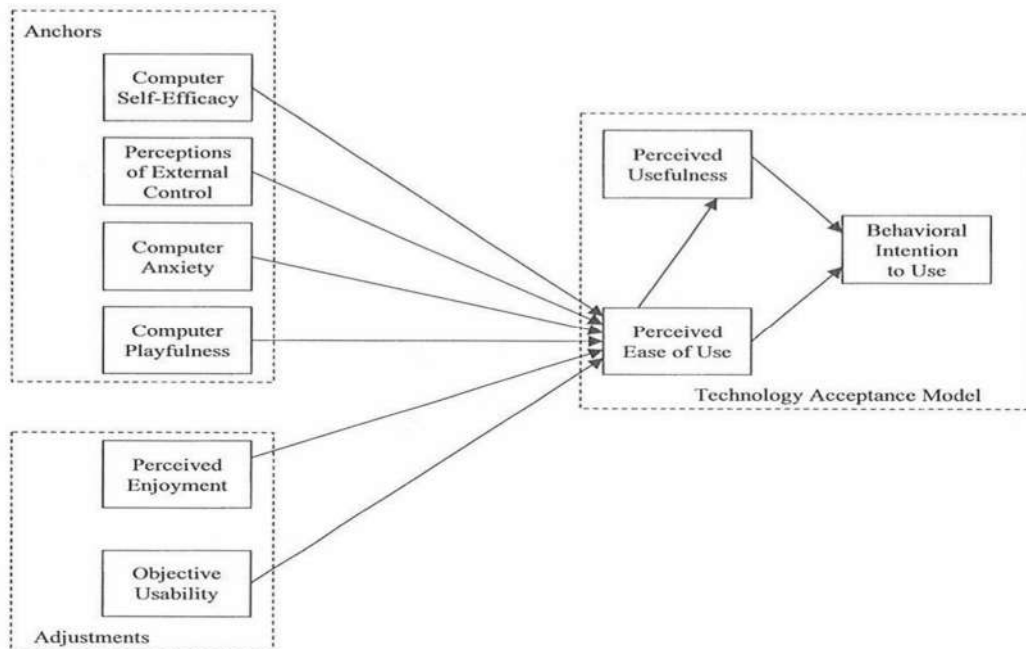
Figure 2.2. Extended TAM 2 model adopted from Venkatesh [40]

The first TAM 2 model has limitation of mixing the expected outcome from the system and final output of the system. Also it tries to form strong relationship between users' perception and the system to be adopted. However, in addition to this, there should be clear boundary that clearly show the contribution of environment and organizational culture towards adaptation of the right technological innovation.

The Extended TAM 2 model is better in having clear boundary for innovation, environment, organization and users' perception or attitude. And these attributes are mainly grouped under two classes; i.e. anchors and adjustments. Anchors are the general beliefs about computer and computer usage. Adjustments are the shaped attitude or perception of users, organization and environment because of the direct experience with the system or technological innovation [38].

2.2. Related works

In the education area, advancement of ICT is followed by digital divide [41] [23] [24]. Some groups who can access this technology can get benefit and groups who do not get chance to access the new innovation will be part of individuals who do not have sufficient knowledge to compute and to be good decision makers. "Information and Communication Technology (ICT) is changing every facet of our lives. It is changing the way we do business, the way we live and, more importantly, the way we learn. In this new Golden Age of technology, we see more and more an increasing rift between those who have access to ICT and those who do not. This digital divide can be seen as an educational divide and thus we examine how ICT is influencing education" [41].

Wu and other four researchers [34] studied the impact of digital divide between students with disabilities and other non-disabled students. They used a self-reported questionnaire to collect data about ICT access, ICT competency and scale of digital participation of students. As a result they found that there is no significance difference in accessing computer and internet both at home and at school. However, they found that there is a significance difference in ICT competency. And this reason can make non-disabled students more competent and informed than students with disabilities. Their study still has the gap of identifying the digital divide and its impacts between students with disabilities themselves. One of the aims of this study was to find good answer for the digital divide between students with visual and hearing problems themselves.

Zahid and other four researchers [15] currently studied about assistive technology. By using Technology Acceptance Model (TAM) they have tried to see the gap of previous different ICT interventions. According to these researchers, most of the technological products were not interactive for the user. And the user cannot find the expected benefit from those assistive technologies. In their finding, they have mentioned number of advantages and disadvantages of the assistive technology. As recommendation they indicated that there should be user based intervention before adopting or adapting technological products. The study still have the gap to show the status (effectiveness and efficiency) of the current assistive technology.

Pacheko and Yoong [9] currently studied about the role of digital technologies like social media and ICT in order to communicate, manage the information flow and learning. Their data sources were observation, a researcher diary, focus groups, interview and data from social media. As a result they discussed that ICT has impact on both technological products and students with disabilities. In addition to this, ICT has the enabling role. As recommendation they said that in order to bring quality of education, responsible bodies should link students with disabilities with progress of technology. However, this research has two main gaps; i.e. it focused only on students with visual impairment and it had the gap to show how social media and mobile devices can be useful in having culture of flexible learning.

Cerna [42] conducted a framework on mobile computing for students' engagement system in selected Ethiopian Higher Educational Institutions. According to the study, students within universities get administrative information like admission notices, timetables, events details, assessments and others in two ways. These are traditional paper means and universities' websites. However, the mechanisms are not effective in order to deliver information anywhere anytime. Because of this, the researcher designed a mobile frame work to help students to access the above mentioned information by using their mobile. The limitation of the study is that it has common characteristics for all students. However, students with visual and hearing problems are individuals that need affirmative action and the study would have included instructions that can assist them.

Chand [43] examined the challenges of ICT in inclusive education for students with visual problems. His study mainly focused on Assistive technologies and the students have multiple problems to use these technologies. The main challenges of students with visual problems in using Assistive technologies are accessibility and usability factors. According to his study, the main role player for the problems of accessibility and usability is the community around them. However, the study have limitation to consider the status and complexity of technology as well as rigid organizational culture of universities towards giving awareness for the students. Also the study is limited only to Assistive technologies and students with visual problems.

Maphie and Possi [44] studied on Challenges of Educating Students with Disabilities by applying inclusive education settings in Tanzania. Students with disabilities could not get the right information on time. The factors for this problem are academic, environmental, attitudinal and financial. According to their study, to apply the inclusion policy for students with disabilities, the above mentioned factors should get sufficient answer. However, their study still has limitation to consider ICT as one of the barriers that influence institutions not to implement the inclusion policy in order to give quality of education.

The study by Dr. Bala [45] on use of ICT in higher educational institutions indicate that the impact of ICT obligate every society of 21st century to be dependent on this technology. Also education is socially oriented activity. It has great role in building the society. However, most of the educational institutions use traditional teacher centered education practice. Because of this, students could not get the required skill. This has negative implication on quality of education. Currently, because of advancement of technology, educational institutions are shifted from teacher center to student center teaching learning process. As a result, majority of informed students are competent. But, his study has limitation in identifying the complexity of technology and the way this problem can be solved.

Generally, this research was aimed to investigate the limitations identified on previous studies. The issues were mainly impact of technology on students with visual and hearing problems as well as quality of education, status of assistive technologies and challenges of these students that hinder them not to access relevant information on the right time.

CHAPTER THREE

Methodologies

In this section, research design, study area, study population, sample size, data collection tools, data analyzing mechanisms and sources of data are discussed. For this study, cross sectional survey research method with mixed data collection strategies such as qualitative and quantitative mechanisms were applied.

3.1. Research design

The research design is a plan, strategy and structure that can help the researchers in order to find solutions for the research questions and problems [46]. For this study, the researcher used cross sectional survey. It was cross sectional because it was performed only once within short period of time. And it was survey because it was field work in which data were collected by using questionnaire, observation and interview.

The qualitative data was collected by using observation and interview and the quantitative data was collected by using questionnaire. This study is completed between January and June 2018. It used both descriptive way of statistical methods like measures of central tendencies to analyze the collected data and inferential method to see the relationships between variables. External validity was applied to have some summary or generalization from the sample to the population. The aim of having the external validity was just to develop a kind of generalization for all related population based on information and finding collected from respondents.

3.2. Study area

For this study three Ethiopian Higher Educational Institutions, i.e. Jimma, Hawasa and Addis Ababa Universities were considered. Since the study was focused only on students with visual and hearing problems and because of these students are mostly found in social science study areas, the researcher focused on institutions with well established (experienced) universities in teaching students with visual and hearing problems. Additionally, because of time and budget issues the population was limited to be taken only from three universities.

Addis Ababa University (AAU) is found in the capital city of Ethiopia, Addis Ababa. Jimma University (JU) is located at the southwest of Addis Ababa (located in Oromia region, Jimma zone) and Hawasa University (HU) is found in the capital city of Southern Nations Nationalities and Peoples region.

3.3. Study population

The study population were students with visual and hearing problems within Ethiopian higher education institutions (i.e. Addis Ababa, Hawasa & Jimma Universities). According to information obtained from official website of Addis Ababa University (AAU) and personal communication with students' council, there are about 400 (four hundred) students with disabilities within the university. Out of 400 (four hundred) students with disabilities, 357 (three hundred fifty seven) are undergraduate students and 43 (forty three) are post graduate students.

This study considered only undergraduate students with visual and hearing problems. From the total number of undergraduate students within the university which are 357 (three hundred fifty seven), 115 (one hundred fifteen) are visually impaired and 113 (one hundred thirteen) are students who could hear partially or totally deaf and the remaining 129 (one hundred twenty nine) are students who have physical and other impairments.

In this study, the students with hearing and visual problems were considered. Therefore, 228 (two hundred twenty eight) students with visual and hearing problems from Addis Ababa University were taken to be candidate for the study; i.e.115 (one hundred fifteen) students with visual problems and 113 (one hundred thirteen) students with hearing problems are considered.

Jimma University (JU) was another study area for this research. The university have 75 (seventy five) both undergraduate and postgraduate students with disabilities. These students are attending in different fields of specialization (Jimma University Students' Council, Personal Communication, February, 2018). Out of total number, 57 (fifty seven) are undergraduate students. From these undergraduate students, 31 (thirty one) of them are students with visual problems and 9 (nine) of them are students with hearing problems. The remaining 17 (seventeen) are students with physical and other related impairments. Therefore, the study included only students with visual and hearing problems. For this study, 40 (forty) students with disabilities; i.e. 31 (thirty one)

students with visual problems and 9 (nine) students with hearing problems were considered from Jimma University.

According to information collected from students' council of Hawasa university (HU) and disable association of this university, they have total of 137 (one hundred thirty seven) students with disabilities within the university. This number included both undergraduate and postgraduate students (Hawasa University students' council, personal communication, April 2018). From these students with disabilities, 135 (one hundred thirty five) are undergraduate students. Out of them 103 (one hundred three) are students with visual problems and 3 (three) are students with hearing problems. The remaining 29 (twenty nine) are students who have physical problems. Therefore, from HU, 106 students with visual and hearing problems are considered for the study; i.e. 103 students with visual problems and 3 students with hearing problems.

To get additional information about students with visual and hearing problems, assistants working in laboratories of students with disabilities and instructors who are teaching these students were considered in this study.

Table 3.1. Study Population

Universities	Undergraduate students with different problems			
	Visual	Hearing	Other disability problems	Total
Jimma	31	9	17	57
Addis Ababa	115	113	129	357
Hawasa	103	3	29	135
Total	**249**	**125**	175	549

From the three universities, the total study populations were 249 students with visual problems and 125 students with hearing problems. Additionally, one assistant and one instructor from each university were populations of the study.

3.4. Sampling

The process of selecting a sample from the sampling frame is sampling [47]. It is the process by which a relatively a number of individuals or events are selected and analyzed to find out something about the entire population from which it is selected.

For this study the researcher used both purposive and stratified random sampling techniques. Purposive sampling used for the populations with less numbers. To get sufficient information from respondents, the researcher used purposive sampling for the population with number less than 50. All students with visual and hearing problems from Jimma University, students with hearing problems from Hawasa University and assistants as well as instructors' of students with visual and hearing problems of each university were selected purposively.

For students with visual and hearing problems from Addis Ababa University and students with visual problems from Hawasa University, stratified random sampling was applied. Because their number was sufficient to calculate by using sampling technique. By classifying each population in strata, expected sampling was taken.

Stratified random sampling is the technique in which the population are classified into cluster based on their common characteristics and give them equal chance to be candidate of the sample size [48].

Populations which were taken purposively are, 31 students with visual problems from Jimma University, 9 students with hearing problems from Jimma University, 3 students with hearing problems from Hawasa University, one instructor teaching students with visual and/or hearing problems from each university (1 + 1 + 1 = 3) and one lab assistant from each university (1 + 1 + 1 = 3). The above students, instructors and assistants were considered in the study by using purposive sampling technique. Therefore, total number of population taken purposively was 49; i.e. (31 students with visual problems, 12 students with hearing problems, 3 instructors who teach students with visual or/and hearing problems and 3 assistants who work in the lab of students with disabilities).

For the stratified sampling technique, Kothari's formula was used [49].

$$n = \frac{z^2 * p * q * N}{E^2 * (N-1) + z^2 * p * q}$$

Where **N** is total number of population; **n** is required sample size; **z** is confidence level 95% (1.96); **E** is margin of error 5% (0.05); **q**=1-p and **p** is population proportion. So, the results of the variables were as follow:

Z= 95% = 1.96

E= 5% = 0.05

P= 0.5

Q= 0.5

P*q= 0.25

For this study, total population calculated in the above formula was 331. These were from both Addis Ababa University and Hawasa University. These populations were selected for this calculation, because of their sufficient number to be calculated with formula.

From both Addis Ababa and Hawasa Universities there were 331 total students with visual and hearing problems with population number more than 50; i.e. $115 + 113 + 103 = 331$ (115 students with visual problems from Addis Ababa University, 113 students with hearing problems from Addis Ababa University and 103 students with visual problem from Hawasa University respectively).

$$n = \frac{1.96^2 * 0.5 * 0.5 * 331}{0.05^2 * (331 - 1) + 1.96^2 * 0.5 * 0.5}$$

$$n = \frac{3.84 * 0.25 * 331}{0.0025 * 330 + 3.84 * 0.25}$$

$$n = \frac{317.76}{1.785}$$

$$n = 178$$

To adjust the final sample size there should be Finite Population Correction method (FPC) [49]. According to Kothari, the above number is considered as determined sample size. To get the final

sample size, FPC should be less than 5%. It is calculated by dividing the determined sample size to the total population.

$$c = \frac{n}{N}$$

$$c = \frac{178}{331}$$

$$c = 0.54$$

But, the value of **c** (0.54) is greater than 5%; i.e. n/N > 5%. So, the researcher used additional formula to adjust the FPC.

$$nf = \frac{n}{1 + c}$$

Where, nf is final sample size

$$nf = \frac{178}{1 + 0.54}$$

$$nf = \frac{178}{1.54}$$

$$nf = 116$$

So, the final sample size for the stratified sampling technique was 116. This number is distributed by giving strata for each students with visual and hearing problems who were included in this sampling technique. The stratum for the population is as follow:

$$nh = \frac{Nh * n}{N}$$

Where

Nh is the total population in stratum **h; h= 1, 2, 3, …**

N= total population size

And **n**= the final sample size

For determining the number of sample size for students with visual problems in Addis Ababa University:

$$nB\ AAU = \frac{NB * n}{N}$$

$$nB\ AAU = \frac{115 * 116}{331}$$

$$nB\ AAU = 40$$

Where

n = final simple size of the populations

nB AAU= final sample size of blind students in Addis Ababa University

NB=number of blind students

N=total number of students

Therefore, the final sample size for students with visual problems in Addis Ababa University was 40.

For determining the number of sample size for students with hearing problems in Addis Ababa University:

$$nD\ AAU = \frac{ND * n}{N}$$

$$nD\ AAU = \frac{113 * 116}{331}$$

$$nD\ AAU = 39$$

Where

n = final sample size of the populations

N= total number of populations

nD AAU= final sample size for deaf students in Addis Ababa University

ND= number of deaf students

This means, the final sample size for students with hearing problems in Addis Ababa University was 39.

For determining the number of sample size for students with visual problems in Hawasa University:

$$nB\ HU = \frac{NB * n}{N}$$

$$nB\ HU = \frac{103 * 116}{331}$$

$$nB\ HU = \frac{103 * 116}{331}$$

$$nB\ HU = 36$$

Where

nB HU= final sample size of blind students in Hawasa University

NB= number of blind students

n= final sample size of the populations

N= total number of populations

So, the final sample size for blind students (students with visual problems) in Hawasa University was 36.

Therefore, the researcher took the following final sample size for the study:

Table 3.2. Sample size

Population	Sample	University	Sampling technique
Students with visual problems (31)	31	Jimma	Purposive
Students with visual problems (115)	40	Addis Ababa	Stratified random sampling
Students with visual problems (103)	36	Hawasa	Stratified random sampling
Students with hearing problems (9)	9	Jimma	Purposive
Students with hearing problems (113)	39	Addis Ababa	Stratified random sampling
Students with hearing problems (3)	3	Hawasa	Purposive
Lab assistants	3	Jimma, Addis Ababa and Hawasa (one person from each university)	Purposive
Instructors who teach students with visual or/and hearing problems	3	Jimma, Addis Ababa and Hawasa (one person from each university)	Purposive
TOTAL	164		

3.5. Data collection instruments

Questionnaire, observation and interview were the techniques applied to collect data. The questionnaire was for all students who were mentioned in sample size (students with visual and hearing problems) and interview was for instructors who teach students with visual and/or hearing problems, lab assistants and 3 students with visual or hearing problems (one student from each university by using purposive sampling). Since it was difficult to find these students in one place snow ball technique was applied to collect data by using questionnaires and interview.

Questionnaire was distributed to know the impact of ICT on students with visual and hearing problems, information behavior of these students towards ICT, the digital divide between students with visual and hearing problems and the roles and efficiency of assistive technologies. For this purpose, 158 students with visual and hearing problems were respondents. Interview was focused on issues related to the status of assistive technology, challenges of students with visual and hearing problems, status and role of using mobile devices for educational purpose and the role of digital technologies for students with visual and hearing problems in order to enhance the quality of education. For this study, 9 interviewees were considered; i.e. 3 instructors who teach students with visual and hearing problems, 3 assistants within the laboratory of students with visual and hearing problems and the remaining 3 interviewees were students with visual and hearing problems. The observation was to identify the available resources and technologies for students with visual and hearing problems in order to bring quality of education.

3.6. Data sources

For this study, there were both primary and secondary types of information sources. The primary data were collected from respondents through interview, questionnaire and observation, and the secondary data were from different journals, books, articles and reliable websites.

3.7. Data analyzing mechanism

SPSS version 20 was applied for the data collected with questionnaire. Information which was gathered by interview and observation was analyzed independently. Data collected with questionnaire was analyzed and discussed by using descriptive and inferential statistical tools. Descriptive statistical tools were used to clearly discuss the results and also find the central tendency of the collected data. Inferential statistical tool was applied to see and identify the relationships of between variables. Finally, the results was shown by using tables, graphs and pie charts. Based on the final out put there is the conceptual framework that can indicate the gaps and solutions for the problems related to ICT and quality of education that are facing students with visual and hearing problems in Ethiopian higher educational institutions.

CHAPTER FOUR

Results and discussion

According to [47], result and discussion of the study should be presented in simple, detail and descriptive ways. Additionally, to bring good quality for that result, it should be also well organized and systematic. Kumar [50] also agree with this idea; the author indicated that the research finding should be presented in the form of well-defined text, tables and graphs. Therefore, the analysis of this study is presented in clear and simple way.

4.1. Response rate

Total of 158 questionnaires were distributed to students with visual and hearing problems in Addis Ababa, Jimma and Hawasa Universities. Out of these, 107 questionnaires were distributed to students with visual problems and 51 of them were for students with hearing problems. Among total number of distributed questionnaires, 153 were returned and 5 were not returned properly.

Table 4.1. Response rate

University	Population with	Distributed questionnaires	Returned questionnaires	Result achieved
AAU	Visual problems	40	39	97.5%
	Hearing problems	39	37	94.9%
JU	Visual problems	31	30	96.8%
	Hearing problems	9	9	100%
HU	Visual problems	36	35	97.2%
	Hearing problems	3	3	100%
Total		158	153	96.8%

AAU= Addis Ababa University JU= Jimma University   HU= Hawasa University

This response rate indicates that 96.8% of the questionnaires were returned successfully. Therefore, the researcher can proceed the study based on the adequate data gathered.

4.2. Demographic information

4.2.1. Gender, years and disability types

This section covered information about gender, age, university in which the respondents attend, field of specialization or department of respondents and type of disability the respondents have.

Table 3.2. Demographic information of respondents

No	Respondents' profile	Item		Number	Percentage
1	Gender	AAU	Male	47	61.8%
			Female	29	38.2%
			Total	76	100%
		HU	Male	26	68.4%
			Female	12	31.6%
			Total	38	100%
		JU	Male	29	74.6%
			Female	10	25.6%
			Total	39	100%
	Total	Male		102	66.7%
		Female		51	33.3%
2	Age in years	18-25		92	60.1%
		26-30		53	34.6%
		31-35		8	5.2%
3	University they attend	AAU		76	49.7%
		HU		38	24.8%
		JU		39	25.5%
4	Years within university	1st year		79	51.6%
		2nd year		48	31.4%
		3rd year		20	13.1%
		4th year		5	3.3%

		5th year	1	0.7%
5	Disability status	Low vision problem	43	28.1%
		Totally blind	61	39.9%
		Low hearing problem	24	15.7%
		Totally deaf	25	16.3%

The first section of the above table 4.2 Shows gender of respondents. The exact number of gender status is calculated for each university independently. From Addis Ababa University, the total number of respondents were 76. Out of this number 47 (61.8%) of them were Males and 29 (38.2%) were Females. From Hawasa University, there were total number of 38 respondents. Out of this number, 26 (68.4%) of them were Males and 12 (31.6%) were Females. And from Jimma University, there were total number of 39 respondents. From this number, 29 (74.4%) of them were Males and 10 (25.6%) were Females. This result shows that the majority of the respondents were males for all universities mentioned above.

Totally, there were 153 respondents for this study. Out of the total respondents, males are 102 (66.7%) and 51 (33.3 %) are females. This indicates that more male students with visual and hearing problems are giving response than female students. This might be because of two reasons: the first one is that universities might have less number of Female students with disabilities and the second one is that it might be because of the participation of Female students is less. According to [5], Females' participation can be hindered because of two main reasons; discrimination from gender side and being disabled person in addition to gender influence. The researcher tried to observe both Male and Female students with disabilities in the three universities; i.e. Addis Ababa, Hawasa and Jimma Universities. It is true that the number of Female students with disabilities in these universities are less compared to Male students with disabilities. In addition to their number, these Female students were not active to participate in giving response for the study. To minimize such kinds of problem, the researcher used snow ball data collection mechanism.

According to the above table 4.2 of gender status, the number of respondents from Addis Ababa University is large compared to that of Hawasa and Jimma Universities. Out of 153 (100%) respondents, 76 (49.7%) of them were from Addis Ababa University. Jimma University's

respondents were 39 (25.5%) and 38 (24.8%) of them were from Hawasa University. The problems is not from lack of attention to use proper sample size, instead it is because of the Addis Ababa university has the capacity to teach more number of students with disabilities compared to both Jimma and Hawasa Universities. For instance, all students with visual and hearing problems from Jimma University were considered as sample size. Also all students with hearing problems from Hawasa University were considered as sample size purposively. However, to determine the sample size for students with visual problems from both Addis Ababa and Hawasa Universities, as well as for students with hearing problems from Addis Ababa University, the researcher used stratified random sampling technique.

The second section of table 4.2 above shows age of respondents. For this study purpose, the researcher clustered ages of respondents into four categories; i.e. 18-25 years, 26-30 years; 31-35 years and above 35 years. Based on the result obtained from the study, 92 (60.1%) of them are found between 18 and 25 years. Also 53 (34.6%) of them are between 26 and 30 years. The rest of the respondents 8 (5.2%) of them could not graduate from universities early, but their age is about 35 years. This result indicates that there are about 61 (39.8%) of respondents who are above 26 years old. The maximum age is about 35 years. Still they did not complete their tertiary school education. But why? The researcher thought that this might be because of several factors; i.e. economic status, discrimination from society, lack of personal assistance and lack of skill or awareness to use assistive technologies properly and others.

According to the table 4.2 above, 79 (51.6%) of respondents are first year students with disabilities. This number clearly shows that about half of the respondents are first year students. Second year students are 48 in number; it is 31.4%. There is also 1 individual who attended his/her fifth year education.

Majority of the **respondents** and **the number of students with disabilities** in each university have visual problems. According to the result of this study 104 (68%) of them are students with visual problems. And only 49 (32%) of the respondents have hearing problems. Out of students with visual problems, 43 of them are students with low visual problem. This covered about 28.1%. Also there are students who are totally blind; they are 61 in number and about 39.9% of the total respondents in this study.

Another groups who are considered in this study are students with hearing problems. They also have two main status; low hearing problem and totally deaf. Out of 49 total number of students with hearing problems, 24 and 25 of them are students with low hearing problem and students who are totally deaf respectively.

4.2.2. Field of study
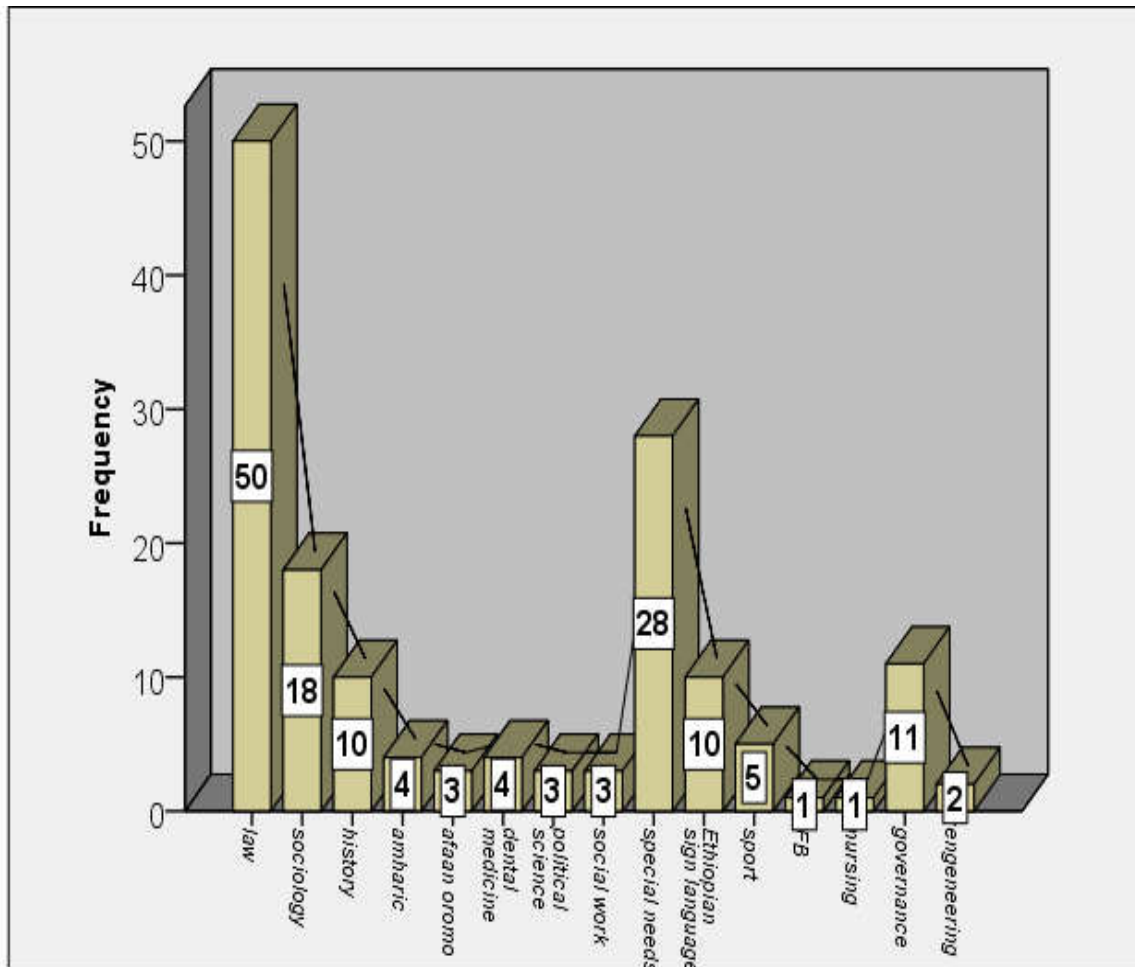
Figure 4.1. Fields of study

According to the result obtained from the study, students with visual and hearing problems are attending several fields of specialization in each university. The most commonly mentioned departments are law, special needs, sociology, Ethiopian sign language and deaf culture, governance and others.

The above figure 4.1 indicates that students with visual and hearing problems are learning in different fields of specialization. Majority of them were attending their education in department of law 50 (32.7%) and special needs 28 (18.3%). Sociology 18 (11.8%), governance 11 (7.2%), history 10 (6.5%) and Ethiopian sign language and deaf culture 10 (6.5%) are with medium number. Also departments like Faculty of Business (FB), nursing, engineering, Afaan Oromo language, political science, social works, Amharic language, dental medicine and sport science are with less number of students with visual or/and hearing problems. According to result obtained, more than 140 respondents are attending departments related to social sciences.

4.2.3. Disability status and field choice

According to [51], correlation is the technique which supports to indicate the relationship between two variables. Their range is between -1 and 1. If it is 1 and -1, it indicates there is perfect positive and negative relationship between variables respectively. This numbers indicate about the Pearson's correlation coefficient (r). 0 indicates that there is no clear relationship between variables. If the value is $\leq$ -1, one variable increases while another decrease. If it is $\geq$ 1, both variables increase in the same direction. However, relationship may not mean causality!

Another important thing that should be considered is the value of p. The value of p in Pearson's correlation technique indicates whether the value of r is significant or not. If the value of p (number under Pearson's correlation coefficient) is less than or equal to 0.01, it is possible to conclude the relationship between the two given variables is significant. But, if the value of p is greater than 0.01, it is not good to conclude the relationship between the two given variables is significant [40].

Based on the result from table 4.3 below, disability status and field choice of students with visual and hearing problems have moderate relationship (r=0.404 and p<0.01). The value of p indicates that the relationship between the variables (disability status and field selection) is significant. Also 0.404 (the value of r) indicates that the above mentioned variables have moderate relationship. On the other hand, students with visual and hearing problems who are currently attending in higher educational institutions of Ethiopia are limited to specific fields of specialization based on the problems they have.

Table 4.3. Relationship between disability status and field selection

Parameters		Fields of specialization (departments)	Disability status
Fields of specialization (departments)	Pearson Correlation	1	.404[**]
	Sig. (2-tailed)		.000
	N	153	153
Disability status	Pearson Correlation	.404[**]	1
	Sig. (2-tailed)	.000	
	N	153	153

**. Correlation is significant at the 0.01 level (2-tailed)

This description will be clearly stated based on the information which is given below in table 6.

Table 4.4. Field selection of respondents

Departments	Respondents			
Amharic language	Disability type	Number	% from related disability type	% from total population
	Low vision	3	2.90%	1.96%
	Totally blind	1	0.96%	0.65%
Afaan Oromo	Totally blind	3	2.84%	1.96%
Dental medicine	Low hearing	3	6.12%	1.96%
	Totally deaf	1	2.04%	0.65%
Engineering	Low hearing	1	2.04%	0.65%
	Totally deaf	1	2.04%	0.65%
Ethiopian sign language and deaf culture	Low hearing	7	14.29%	4.58%
	Totally deaf	4	8.16%	2.61%
FB	Low hearing	1	2.04%	0.65%
Governance	Low vision	4	3.85%	2.61%
	Totally blind	4	3.85%	2.61%
	Low hearing	2	4.08%	1.31%

	Totally deaf	1	2.04%	0.65%
History	Low vision	5	4.81%	3.27%
	Totally deaf	4	8.16%	2.61%
	Low hearing	1	2.04%	0.65%
Law	Low vision	18	17.31%	11.77%
	Totally blind	31	29.81%	20.26%
	Totally deaf	1	2.04%	0.65%
Nursing	Totally deaf	1	2.04%	0.65%
Political science	Low vision	1	0.96%	0.65%
	Totally blind	2	1.92%	1.31%
Social works	Low vision	1	0.96%	0.65%
	Totally blind	2	1.92%	1.31%
Sociology	Low vision	6	5.77%	3.92%
	Totally blind	8	7.69%	5.23%
	Low hearing	3	6.12%	1.96%
	Totally deaf	1	2.04%	0.65%
Special needs	Low vision	5	4.81%	3.27%
	Totally blind	10	9.62%	6.56%
	Low hearing	6	12.24%	3.92%
	Totally deaf	7	14.29%	4.58%
Sport science	Low hearing	1	2.04%	0.65%
	Totally deaf	1	2.04%	0.65%
Total		153		100%

Based on table 4.4 above, field selection of students with disabilities are limited. For instance, the law department is assigned almost only for students with visual problems (both low vision problem and totally blind). Ethiopian sign language and deaf culture and sport science are assigned only for students with hearing problems (both low hearing problem and totally deaf). Students with visual problems are mostly related with fields of specialization like law (49 students), special needs (15 students) and sociology (14 students). Students with hearing problems are related with fields like special needs (13 students) and Ethiopian sign language and deaf culture (11 students). Except on

governance, history, sociology and special needs, students with visual and hearing problems had no similarity in their field selection.

4.3. ICT experiences of respondents

Table 4.5. Computer, internet and assistive technological experiences of respondents

Parameters	Options				
	none	1 year	2 years	3 years	> 3 years
Experience of using computer	81 (52.9%)	3 (2.0%)	21 (13.7%)	21 (13.7%)	27 (17.6%)
Experience of using internet	89 (58.2%)	7 (4.6%)	22 (14.4%)	13 (8.5%)	22 14.4%
Experience of using assistive technologies	35 (22.9%)	6 (3.9%)	25 (16.3%)	23 (15.0%)	64 (41.8%)

Table 4.5 above indicates that more than half of students with visual and hearing problems (81 or 52.9% of them) have no computer experience. 27 (17.6%) of the respondents have experience of using computer for more than 3 years. The rest of the students with visual and hearing problems have at least one year of using computer. Therefore, without having better understanding how to use computer, it is difficult for students with visual and hearing problems to be effective in order to access information from computer. Today computer is the most common enabler and assistive technology that majority the learners use it commonly to access information and share resources [2].

More than half of the respondents (89 or 58.2% of them) have no experience of using internet. It is clear that such kind of limitation in the age of information era can hinder or limit the way this respondents get current and updated information. This problem has negative impact on this students not to actively participate in teaching and learning process and become competent with others. And about 42% of the respondents had at least one year of experience of using internet.

Majority of the students with visual and hearing problems have experience of using assistive technologies for their daily life situation or/and for their educational purposes. About 118 (77.1%)

of them have at least one year experience of using assistive technologies. But, still there are students with visual and hearing problems who could not use these technologies. They are 35 in number and covers 22.9% of the total respondents. If these respondents have a problem of disability and no skill to use the assistive technologies, it is difficult to think quality of education for them. Because, one criteria of quality of education is helping the learners to get the right information at the right time with minimum effort.

4.4. Technology and information seeking behavior of respondents

According to [52], Information seeking behavior is the set of actions which can be performed by individuals and used to identify their information need, seek information based on their interest, evaluate the sources and select the right information and information sources. This section discusses about information seeking behavior of students with visual and hearing problems by relating the technology they have selected with information need they intended to achieve.

4.4.1. Internet and information seeking behavior

Table 4.6. Internet usage of respondents

No	Questions	Options	Number of respondent	Percent
1	Do you use internet?	Yes, I do	62	40.5%
		No, I don't	91	59.5%
2	How often do you use internet?	Several times a day	41	26.8%
		About once a day	12	7.8%
		3-5 days a week	6	3.9%
		1-2 days a week	3	2.0%
		Never	91	59.5%
3	If you use internet, what are the main reason to use it?	Education/ study	26	17.0%
		Entertainment	20	13.1%
		Personal/ private	16	10.5%
4	If you use internet, for what purpose you use it mostly?	Chat	18	11.8%
		Copy learning materials	13	8.5%
		Play game	2	1.3%
		Search for the information	28	18.3%
		Downloading music and videos	1	0.7%

Table 4.6 above shows that 60% of the students with visual and hearing problems do not use internet at all. This indicates that the students have difficulty to get current and updated information for their educational purposes. On the other hand, these students can be dependent only on the resources delivered by instructors or/and libraries. This might not be enough especially to be competent and to share latest information with information society.

In the table 4.6 above, 41 of the respondents (26.8%), are using internet several times a day. Individuals who are using internet about once a day are 12 (7.8%). Still there are groups who need training to access internet. They are in the tertiary school and have visual or hearing problems; as well as they never had culture or skill of using internet. These students are 91 in number and covered 59.5% of the total respondents in the study.

Students with visual and hearing problems use internet for three main reasons; i.e. educational/study, entertainment and personal/private. 26 (17.0%) of them are using internet for educational purpose. 20 (13.1%) of the students are using internet to refresh their mind and 16 (10.5%) of the students with visual and hearing problems use internet for personal reasons.

Students with visual and hearing problems have different purposes to use internet mostly. Some of them used for chat 18 (11.8%); some of them for copying material from internet 13 (8.5); others use it to play a game 2 (1.3%). Additionally, these students use internet for searching information 28 (18.3%). Majority of them are using internet mostly for searching information and communicating with others.

4.4.2. Assistive technology and information behavior

Table 4.7. Assistive technological usage of respondents

No	Questions	Options	Number of respondent	Percent
1	Do you use Assistive technology?	Yes, I do	121	79.1%
		No, I don't	32	20.9%
2	How often do you use Assistive technology?	Several times a day	83	54.2%
		About once a day	20	13.1%
		3-5 days a week	15	9.8%
		1-2 days a week	3	2.0%
		Never	32	20.9%
3	Why you use Assistive technology?	Education/ study	104	68.0%
		Personal/ private	17	11.1%
4		Voice recorder	9	5.9%

		Tape	13	8.5%
	What type of Assistive technology do you use?	Screen reader/ Jaws	22	14.4%
		Braille system	14	9.2%
		Personal FM system	14	9.2%
		Eye glasses	12	7.8%
		Talking book player	7	4.6%
		Magnifier	2	1.3%
		Computer	3	2.0%
		Hearing aid	12	7.8%
		Speech recognizer	3	2.0%
		Dragon detector	2	1.3%
		Telecommunication device for the deaf	2	1.3%
		Real time text	4	2.6%
		Math talk	1	0.7%
		Headphone	1	0.7%
5	Why you choose Assistive technology?	To record lectures in the class	9	5.9%
		To convert text into audio	21	13.7%
		To access information	13	8.5%
		To read and write	13	8.5%
		To hear properly	24	15.7%
		To learn from recorded materials	13	8.5%
		To see properly	12	7.8%
		To read books/PDF without seeing them	5	3.3%
		To convert audio and video into text	6	3.9%
		To see text clearly	2	1.3%
		To communicate with others through technology	2	1.3%
		To do some calculations	1	0.7%

Based on the result from the above table 4.7, 121 (79.1%) of respondents are using Assistive technologies. And 32 (20.9%) of them are not using Assistive technology for their day to day life experiences. More than half of the students with visual and hearing problems 83 (54.2%) are using these technologies several times a day. 20 (13.1%) of them are using the Assistive technology at least once a day. But, there are groups (32 or 20.9% of the respondents) who cannot use Assistive

technologies. This is another challenge which has ability to hinder the students with visual and hearing problems not to effectively access relevant information and react with their environment as it is expected. This in turn has negative impact on the quality of education.

Students with visual and hearing problems are using the Assistive technologies for two main reasons. These are educational 104 (68.0%) and personal/private 17 (11.1%) reasons. Also these students are using different Assistive technologies like voice recorder, tape, screen reader/Jaws, braille system, personal Frequency Modulation (FM) system, eye glasses, talking book player, magnifier, computer, hearing aid and others. But, technologies like screen reader/Jaws, braille system, personal Frequency Modulation system, tape, eye glasses and hearing aid are used by majority of the respondents. Also technologies like math talk and headphone are used by few number of respondents.

Based on the above table 4.7, students with visual and hearing problems are using different assistive technologies. However, almost all students who are using this technologies have their own specific choice. The reasons are to hear properly 24 (15.7%), to convert text into audio 21 (13.7%), to access information 13 (8.5%), to read and write 13 (8.5%), to learn from recorded materials 13 (8.5%), to see properly 12 (7.8%), to record lectures in the class 9 (5.9%) and others.

4.4.3. Usage of internet by students with visual and hearing problems

Students with visual and hearing problems are one part of Ethiopian higher educational institutions' community. Success or failure of these institutions can be measured by considering all communities within it. Contributions of all society within the universities bring a progress for the universities and societies around them. Respondents of this study are also one of the contributors. To contribute something for their universities and communities around them, they have to do their projects, assignments and different group works by using different information sources. Today, in the digital era, internet is chief source of updated, current and relevant information.

Table 4.8. Usage of internet by respondents

No	Questions	Options	Number	Percent
1	Do you use internet when you do your project, assignments and/or group works?	Yes, I do	58	37.9%
		No, I don't	95	62.1%
2	If you use internet for your assignments, how often do you use it?	Sometimes	26	17.0%
		Usually	24	15.7%
		Always	8	5.2%

From total of respondents, only 58 (37.9%) of them have experience of using internet for assignments, projects and different group works. However, still majority of students with visual and hearing problems (95 / 62.1%) have limitation to use internet. This by itself has negative impact for good environment of teaching learning processes. In other words, if students with visual and hearing problems have no or limitation of experience of using internet, it is difficult to imagine accessing of updated and relevant information at the right time.

These individuals (95 of respondents) never used internet for their different assignments. They might use other documents like books or use personal assistants to get information. However, this is not enough for higher educational institutions' student. In order to be competent and achieve their goal properly, they have to be member of information society (the societies who consume different updated and current information for their information need). To be part of the society who consume updated and relevant information, using internet becomes mandatory for students with visual and hearing problems.

Table 4.8 above shows that 26 (17%) of the students with visual and hearing problems are using internet sometimes; 24 (15.6%) of them are using usually and only 8 (5.2%) of the respondents are using internet always for their assignments, projects and group works.

4.4.4. Usage of Assistive technologies for students with visual and hearing problems

Table 4.9. Usage of Assistive technology by respondents

No	Questions	Options	Number	Percent
1	Do you use Assistive technologies when you do your project, assignments and/or group works?	Yes, I do	116	75.8%
		No, I don't	37	24.2%
2	If you use Assistive technologies for your assignments, how often do you use it?	Sometimes	13	8.5%
		Usually	30	19.6%
		Always	73	47.7%

Table 4.9 above indicates that about 116 (76%) of the respondents are using Assistive technologies to do their assignments. Still there are 37 (24.2%) students who are not using these technologies for their projects or assignments. This is another challenge facing students with visual and hearing problems not to effectively participate in their education. However, the culture of using Assistive technologies is more compared with that of internet; i.e. based on the result from table 4.8 and 4.9 above, 58 (37.9%) of the respondents have experience of using internet and 116 (76%) of the total respondents have experience of using Assistive technologies.

In table 4.9 above, 73 (47.7%) of the respondents are using Assistive technologies for different assignments always. And 13 (8.5%) of them are using these technologies sometimes for the same purpose.

4.4.5. Usage of offline resources for students with visual and hearing problems

Table 4.10. Usage of offline resources by respondents

No	Questions	Options	Number	Percent
1	Do you use any offline resource for your information need?	Yes, I do	152	99.3%
		No, I don't	1	0.7%
2	If you use Assistive technologies for your assignments, how often do you use it?	Sometimes	4	2.6%
		Usually	67	43.8%
		Always	81	52.9%

Students with visual and hearing problems have motivation to use offline resources in addition to online resources. They are using these resources by using Assistive technologies or without using

them (sometimes they use personal assistants). Based on the table 4.10 above, almost all of the students with visual and hearing problems are using offline resources for their information needs. In the table 12 below, 4 (2.6%) of respondents are using offline resources sometimes, and also the rest of students 67 (43.8%) and 81 (52.9%) are using offline resources usually and always respectively.

4.4.6. Appropriate information sources for students with visual and hearing problems
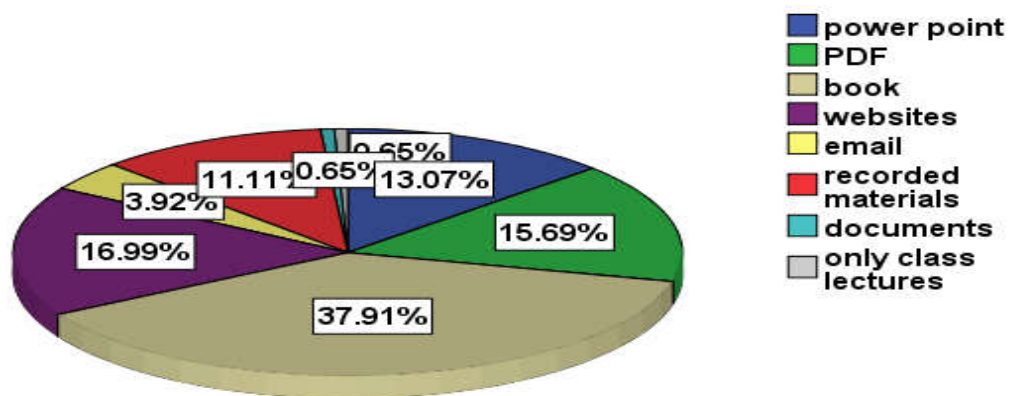
Figure 3.2. Main information sources of respondents

Students with visual and hearing problems can use different information sources to satisfy their information needs. Some of the sources like Power points, Portable Document Format (PDF), books, websites, email, recorded materials, documents and class lectures are selective information sources for the above mentioned students. About 38% (58) of the students use only books as their best information source. Websites, PDFs, power points and recorded materials are used by 17.0% (26), 15.7% (24), 13.1% (20) and 11.1% (17) of students with visual and hearing problems respectively. However, email, documents and class lectures are used by small number (about 8) students. This covered about 5% of total respondents in the study.

4.5. Availability of Assistive technologies

This section discusses about the availability of Assistive technologies in Ethiopian Higher educational institutions. Also the researcher tried to indicate status of usage of these Assistive technologies by students with visual and hearing problems including the challenges they are facing to use these technologies.

4.5.1. Services of Assistive technologies and challenges of respondents
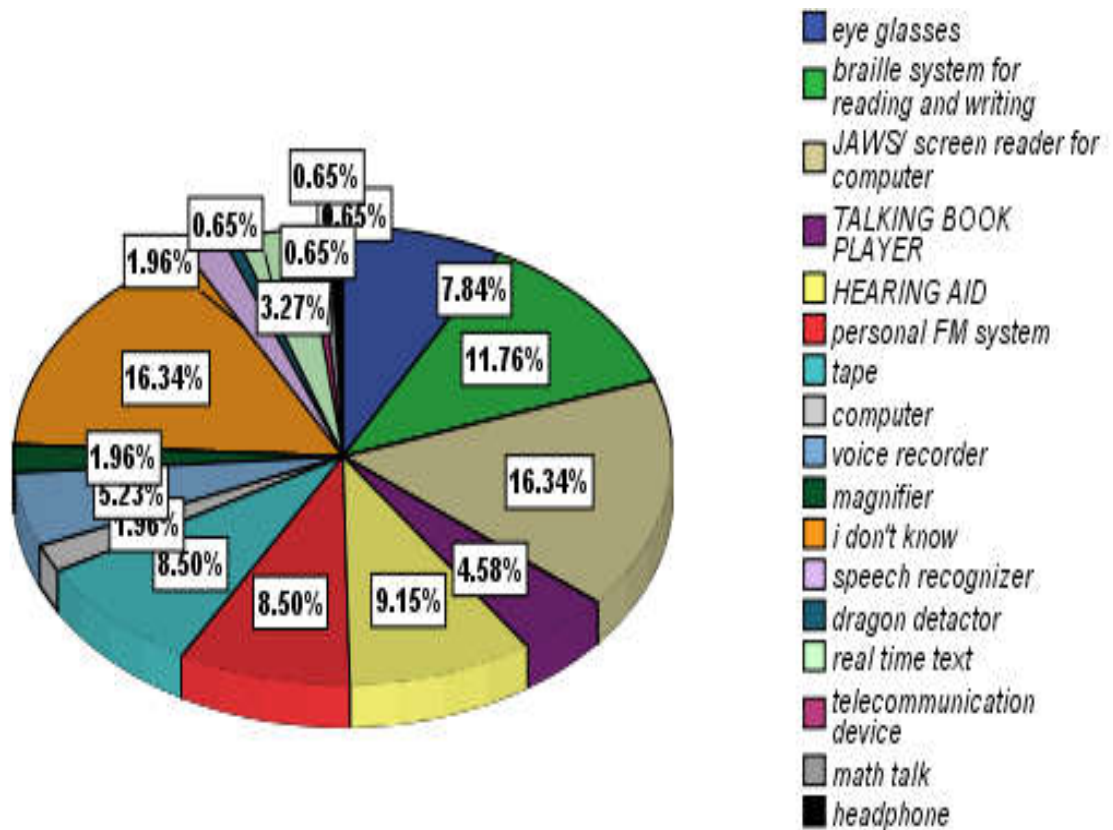
Figure 4.3. Available Assistive technologies in the universities

According to figure 4.3 above, 16.34% of respondents agreed that there is service of Assistive technology which is called Jaws (one of screen readers for visually impaired students). Parallel to this, again 16.34% of respondents do not know whether their university has assistive technology or not. Mainly the assistive technologies available in Ethiopian higher educational institutions are braille system, hearing aid, personal Frequency Modulation system, recording tapes and eye glasses.

Assistive technologies like headphone, math talk, telecommunication device, real time text, dragon detector and speech recognizer are owned privately by some students with visual and hearing problems. Each universities have limitation to fulfill the required Assistive technologies in both number and kind.

Table 4.11. Assistive technological services and challenges of respondents

No	Questions	Options	Number	Percent
1	Where do you get services of Assistive technologies?	Laboratory	50	32.7%
		Library	21	13.7%
		Private/personal	48	31.4%
		Never get the service	33	21.6%
		Dormitory	1	0.7%
2	How often do you get the above services?	Always	56	36.6%
		Sometimes	5	3.3%
		Usually	59	38.6%
		Never	33	21.6%
3	Do you think the available Assistive technologies are sufficient for your education?	yes	14	9.2%
		No	126	82.4%
		I don't know	13	8.5%
3a	If your answer for the above question is No, do you think the problems is about number of Assistive technologies?	Yes	123	80.4%
		No	3	2.0%
3b	If your answer for the above question is No, do you think the problem is about type of Assistive technologies?	Yes	95	62.1%
		No	31	20.3%
4	Can you access the available technology without challenge?	Yes	23	15.0%
		No	130	85.0%
4a	If your answer for the above question is Yes, what are the reasons?	Lack of awareness or know how	53	34.6%
		Lack of skill or experience	42	27.5%
		Complexity of technology	24	15.7%
		Lack of training	1	0.7%
		Lack of sight	6	3.9%
		No sufficient materials	4	2.6%

Based on the result from table 4.11 above, students with visual and hearing problems get services of assistive technologies from laboratories 50 (32.7%), libraries 21 (13.7%), dormitory 1 (0.7%) and there are also individuals who are using their own Assistive technologies 48 (31.4%). The rest

of them are never get services of the above mentioned technology 33 (21.6%). Majority of the students who do not use services of Assistive technologies do not have skill or awareness of using the available technologies. According to result obtained from interview with some assistants, these students are using personal assistants instead of Assistive technologies.

About one third of the respondents get services of Assistive technologies from laboratories. Within the laboratories of students with visual and hearing problems there are computers, magnifiers and some application software like screen readers. Students with visual problems get services of braille system from libraries 21 (13.7%). Braille system is the technology which can help the students with visual problems to read and write.

There are some respondents who are using their own Assistive technologies; i.e. 48 (31.4%) of the respondents are using their own Assistive technology. These are because of two main reasons; i.e. lack of sufficient Assistive technologies in the universities and total dependency of some respondents on this technological products.

Still there are 33 (21.6) respondents who do not use services of Assistive technologies. This number covered about one fifth of the studied population. In order to increase the effectiveness of these students there should be consideration from university side to create awareness of using the above technology.

About 115 (75.2%) of the respondents are using the Assistive technologies most of the time and 5 (3.3%) of them are using it sometimes.

The respondents agreed that the available Assistive technology within the universities are not sufficient. 126 (82.4%) of the respondents agreed that the available Assistive technologies are not sufficient for effective teaching learning process. This is happened because of the number and types of Assistive technologies. Majority of the students with visual and hearing problems believe that the two above mentioned problems are currently the challenges in the universities. 123 (80.4%) of the students agreed that there is the problem of getting sufficient number of Assistive technologies for their educational purpose and to access information like students with no disability status. Again 95 (62.1%) of the respondents responded that there are lack of different types of Assistive technologies. This hindered them not to fully participate in their education and get relevant information for their daily life experiences. This is another key challenge which can

bring questions on the quality of education for university students who have problems of vision and hearing difficulties.

The other result from table 4.11 above is the challenge of students with visual and hearing problems to use the current available technology without any problem. 130 (85%) of the respondents have a gap to use the available technology without challenge. This is because of several factors; i.e. lack of awareness or know how 53 (34.6%), lack of skill or experience 42 (27.5%), complexity of technology 24 (15.7%), lack of sight or vision 6 (3.9%) and others. This shows that there are gaps from university (not properly giving training for these students), from lab assistants (limitation of giving awareness for the students how to use Assistive technologies) and from the students side (lack of motivation).

4.5.2. Internet services and challenges

Table 4.12. Internet services and challenges

No	Questions	Options	Number	Percent
1	Where do you get services of internet?	Laboratory	47	30.7%
		Library	2	1.3%
		WIFI	15	9.8%
		Never get the service	88	57.5%
		Dormitory	1	0.7%
2	How often do you get the above services?	Always	19	12.4%
		Sometimes	4	2.6%
		Usually	42	27.5%
		Never	88	57.5%
3	Can you get 24 hours services of Assistive technology or/and internet?	yes	73	47.7%
		No	80	52.3%
4	It there any kinds of restriction that is proposed by university for services of Assistive technologies or/and internet?	Yes	45	29.4%
		No	61	39.9%
		I don't know	47	30.7%

Table 4.12 above shows that students with visual and hearing problems are getting services of internet at different places. 47 (30.7%) of them are getting from laboratory; 15 (9.8%) of them from WIFI; and 2 (1.3%) also 1 (0.7%) of them are getting the services of internet from library

and dormitory respectively. But, still about 58 % (88) of the students with visual and hearing problems cannot get internet services somewhere.

About 12% (19) of respondents are using internet always. And 42 (27.5%) of them are getting the above mentioned services usually.

More than half of the respondents cannot get internet services for 24 hours a day. They have indicated that there is restriction from universities that limit them not to use the services of both Assistive technologies and internet the whole day. There is time limitation to use laboratory materials including internet service. The leading factors are unequal distribution of Assistive technologies; limitation of number of computers to give services for all students with visual and hearing problems at the same time; and lack of sufficient and qualified assistants within each universities laboratories.

4.6. Roles of internet and Assistive technologies and digital divide between respondents

Table 4.13. Roles of digital technologies and digital divide of respondents

No	Parameters	Level of satisfaction				
		SA	A	N	D	SD
1	I can access reference materials by using assistive technologies	7	112	5	26	3
2	I can access reference materials by using internet	5	70	5	64	9
3	To use the available technologies training is given for us	2	46	20	71	14
4	Assistants are qualified to help us	2	42	36	62	11
5	The university maintain, update and repair its Assistive technologies on the right time	1	38	38	66	10
6	There is a difference of treating between students with visual and hearing problems in the laboratory and/or library	10	63	60	19	1
7	There is a difference of treating between students with visual problems in the laboratory and/or library	4	35	92	21	1
8	There is a difference of treating between students with hearing problems in the laboratory and/or library	10	46	73	23	1

The above table 4.13 shows that the role of digital technologies and the digital divide of respondents. Its contents are with three main areas; i.e. effectiveness of the respondents to use assistive technologies and internet; the role of universities in order to enhance the effectiveness of the technologies and digital divide between respondents.

Respondents use both Assistive technologies and internet to get relevant information for their information need. Majority of them (119 respondents) are dependent on Assistive technologies. Respondents who use internet are about 75. This result clearly shows that majority of the students with visual and hearing problems have experience of using Assistive technologies.

To check the role of universities in order to enhance the effectiveness of students with visual and hearing problems and the status of digital technologies, three issues are considered in this study. The first issue is to check whether training is given for the respondents or not. 85 respondents do not agree on the role of universities to give them training in order to understand the available Assistive technologies and internet. About 48 respondents are agreed that there is proper training for the awareness creation purpose. 20 of them are neutral to give response. Generally, the result shows there is a problem of giving training for students with visual and hearing problems in order to help them use Assistive technologies and internet properly.

The second issue is about the qualification of assistants within the laboratories of respondents. Even though about 44 of the respondents agreed on the qualification of assistants, 73 of them said that assistants within the laboratories are not qualified and 36 of them are neutral to give the expected answer. But, still the result clearly shows that there is a problem of qualification on the side of assistants to help students with visual and hearing problems within the laboratories.

Thirdly, it is aimed to check the role of universities to repair and update the available Assistive technologies and internet services on time. 76 respondents said that universities do not repair and update the available digital technological services and 39 of them agreed there is good participation from university to maintain and repair technological devices and services on time. Again there is clear indication that there is limitation from universities to keep effectiveness of the digital technological products and services on time in order to help students with visual and hearing problems.

Table 4.13 above also has information about the digital divide which is currently observed between students with visual and hearing problems. There are differences in treating the above mentioned students when they are using libraries and laboratories. About 73 respondents agreed that there is discrimination in treating students with visual and hearing problems. Only 20 respondents agreed there is fair treatment of both students with visual and hearing problems within libraries and laboratories. This clearly shows that there is a gap in universities of Ethiopia to deliver important information for both students with visual and hearing problems equally.

There is also the digital divide between students with visual problems themselves. 39 respondents agreed with this idea and about 22 of them said that there is no digital divide between students with visual problems. Another problem which is directly related with digital divide is the difference of treating students with hearing problems. In another words, between students with hearing problem themselves, there is a gap of getting relevant information at the same level. Some of them can get it easily and within short period of time and the rest of them discriminated not to effectively access information by using different technological products. About 56 respondents agreed that there is digital divide between students with hearing problems and 24 of them disagreed with this idea.

Another important issue that should be considered in this study is the transparency and actively participation of respondents. Especially in identifying the digital divide of respondents, the response of majority of the students with visual and hearing problems were inclined to the degree of *neutral*. For the three types of digital divide mentioned above (between students with visual and hearing problems, between students with visual problems themselves and between students with hearing problems themselves), the response of respondents were **neutral** by having 60, 92 and 73 number of respondents respectively. This by itself has negative effect in having good conclusion.

4.7. Effectiveness and efficiency of Assistive technologies

Table 4.14. Measurement of effectiveness and efficiency of Assistive technologies

No	Parameters	Level of satisfaction					Central tendency and dispersion	
		SA	A	N	D	SD	Mean	SDv
Importance of Assistive technologies (AT)								
1	AT can help me to learn content areas	14	105	24	6	4	2.78	0.771

		SA	A	N	D	SD		SDv
2	AT have limitation to help me to fully understand content areas	16	100	31	5	1	2.82	0.683
3	AT are important for academic achievements	16	106	25	4	2	2.85	0.686
4	AT can help me to learn how to learn	27	100	16	8	2	2.78	0.752
5	AT can fulfill the students' information need	13	76	32	26	6	2.42	0.997
6	AT can motivate me to learn	15	104	25	6	1	2.81	0.705
7	AT can fulfill students' specific academic need	14	78	29	28	4	2.46	0.980
8	I can access information by using AT	15	102	32	3	1	2.83	0.647
Interactive and easiness of AT								
9	By using AT I can access information with short period of time	15	93	33	11	1	2.72	0.765
10	AT can cause pain or discomforts	18	60	35	36	4	2.34	1.046
11	The interface of the AT is efficient for the students	12	70	37	26	8	2.34	1.021
12	AT are easy to understand	14	73	39	23	4	2.46	0.946
Dependency level of respondents on AT								
13	AT can help students to become independent	12	82	29	21	9	2.44	1.018
14	AT can influence students to be dependent on the technology	24	90	31	4	4	2.82	0.820

SA= strongly agree; A= agree; N= neutral; D= disagree; SD= strongly disagree; SDv= standard deviation

The above table 4.14 shows the evaluation of effectiveness and efficiency of Assistive technologies. Better Assistive technology can help students with visual and hearing problems to get information for their information need within short period of time and with minimum effort. To make it clear, the researcher classified the variables into three categories; i.e. variables which show importance of Assistive technologies in order to achieve the expected goal; variables which show interactive and easiness of the Assistive technologies and variables which show dependency level of the users on the current available Assistive technologies.

For the importance of Assistive technologies, the mean values are between 2.42 and 2.85. The maximum value 2.85 indicate that Assistive technologies are important for academic achievement of students with visual and hearing problems. Out of 153 respondents 122 of them agreed with this idea. Next high ranked mean indicate that the respondent can access information by using Assistive technologies. This is indicated with mean value of 2.83 and about 117 respondents agreed with this issue. Parallel to the above two core importance of the Assistive technologies, there are also limitations of this technological products. About 116 respondents responded that there are

limitations of Assistive technologies in helping students with visual and hearing problems to learn content areas of education fully. It is supported by mean value of 2.82. This result shows that even though respondents have information need, assistive technologies are not fully effective to help students with visual and hearing problems to learn content areas of education as it is expected.

Another group of variables indicate that the efficiency of Assistive technologies. According to table 4.14 above, the mean values which indicate the efficiency of Assistive technologies are ranged from 2.34 to 2.72. About 108 respondents responded that by using Assistive technologies they can access information with short period of time. It is indicated by the first highest mean value of 2.72. Also the second highest mean value (2.46) indicates that Assistive technologies are easy to understand. But, opposite to the above two results, the third highest mean value (2.34) shows that Assistive technologies cause pain or discomfort when students with visual and hearing problems use them. This result indicates that even though majority of the respondents have experience to use Assistive technology and those technologies are efficient, these students cannot use them for long period of time. Because majority of the Assistive technologies cause pain or discomfort when they are used by students with visual and hearing problems.

The third group of variables indicate the level of dependency of respondents on Assistive technologies to satisfy their information need. The mean values for this group are 2.44 and 2.84. About 94 respondents (mean value of 2.44) responded that Assistive technologies help them to find current and relevant information independently (without the interference of others). But, the other variable within this class indicated that even though students with visual and hearing problems access information independently, they are also dependent on these technological products. This result is supported by majority of the respondents (114) and it has mean value 2.82. Therefore, students with visual and hearing problems are dependent on the current technological products (mainly assistive technologies).

4.8. Interview results

For interview purpose four main issues were proposed. These are status of Assistive technologies; challenges of students with visual and hearing problems in order to use digital technologies and access relevant information; usage of mobile technologies for educational purpose and the role of digital technologies for quality of education. For this study, 9 interviewees were selected

purposely; i.e. 1 student with visual or hearing problem from each university (three universities are considered for this study), 1 instructor who teach students with visual and hearing problems from each university and 1 assistant who assist students with visual and hearing problems from each university.

4.8.1. Status of Assistive Technologies

As the information obtained from the three universities (Addis Ababa, Jimma and Hawasa) indicates, the laboratories of the Universities have Assistive technologies like computer, internet, different application software and other technological tools designed to deliver information for the students with visual and hearing problems. However, students with visual and hearing problems, assistants and instructors who are interviewed have different perception and understanding of the status of the available Assistive technologies.

One of the interviewees said the following:

"In the Mandela building of Addis Ababa University, we have total of 40 computers. However, these computers are not only for students with visual problems. Others with different disability types also can use it. All computers are functional and two of them have no internet service."

In the case of Addis Ababa University, there are total of 400 students with different disability types. Out of this total number of students, undergraduate students with visual and hearing problems are 228. It is clear that the number of students and available computer in the laboratory are not related. In another building of this university, there is another laboratory with total number of 46 computers. This means that at Addis Ababa University level, there are only 86 computers for 400 students with disabilities. In other words, the ratio from computer to students with disabilities is 43:200. This means that if all students with disabilities in this university want to use computer at the same time and if one student use computer only for two hours, every students with disabilities should wait for his/her turn after ten hours. This makes difficult to measure the status of each Assistive technologies including computers. Because, without using the technological products frequently it is difficult for students with disabilities to conclude the Assistive technologies are at good status or not.

The problem of not having sufficient number of computers also true for Jimma and Hawasa universities' laboratories too. In the case of Jimma University, there are total number of 75 students

with different disability types (mainly visual, hearing and motor). To give services for these students only 20 computers are available and two of them are for lab assistants. The ratio of computers to students with disabilities in Jimma University is 6:25. If all students with disabilities in in this university want to use computer at the same time and if one student use computer only for two hours, every students have to wait for his/her turn after eight hours.

In the Hawasa University, there are total of 137 students with disabilities and only 30 computers are available for them. The ratio of computers to students with disabilities in this university is 30:137. If all students with disabilities in Hawasa University want to use computer at the same time and if one student use computer only for two hours, every students have to wait for his/her turn after ten hours. This makes difficult even to give them offline resources properly.

Some students have awareness about assistive technologies and others do not have.

"To speak frankly, some of students with visual and hearing problems are good in using Assistive technologies. However, majority of them have difficulties to use these technologies in order to achieve their information need. The response they can give you about the status or effectiveness of the Assistive technologies depend on the awareness level they have. As instructor, for me the status of current technological products are good; for the students who are blind and deaf, still there should be consideration about Assistive technologies. Because, todays Assistive technologies are complex and dynamic. "

So, the status of Assistive technologies are determined based on the awareness level of students with visual and hearing problems. To enhance skill of using technological products, universities have responsibilities starting from creating good environment that strive for awareness creation and quality of education for the students with visual and hearing problems.

According to the response from interviewed lab assistants, because of lack of awareness only the same students use lab tools frequently.

"When you observe our laboratories daily, you can see the same face in the laboratories of students with disabilities."

This by itself have implication on the status of Assistive technologies, especially in addressing majority of students with hearing and visual problems. If students with visual and hearing problems cannot use technological products properly, it is difficult to say there is good quality of education

for these students. Because of lack of personal assistants for them and to satisfy their information need, students with visual and hearing problems have to use technological Assistive technologies including computers frequently. Unless it will be difficult for them to achieve their goal properly and this situation can has negative impact on quality of education.

The application software laboratories use for students with visual and hearing problems are mostly default. In other words, they have no culture of using commercial software in order to help the above mentioned students effectively. Because of this it is difficult for the students with visual and hearing problems to get relevant and current information.

"In the case of Assistive technologies, we use default applications which are common for all. However, because of lack of awareness, the understanding of students with disabilities is different."

The Assistive technologies universities use currently is unidirectional in converting format. For instance, Jaws is common for universities to help students who have visual problems. However, this application can convert only text to audio and the reverse is impossible by using it.

"Still the Assistive technologies that we use are limited to change text to sound. The reverse function is not active in our universities."

This idea indicate that the students with hearing problems have a gap to access information which are in audio or/and video formats. This leads the researcher to conclude in tertiary education institutions, there is unequal consideration for students with visually and hearing problems.

However, there are some students who have good economic status and use commercial application software to satisfy their information needs.

"I am deaf student; I have personal computer which is called laptop and I use the software which is called dragon detector. This application is flexible to convert text to audio and audio to text. Because of this, I have no difficulty to access audio and video formats. Especially, I can access online tutorials by converting them. But, other deaf students have limitation to do so."

Majority of students with visual problems are familiar with screen reader which is called Jaws. Especially, Law school blind students use it frequently both on the desktop and on android mobiles. However, this application software have its own limitations. The first gap is it cannot read

documents in Portable Document Format (PDF). If the students with visual problems want to read such kind of documents or books, they have to use another software to convert them to word format.

> *"In our laboratories, the Assistive technology we use commonly is Jaws. It is one of screen readers with its gap to read documents with* Portable Document Format (*PDF). We use converters like EBBY to solve this problem. So, students with visual problem can access information with Portable Document Format by using both converter and Jaws."*

Another limitation of Jaws is that it cannot read Amharic alphabets. On this category, there are two groups who have two different idea. The first group said that Jaws has limitation to read Amharic documents.

> *"In Ethiopia, blind students use mostly screen reader which is called Jaws if they use computer. Since Jaws has limitation to read Amharic, we students use another program called Visual Desktop Access (VDA). However, this program has a gap to read Amharic characters clearly. Because of this, we blind students, especially blind students who are learning at Law school have problem to access documents that are related with law. This is heart touching!"*

> *"This software has limitation to read Amharic alphabets. Our students face challenges when they want to access information from documents which are prepared with Amharic language. To minimize such problem, we use another program which is portable (not installed like Jaws). By using this additional program, our students with visual problems try to get information from Amharic documents and books. However, this portable program is not effective in telling clear sound."*

According to the above interviewees, students with visual problems use another portable program that can read Amharic alphabets directly. The problem this program has is that limitation of giving clear pronunciation of alphabets.

The second group of interviewees disagree with the limitation of Jaws to read Amharic Alphabets. They think that this problem is related with versions of Jaws; i.e. previous versions of jaws were not good in reading the Amharic alphabets and the current latest versions can do it.

"Our students think that Jaws cannot read Amharic characters. Yes, it is true for several versions of the program. However, current versions of Jaws are good in reading both English and Amharic alphabets. I think there should be awareness creation and update the latest versions for students with visual problems."

"I use Jaws in the laboratory and on my android mobile. It is active to read both English and Amharic alphabets. I can show you now!"

According to the above interview result, there are two important issues. The first one is the gap to aware students with visual problems. Because of this students with visual and hearing problems do not have knowledge about the characteristics application software have. And the second issue is that lab assistants have a gap to find latest version of software and update for students with visual and hearing problems. Most of the time, universities have problem of adapting (re designing and customizing applications based on background of the users). They simply adopt (accept as it is) what is already available globally. Because of this, Assistive technological products are complex for majority of students with visual and hearing problems to use them effectively as it is expected.

4.8.2. Challenges of students with visual and hearing problems in accessing information for their information needs

Students with visual and hearing problems face multiple challenges when they are attending at tertiary schools. The problems start from lack of awareness to use technological products like computer and assistive technologies and it goes to main challenge which is the gap not to get relevant and updated information for their educational purpose. This has its own implication not to have good quality of information.

In each universities, there is lack of computers and Assistive technologies in the laboratories of students with disabilities. One of the lab assistants said that:-

"We do not have sufficient number of computers for our users."

This is the first challenge of students with visual and hearing problems that hinder them not to access information by using technological tools. Because of lack of sufficient computers, lab assistants use regulation that limit time to use computers and Assistive technologies of the universities.

"We do know that at what time the students use the laboratories more frequently. It is when assignments are given and during exams. At that time we strictly use the time limitation of using computers. The main reason is that we do not have enough number of computers. To help majority of students with disabilities we are obligated to use regulation."

"There are two rules strictly applied in computer lab or assistive technologies at exam time . The first rule is that the maximum time usage of computers and Assistive technologies is limited to two hours. And the second rule is that the students within laboratory have to use only educational contents. Students with disabilities who do not respect this rules are obligated to go out of the laboratories and that computer will be given for another user."

Another problem of students with visual and hearing problems is lack of awareness to use the available technologies. Instructors, lab assistants and vulnerable students themselves agree with this issue.

"Our students with visual and hearing problems have limitation to use computers and internet."

These students have difficulty to use computers and assistive technologies. This can increase the level of digital divide between non-disabled and students with disabilities.

"I do not think that the environment of the universities are comfortable for students with disabilities. For instance, these students have no persons that can assist them mostly and there is a gap to create awareness how to use computers and other technological products."

"The universities have limitation to give awareness for the students who have different disability types, especially how these students can use computers and access information."

Other interviewee think that the gap of university to give awareness for students with visual and hearing problems is because of lack of understanding information behavior of these students. According to this person, if quality of education is not imagined without using technology and technological products, understanding information behavior of the students with disabilities and fulfilling the required things will be responsibility of universities.

"Our university (Addis Ababa University) thought that it is famous institutions in the horn of Africa by involving more number of students with disabilities. However, there is still a gap to satisfy information needs of these students. Having more number of students is not enough,

finding solution in order to make these students competent is mandatory. Without understanding information behavior of students with disabilities, it is difficult to imagine quality of education for them. Again fulfilling technologies for students with disabilities should be followed by awareness creation in order to enhance know how of using technology between students. "

Another problem for the lack of awareness between students with visual and hearing problems to use computer and related technologies is lack of well-organized curriculum to teach computer related topics starting from elementary and high schools. So, today these students with disabilities are obligated to lost most of their time to know what technology is and how it works. However, this time used to be the time to collect information related to their lessons only.

"Students with visual and hearing problems should get awareness how to use computers and Assistive technologies starting from elementary and high schools. Because, at tertiary schools, these students are consuming majority of their time to know the technology not contents related to their lessons. This can be problem for the learners who are disabled. At the time when they should get relevant and latest information for their information needs, they are influenced to learn technology not education."

Still there is a gap of knowing how Assistive technologies work. For instance, some groups of students with visual problems think that Jaws cannot read Amharic alphabets and some of them said Jaws can read both Amharic and English characters. The problem is the gap of identifying latest version of such kinds of application software.

"Jaws is worldwide well-known application software. However, it cannot read Amharic materials. We refer to different countries materials; it becomes heart touching not to access our own country's resources because of lack of interactive software that can help blind students like me. "

"When you use technological products, the problem you may face depend on the level of awareness you have."

"We have difficulty to use internet when we do assignments and projects. I think this problem is because of lack of awareness to use this technology."

Another challenge of students with visual and hearing problems is lack of good self-esteem and perception they have towards technological products. The perception gap is from two dimensions: i.e. students with disabilities themselves and other individuals.

"The problem of most of students with visual and hearing problems is that they think they cannot find relevant information from computers and internet. This students usually try to find information from books."

"I am blind student; most of individuals think that we blind students cannot be active in using computer and internet. However, that is not true. If you have better self-esteem, you can be what you want to be."

Digital divide is another challenge widely observed between students with visual and hearing problems. The first reason for this condition is the difference of interpersonal relationship they have. According to result obtained from interviewees, students with visual problems have better inter personal relationship than students with hearing problems. This helps students with visual problems to share information and know-how of using digital technologies.

"Blind students have good relationship compared to students with hearing problems."

"I am lab assistant; I am working here for years. And I observed that students with visual problems are faster than students with hearing problems by using computer and other related technologies. Some of them even can scan documents to change it to softcopy. Only they have difficulty to identify page numbers when they want to scan documents with several pages."

The second reason to find digital divide between students with visual and hearing problems is the unequal consideration of universities for these students.

"For students who have visual problems, we usually install screen readers like jaws. However, we have no special application software that we deliver for students with hearing problems. They simply use computer or internet."

This is clear that there is a difference of treating students with disabilities when universities deliver information through technologies. Also, assistants who work in the laboratories have better relationship with blind students than students with hearing problems.

"I am lab technician. Most of the time, I pay more attention towards student with visual problems. The reason why I do this is because of blind students challenged to use technological tools without personal assistance and some instructors give hard copy of learning material for these students. I help them by scanning the hard copy. Because, they can read the softcopy by using screen readers."

Another factor for digital divide between students with visual and hearing problems is the lack of know-how or awareness how to use both computers and technological services.

"There are smart students with disabilities who can use computer and other technologies effectively. However, students like me have limitation of awareness to use computers and other technologies as it is expected."

In addition to digital divide, students with visual and hearing problems have also lack of having good protection of personal data or privacy. Non-disabled students can use multiple options in order to protect his/her personal data; unlike these students, blind and deaf students are victims of unauthorized access.

"Both students with visual and hearing problems have problem to keep their personal or other related information confidentially. Within the universities, there is no regulation that is already designed to protect privacy of these students."

According to information collected from interviewed persons, students with visual and hearing problem have challenge from gender side also. From this direction, female students with disabilities are victims not to get relevant information as it is expected.

"Our laboratories are open for all students with disabilities. We do not have rules and regulations that discriminate male and female students. However, participation of female students with disabilities in the laboratories is less compared to male students with similar problem."

Some respondents think that participation of female is not affected only by gender case. Their field choice also affect them; in other words, most of the time fields selected by female disabled students can be learned without using computer and internet resources. This by itself has negative impact on the students to be dependent on instructors' teaching materials only.

"Participation of female students with disabilities in computer laboratories is limited compared to male students with similar problems. I think their usage gap is not only because of gender or being disabled students. Also their field choice is mostly not obligate them to use computers and Assistive technologies. I mean that they can understand educational contents without using computers and Assistive technologies. Instead they prefer to use personal assistants. However, this is not always true. For instance, female disabled students who are learning Law use computer and Assistive technologies like Jaws."

Another challenge of students with visual and hearing problems is not having updated information. This can happen because of several factors like lack of awareness, complexity of technology and others.

"We have braille services; however, we cannot say they are updated."

4.8.3. Usage of mobile technologies for educational purpose

Currently, most of students with visual and hearing problems are using android and Nokia mobiles. These students are getting multiple benefits from these devices. The first benefit of using mobile technologies is getting motivation to learn and study their lessons.

"I use mobile technology for my education. It is more fun to give me more motivation to make learning easy and attractive. To speak frankly, I am addicted to use my mobile in order to refer my lessons online and offline. "

The second benefit of android mobiles is being flexible for multiple purposes.

"Have you heard about talk back? Android has such thing which makes it unique. Talk back helps blind students to hear what they are doing on the mobile. I can use everything by using talk back; i.e. internet, calling, reading book, and accessing information from websites and so on."

Other students with visual and hearing problems use android and Nokia mobiles for communication purposes and file sharing. This activity has its own advantage for quality of education.

"Some instructors give us teaching materials using email. At that time android is my first choice."

"By using my android mobile, I communicate with friends, instructors and relatives through social Medias and email account."

There is also the most important thing about today's mobile; it is helpful for flexible learning. The students with visual and hearing problems can access contents related to education everywhere and anytime.

"Now, we students with disabilities use mobile technology to access information everywhere. That makes us to be informed and competent learners."

4.8.4. The role of digital technologies for quality of education

There are digital technologies like social media and Assistive technologies which have capacity to help students with visual and hearing problems in enhancing the understanding level. These digital technologies play great role in fulfilling information needs of the above mentioned students.

The first and the most essential part of the digital technologies is being general purpose to be used in multiple activities.

The responses which are given below are collected through interview from different individuals. They have the ability to show the general purpose capacity of digital technologies currently available.

"Within our laboratories we have several computers. These devices are designed for several purposes. Computers store materials with multiple formats. They also handle multiple application software that can help students with disabilities. These students use internet service by using different browsers on computers."

Digital technologies can help students with visual and hearing problems to convert the learning materials to different formats.

"Blind students have difficulty to use hard copy. To minimize such kind of problems, digital technologies are important for scanning purpose."

By using digital technologies, students with visual and hearing problems can download and upload different information.

"Some students with disabilities use computer and internet to download Portable Document Formats, word and power point to read."

Digital technologies like computers can help the students to store offline resources.

"In our laboratories, to help students with hearing and visual problems, we put all teaching materials in the computer."

If the students are with low vision problems, there are digital technologies like magnifier that help them to increase the size of text or image they want to see.

"For students who have low vision problem, we give them service of digital technology which is called magnifier."

Copying audio format by using cassette is another importance of digital technologies.

"We also have a machine which can copy information from cassette to cassette within 15 minutes. However, currently it is not active; I mean not used by most students."

However, always digital technological products and services may not work properly.

"Usually, we have difficulty to use internet; because it does not work properly. However, that does not limit students with disabilities to access information; they can use offline resources those are stored in computers and local servers. That is alternative of digital technologies."

And, students with visual and hearing problems can have multiple options to access information.

"We can get service of technology in the laboratories."

"For me computer is my primary digital technology to get information related to my lessons."

"Blind students have special device which can record lectures within the class."

Digital technologies are also have the role of helping students with visual and hearing problems to communicate and to share files.

"Students with disabilities use Facebook and other social Medias. However, their usage characteristics is unique when we compare with using habits of other non-disabled students. That means, students with visual and hearing problems use these digital technologies mostly for the purpose of education and resource sharing."

"Students with visual and hearing problems usually using social media accounts for file sharing."

"I use social Medias for information sharing"

Other students with visual and hearing problems use YouTube to learn online courses.

"Some of the students with visual and hearing problems use you tube to attend online tutorials."

Also digital technologies help these students to manage their time. According to information collected from instructors and lab assistants, students with visual and hearing problems are better to manage their time compared to other students. Especially, when they use digital technologies, mostly they use them only for educational purposes.

"I personally appreciate most of students with visual problems because of their time management and usage of internet and Assistive technologies for only educational purposes."

"I use most of websites and sources of information including social Medias. But, usually my interest is to use internet only for educational purposes."

In addition to their roles, digital technologies have limitations that hinder students with disabilities not to effectively access information.

"We have limitation of internet connections."

"Because of complexity of technology, several students with disabilities prefer personal assistants than digital technological tools."

Respondents believed that the limitation of digital technologies is related with the gap of universities not to have good regulation and policy how to select technologies and create awareness for the users. Universities are adopting digital technologies without customizing; i.e. adapting technologies (redesigning the technological tools based on background of the user) is limitation of them.

"It will be better if technological tools which are designed to help students with disabilities like me are also modified or redesigned based on background of the users. Adopting technological tools is good; but, thinking about customizing them is better."

4.9. Observation results

Observation was applied in this study to get information about the available technological resources in each university that are related with education in order to satisfy the information needs of students with visual and hearing problems.

Table 4.15. Available technological resources and services

No	Available technology & services	Universities			Remark
		AAU	HU	JU	
1	Computer	√	√	√	The number of computers in all Universities are not sufficient
2	FM systems	√	√	√	Less number and only private
3	Braille system	√	√	√	Found in the libraries of university And not updated
4	Scanning service	√			Less in number
5	Screen readers	√	√	√	Only Jaws is available and not Latest version
6	Hearing aids	√	√	√	Less number and only private
7	Magnifier	√	√		Only two devices in both universities
8	Voice recorder	√	√	√	Less number and only private
9	Eye glasses	√	√	√	Only private
10	Internet	√	√	√	The service has limitation in all universities
11	Cassette service	√			Not updated and not sufficient
12	Math talk	√		√	Only private
13	Dragon detector	√			Only private

14	Talking book	√		√	There is gap of awareness to use it

AAU= Addis Ababa University HU= Hawasa University JU= Jimma University

According to table 4.15 above, all universities try to use different technological resources and services for students with visual and hearing problems. Mainly they have computers, braille system, internet service and screen readers like Jaws. However, the number of technological devices and services are not sufficient. Also there are some application software and devices which are not fulfilled in type and kind by universities. The shortage of technological devices and application software affect students with visual and hearing problems' information need negatively.

Universities have laboratory for students with disabilities. However, the ratio of computers and students who want to use is are not proportional (balanced). Technologies like frequency modulation system, eye glasses, Math talk and dragon detector are owned privately by some students who have good economic status.

Technologies like magnifier, scanner and cassette services are limited in number and they are not enough to satisfy the users' information need. The most common problem observed around laboratories of students with disabilities is lack of awareness and skill to use the complex technology.

4.10. Discussion

In this section key findings of the study are stated clearly. The discussion part focusses on the following issues: - the problems of students with visual and hearing problems that hinder them not to access relevant information for their educational purposes; the positive and negative impacts of technology and technological products in enhancing quality of education for these students; how problems related to quality of education for students with visual and hearing problems are happened and how these challenges can be minimized. For each issue there is discussion of finding of this study by relating to results from previous researches.

4.10.1. Impact of ICT on students with visual and hearing problems

In this digital era, it is difficult to think the progress of quality of education without the role of ICT [2]. It is clear that ICT is broad term; because of that this study is focused main technological products and services directly related to education. Those products ranged from tools like hearing

aid up to different application software that help students with visual and hearing problems to have better understanding of their lessons.

According to the finding identified from this study, ICT have impact on the learners and progress of universities in achieving goal of quality of education. The impact of this technology can be seen from two dimensions; i.e. positive and negative impacts.

The positive impact of ICT for students with visual and hearing problems are the following: - 1) It reshape the information behavior of these students mainly to use the technological tools for their educational purposes. Out of 62 respondents (students with visual and hearing problems) who can use internet, 20 of them are using internet only for educational purposes. Also, out of 121 respondents who use Assistive technologies, 104 of them are using it for educational purposes. 2) It motivate students to do their assignments and projects by using different technological tools. Out of 153 respondents 58 of them use internet for their assignments and 116 of them use Assistive technologies for similar purpose. 3) There are multiple alternatives for students with visual and hearing problems to get relevant information for their information needs. 4) Assistive technologies made these students to independently access information without interference of others. Out of 153 total respondents 94 of them agreed The ICT and assistive technologies helped them to access information. 5) Technological products are helping students with visual and hearing problems to understand content areas (119 respondents) and help them to manage their time. In other words by using technological products they can get or/and share the information they want within short period of time. 108 students with disabilities involved in this study agreed they can access and share information within short period of time. 6) Students with visual and hearing problems are supported by technologies in order to communicate with others and for file sharing purposes. 7) Also students with visual and hearing problems who are using android mobiles are currently accessing any information everywhere and any time.

According to [53], ICT is essential role player in having informative and communicative roles. This paper also indicate that ICT or technological products are primary choice to solve problems related to information access, management and to bring quality of education. Similarly, [54] indicates that current technology has role of shaping both learners and institutions which are delivering courses. It reshape the institutions starting from curriculum design and at the same time

helps the students to get the right information at the right time. That is good indicator of quality of education.

Another impact of ICT or technological products is with negative side. Even though current progress of technology is force of momentum for the production of qualified professionals from higher institutions, it has also its own negative implications [55]. For instance, students with visual and hearing problems have the following negative impacts: - 1) Because of the requirement of know-how to use technologies, most of the students with visual and hearing problems are hindered not to effectively collect information and become competent. Out of 153 respondents (students with visual and hearing problems), more than half (81) of them have no experience or/and awareness to use computer. Again out of total number of respondents, 89 of them cannot use internet for their information need. Also 35 of them have no idea how to use Assistive technologies. By having such amount of result, it is difficult to conclude that students with visual and hearing problems are using the current technological tools effectively. According to [55], the two main challenges that affect technology not to be effective are infrastructural factors and cultural factors. The infrastructural factors of ICT within higher educational institutions of Ethiopia is not bad. The problems are from cultural factor and the organizational culture to create awareness how to use technology is weak. Because of this, students with disabilities are influenced or hindered not to get the right information at the right time.

2) Another negative impact of ICT is that because of lack of awareness created for students with visual and hearing problems, the students are investing much of their time to learn technology not their lessons. In other words, the respondents are obligated to find know-how of technological tools at the time when they should study their lessons properly. Also [56] agrees with this concept; according to the result obtained from this paper, the students are shifted from primary goal (learning their lesson) to secondary goal (trying to understand the complex technology). This is clearly indicated on the result of this study; out of 153 total respondents, 130 of them cannot use the current technology without difficulty. They have their own reasons for this; 95 of them have problem of skill and awareness, also 24 of them hindered because of complexity of technology. The remaining have problem of sight, lack of sufficient materials and others.

3) The third impact of ICT or technological products is that the respondents are dependent on the technology. They thought that success cannot be considered without using different digital

technological tools. Out of total number (153) respondents, 114 of them are dependent on the technological tools like Assistive technologies. This can affect them from two main dimensions; i.e. the students with disabilities can have less self-confidence if they learn without using technological tools and this culture can bring to tendency to copy other's work without modification or/and without acknowledging authors. Another researcher also proved this; according to [56], the dependency of individuals or learners on the ICT can create way for the potential of plagiarism.

4) Another impact of ICT on these students is digital divide. Digital divide is the difference of getting access to digital resources including relevant information. The digital divide observed between respondents are three types; 1. Digital divide between students with visual and hearing problems (about 73 respondents); 2. Digital divide between students with visual problems themselves (about 49 respondents) and 3. Digital divide between students with hearing problems themselves (about 56 respondents) agree with this idea. For this study the respondents are mainly shifted to select the **neutral** option from Likert scale options. But, still the result obtained is enough to indicate there is digital divide between the students. And the actors for this problem are assigned personal assistants (lab assistants) within the universities. And also about 73 respondents responded that the personal assistants assigned in the laboratory are not qualified to help or assist students with visual and hearing problems properly. According to [56], the place where there is services of technological products like computers are the places where there might be digital divide.

To have better solutions for negative impacts of ICT products and to enhance the effectiveness of these technologies, at least the following two considerations should be fulfilled: - 1) universities should develop good organizational culture that motivate awareness creation to help students with visual and hearing problems. Also this awareness creation technique should have easy and understandable systems in order to solve gap of understanding the complexity of technologies. 2) Universities should pay attention for the adapting (modifying or redesigning based on the background of the users) of ICT products and services rather than adopting (accepting as it is) it. Because, if technological products and services related to education are modified for students with visual and hearing problems, they can be motivated more to use them and this can create good environment for quality of education. According to [56], there are two main challenges of using

technologies and technological services; i.e. installing the software without giving know-how for the user and using available software without customizing based on the users' need.

4.10.2. Information seeking behavior of students with visual and hearing problems

Information behavior is the characteristics of the user to get and use information and information sources. According to information collected from respondents, students with visual and hearing problems have different information behavior towards using ICT. To get result from this concept, 153 respondents were asked.

Out of total number of respondents 62 of them use internet. From these respondents 26 of them use it for the purpose of education, 20 of them for the purpose of entertainment and 16 of them use internet for personal and private case. Again out of 121 respondents who use Assistive technologies, 104 of them use it for educational purpose and 17 of them use it for personal cases.

Another result obtained from the study indicates that students with visual and hearing problems also have culture of using Assistive technologies in addition to internet service. Out of total number of respondents 121 of them are using Assistive technologies for educational and personal reasons. However, still there are 32 respondents who do not use this technology. These students usually use personal assistants instead of Assistive technologies.

The type of Assistive technologies they use also different. Majority of the students with visual and hearing problems use screen readers, braille system, personal Frequency Modulation system, tape, eye glasses and hearing aid. Assistive technologies like voice recorder and talking book players used by several number of respondents.

The reasons why Assistive technological tools used by students with visual and hearing problems are to record lectures in the class, to convert text into audio format, to access information, to read and write, to hear and see properly as well as to learn from recorded materials.

Even though the level of understanding and using technological products is different, students with visual and hearing problems have behavior of using internet and Assistive technologies for their assignments and projects. However, majority of the respondents have the limitation to use internet. Out of total number of respondents, 95 of them do not use internet for their assignments and

projects. Status of usage of Assistive technologies for assignments and projects is better compared to internet. About 116 of them have culture of using these technologies for their assignments and projects. It is assignments of universities and responsible bodies to motivate and enhance awareness level of students with visual and hearing problems to help them use internet services properly.

Information behavior of students with visual and hearing problems is mostly dominated by using offline information sources. Almost all of the above mentioned students use offline information sources for their information needs. This by itself has positive and negative impacts on the user. The positive impact is that the user can get those information sources from the libraries and teaching materials. Also the students can access them easily within short period of time. And the negative impact can be the issue of relevancy. The resources accessed offline are mostly outdated (which have less value of relevancy for the user). For instance, students with visual problem have culture of using braille from libraries. However, majority of braille resources available are not updated in each university.

The reason why universities cannot fully satisfy the information needs of students with visual and hearing problems is mainly lack of sufficient Assistive technologies. According to the information collected from respondents, this problem can be seen from two dimensions; i.e. limitation of enough number of Assistive technologies and type of Assistive technologies. Out of total number of respondents, 123 of them agreed that there is limited number of Assistive technologies in the universities and 95 of them responded that the type of Assistive technologies within universities are not sufficient to satisfy the information need of the students with visual and hearing problems.

4.10.3. Availability of services, technologies and digital divide

In higher educational institutions of Ethiopia, there are services like scanning, exam reading, sign language translating, converting learning materials from one format to another, installing application software related to education, internet and Assistive technologies for students with visual and hearing problems. These services are given by individuals (personal assistants) and technological products. According to [57], services of technological products have two main importance; i.e. giving good momentum for higher educational institutions by contributing for the goal of universities to deliver quality of education and motivating students in order to be effective and competent.

There are several technological products available for students with visual and hearing problems. Starting from hearing aid up to application software which are designed for students with disabilities can be considered as a part of technological products. Within universities of Ethiopia, Assistive technologies commonly found are computer, screen readers, braille system, tape, cassette, hearing aid, magnifier and others. However, these tools have limitation in both number and type. Also there is gap of awareness creation within higher educational institutions of Ethiopia. If they are used effectively, the Assistive technologies have capacity to replace instructors. According to [56], due to flexibility nature of current technologies, there is a tendency to substitute teachers by technology.

Digital divide is another issue which is observed between students with visual and hearing problems. Digital divide is the difference of using digital technologies because of lack of resources or awareness. Even though these students become partial (select mostly the option *neutral*) in giving response, the result obtained clearly showed that there is problem of digital divide between the respondents. The main role players for this problem are personal assistants within library and laboratories. The digital divide identified in this study is clustered into three categories based on their similarity. 1) Digital divide between students with visual and hearing problems; 73 respondents are agreed by this idea. 2) Digital divide between students with visual problems themselves; responded by 39 respondents. 3) Digital divide between students with hearing problems; this is agreed by 56 respondents. If there is digital divide, there will be difference of accessing relevant information. Unless this problem is considered and got solution on the right time, it might be difficult to think about quality of education for students with visual and hearing problems. According to [56] [58] [59], digital divide is one of the risks of using ICT products for business or/and educational purposes. Because, in the presence of this problem, the users can be obligated to be grouped into two clusters; i.e. haves and have not (individuals who are informed and have no information about specific work or goal).

Generally, to solve the above mentioned problems related to services, technologies and digital divide, universities and responsible bodies like ministry of education and association of disabilities should work cooperatively. The main solutions that should be consider are enhancing the services of technological products based on the interests of the students with disabilities; increasing the

number and type of technological tools related to education and having good organizational culture that motivate awareness creation between students with visual and hearing problems.

4.10.4. Effectiveness and efficiency of Assistive technologies

Assistive technologies are important role players in helping students with visual and hearing problems. According to [56], technological products like Assistive technologies are powerful tools for dissemination of knowledge and information. Especially in teaching learning process, these tools are enablers that help individuals (both instructors and learners) to achieve their goal and manage their time.

Based on the result obtained from the respondents, Assistive technologies available in universities are effective if they are used properly. Some of the criteria to measure the effectiveness of Assistive technologies which are accepted by the respondents are helping the students with visual and hearing problems to learn, to fully understand content areas; motivate them to learn and become independent in searching and access information; easiness of the technological tools and capacity of the devices in fulfilling the academic needs. These criteria are supported by majority of the respondent as they are effective. However, the degree of achieving goal for the students is vary. One of the interviewees responded like this:

"Assistive technologies are effective for individuals who have know-how and use it properly and not effective for others who do not use it. Therefore, the measurement of the effectiveness of the Assistive technologies should be measured based on the awareness level of the students with visual and hearing problems."

Starting from the limited number of computers within laboratories of students with visual and hearing problems up to lack of awareness creation for the users, there should be better solution in order to satisfy the information need of these students and achieve the goal of quality of education for tertiary educational institutions of Ethiopia.

Another feature of this study was to measure the efficiency of the Assistive technologies. For these purposes, two variables were assigned; i.e. instructiveness of the interfaces of the Assistive technologies and Ability of these technologies in order to give information for students with visual and hearing problems within short period of time. Out of 153 total number respondents, 82 of them said that Assistive technologies' interfaces are easy to understand. And about half of them believe

that the Assistive technologies are complex for them to understand. Because of this challenge they cannot access enough information for their education or/and personal reasons. Again, these students are obligated to invest more of their time to understand the technology at the time when they should study their lessons. According to [56], students who access the Assistive technologies are shifting from primary goal (finding materials for their education) to secondary goal (trying to understand the complex technology). This has its own negative implication on the quality of education and effectiveness of the students with visual and hearing problems.

Also about 108 respondents with visual and hearing problems responded that they can access relevant information with short period of time if they use Assistive technologies. But, the reason why this number becomes more is that in addition to the tope Assistive technologies like computer, internet and application software, the study include also the students who use Assistive technologies like eye glasses, hearing aids, voice recorders and other simple devices. Still the respondents have the gap to understand and use computer, internet, scanners and some application software related to their education. This is because of several factors; lack of qualified lab assistants within laboratories of students with disabilities, weakness of the universities to pay more attention towards students with disabilities, accepting the digital technologies without customizing it based on the background of the users and passiveness of students with visual and hearing problems to tell what their information need is and what are their gaps.

Another variable which are assigned to observe the limitation of Assistive technologies are the following: 1) Assistive technologies can cause pain or discomfort and 2) Assistive technologies obligate the students to become dependent on the technologies. Out of total number of respondents, about 78 of them responded that Assistive technologies cause pain or discomfort at the time of usage. On other hand, more than half of the respondents are not comfortable with Assistive technologies when they access information. Also about 114 of respondents believe that the current available technology and technological products obligate students with visual and hearing problems to be dependent on them. If these students are dependent on technologies, there will be multiple negative impacts; for instance, interpersonal relationship with individuals around them, tendency to be plagiarized, loss of confidence if technological services are not available or limited, having wrong information behavior that lead them not to follow their goal, and others.

According to [59], the way institutions measure the quality of education should consider three attributes; i.e. works which are done at parental level, educational organizations level and governmental level. One of the criteria to see quality of education at educational organizational level is measuring the effectiveness and efficiency of the technological tools and services for the learners.

To enhance the positive side of technological services and limitations of these technologies, organizations like higher educational institutions of Ethiopia and ministry of education should pay more attention. Also, the students with visual and hearing problems should be active in telling what their information need is and what are the limitations that should be fulfilled.

4.10.5. Role of digital technologies and mobile devices for quality of education

ICT is playing the role of enabling the user to find and share information with everyone, anywhere and anytime [59]. Currently, working and learning from remote areas, sharing different files, communicating by having multiple alternatives is the result of the digital technologies like social Medias and mobile devices.

For this study the two considerations are social Medias and android mobile devices. These technological products are currently helping students with visual and hearing problems. According to the result obtained from interview, the above mentioned students use social Medias like Facebook and YouTube. The good characteristics of students with visual and hearing problems that make them to be unique from students who have no disability case is that they use Facebook and You Tube mostly for the purposes of file sharing and learning online tutorials.

According to [59], social Medias like Facebook, twitter, You Tube, LinkedIn, and others create the second environment for the user. Individuals who can manage their time in this second environment will be informed and competent locally as well as globally. But, individuals who have bad information behavior will be a loser and addicted for these social Medias.

Students with visual and hearing problems are using android mobile devices to communicate with others and study their lessons anytime. According to result obtained from interview, these students use the system which is called **talk back.** This system tells the students what they are doing by using mobiles. They can chat, call, use internet, and study teaching materials. This condition creates the way for flexible learning. Flexible learning helps students with visual and hearing

problems to learn anywhere and anytime based on the information need they have. For instance, there are some students with visual and hearing problems who are communicating with their instructors through email by using their android mobile devices. According to [60], flexible learning is one of the benefits of ICT and this helps learners to be effective and instructors to disseminate his/her teaching materials and explanation within short period of time. But, still the culture of using android mobile devices for educational purpose is not well organized. Some of the students with disabilities have awareness how to use the devices and have that mobile too. However, some of them have only awareness without having enough economic status to own it. Another groups are individuals who have no both awareness and mobile devices. The government and higher educational institutions should pay attention on this issue in order to help students with visual and hearing problems.

4.11. Major findings of the study

The following are the major findings of this study: -

1. From the study it is found that ICT impacts both students with visual and hearing problems and quality of education positively and negatively.

   A. The positive impacts of ICT are : -

   ✓ Reshaping the information seeking behavior of students mainly to use the technological tools for their educational purposes.

   ✓ Motivating students with visual and hearing problems to consider online resources as alternative for their assignments and projects.

   ✓ Assistive technologies made these students to independently access information without interference of others.

   ✓ Technological products are helping students with visual and hearing problems to understand content areas and help them to manage their time.

   ✓ Students with visual and hearing problems are supported by technologies in order to communicate with others and for file sharing purposes.

   ✓ Some students with visual and hearing problems who are using android mobiles are currently accessing any information everywhere and any time.

   B. The negative impacts of ICT are: -

- ✓ Because of the requirement of know-how to use technologies, most of the students with visual and hearing problems are hindered not to effectively collect information and become competent.
- ✓ Because of lack of awareness created for students with visual and hearing problems, the students are investing much of their time to learn technology not their lessons.
- ✓ Out of 153 respondents 114 of them are dependent on current technology like Assistive technologies.
- ✓ Because of difference in having know-how to use technology, students with visual and hearing problems are currently under influence of digital divide.

2. Even though students with visual and hearing problems have different information seeking behavior, currently most of them use the available technology for educational purposes.

3. Almost all of the students with visual and hearing problems use offline resources like lecture notes, books or recorded materials.

4. Out of 153 total number students with visual and hearing problems, majority of them have no experience to use technological tools and services; i.e. 81 of them have no experience of using computer, 89 of them do not know how to use internet and 35 of them have difficulty to use Assistive technologies.

5. Because of factors like complexity of technology, rigidity of universities organizational culture, lack of skill or awareness and disability status 130 of the total respondents cannot access the current technology without challenge.

6. Digital divide is the challenge that hinder students with visual and hearing problems not to be effective as it is expected.

7. Students who have awareness how to use android mobiles are currently accessing information anywhere anytime.

8. Some students with visual and hearing problems are currently using digital technologies like social Medias and email for communication and file sharing purposes.

9. Students with visual and hearing problems have challenge of getting sufficient technological tools and services both in number and kind.

4.12. Strategies

The aim of this section is to show some strategies or mechanisms that should be implemented in order to solve the challenges identified in the study. Having good strategy for students with visual and hearing problems can benefit both universities and the students themselves. It can help universities to achieve the goal of delivering quality lessons for the students. As well as the students with visual and hearing problems can be competent and qualified professionals if their problems related to their education are solved or minimized. Especially, using scientific and manageable mechanisms to solve problems related to using technological tools and services in educational area can build the effectiveness and efficiency of universities. Inclusion policies which are signed and drafted by Ethiopian government cannot be implemented properly without effective strategy for the problems of students with disabilities.

The strategies of this study are based on the following main issues : - 1) experience of students with visual and hearing problems in using computer, internet and Assistive technologies, 2) information seeking behavior of students with visual and hearing problems, 3) the main challenges of students with visual and hearing problems in using technological tools and services in order to satisfy their information needs, 4) limitations of Higher educational institutions of Ethiopia in connecting quality of education with progress of technology, 5) digital divide observed between students with visual and hearing problems and 6) roles and limitations of digital technologies in order to serve students with visual and hearing problems effectively and efficiently.

The first problem identified in this study is limitation to use computer, internet and Assistive technologies effectively. Majority of students with visual and hearing problems have limitation to use the above mentioned technologies as it is expected. So, the following strategies should get better and immediate response from responsible bodies by working cooperatively: -

- Modifying the organizational culture of universities to include awareness creation of technology usage as one part of their objectives.
- Giving frequent and monitored training for students with visual and hearing problems in order to enhance the experience of using Assistive technologies.
- Designing well-organized curriculum which support learning of technology related courses starting from elementary schools.

- Having good self-esteem from students with visual and hearing problems side.

The second main issue of this study is about information seeking behavior of students with visual and hearing problems. These students have different information seeking behavior. Some of them are the following: - 1) usage of internet mainly for education, entertainment and personal cases, 2) usage of Assistive technologies mainly for educational and personal cases and 3) usage of offline resources than online information resources. In order to satisfy the information seeking behavior of these students and help them to be effective in their academic, there should be strategies like the following: -

- Trying to understand the information seeking behavior of students with visual and hearing problems before fulfilling technological tools and services.
- Fulfilling the required technological tools in number and kind.
- Having good culture of awareness creation how to use both offline and online resources with better perception.
- Selecting user friendly technological tools and services for students with visual and hearing problems.
- Checking libraries whether they have updated references or not. If resources are outdated replacing them by updated ones.
- Customizing technological tools and services based on background of the user instead of adopting it as it is.

The third main issue which is covered in this study is the challenges of students with visual and hearing problems towards getting relevant information compared to other non-disabled students. There are multiple challenges obtained from the result of the study. Some of them are : - lack of flexibility of Assistive technologies, lack of sufficient lab materials including computers, digital divide, lack of identifying information behavior of students with visual and hearing problems in the class or within the laboratories and shortage of good self-esteem and perception towards technology. The following strategies can help the students or/and the responsible bodies to minimize or solve the above mentioned gaps: -

- Equal treatment of students with visual and hearing problems within laboratories or/and libraries.

- Equal consideration of both students with visual and hearing problems at the time of fulfilling the required technological tools and services.

- Assigning qualified lab assistants and personal translators or giving them training.

- In addition to using common application software for students with visual and hearing problems, purchasing flexible technological tools and customizing them based on users' information need.

- Designing better strategy in order to minimize the negative impacts of digital divide.

- From students side, developing culture of information sharing in order to be competent and informed learners.

Another issue which is covered in this study is status of digital technologies; i.e. Assistive technologies, internet, social media and mobile devices. According to the result from the study, majority of the digital technologies are effective in helping students with visual and hearing problems to share information, and access information sources to satisfy their information needs. This help them to learn their lessons independently (without the interference of others). However, there are two main challenges related to the effectiveness of digital technologies; i.e. firstly, digital technologies have limitation to fulfill all content areas of education. Secondly, students with visual and hearing problems (students who use the digital technologies) are almost dependent on the technological tools and services. They think that it is difficult to attend their education without using different technological services. So, the strategies designed for these challenges are the following: -

- Giving students with visual and hearing problems frequent training in order to help them be smart user of the complex technology.

- Motivating students with visual and hearing problems to let them consider both offline and online learning materials as good alternatives.

- Replacing or maintaining assistive technologies which cause pain or discomfort at the time of usage.

Generally actors like government of FDRE, Ministry of Education, lab assistants in the laboratory, universities and students with visual and hearing problems active role players for the above mentioned strategies.

Universities should have the following activities: - 1) replacing libraries and teaching materials by updated and current information sources, 2) giving awareness of using technological tools and services for students with visual and hearing problems, 3) assigning qualified lab assistants or/and training them to help each students with disabilities equally, 4) having frequent training for responsible bodies in order to deliver quality of education for students with visual and hearing problems, 5) developing culture of customizing technology based on information behavior of students, 6) repairing computers and update programs within laboratories, 7) having equal consideration while they fulfill different technological tools for students with visual and hearing problems, and 7) motivating students with visual and hearing problems to do their best and minimize impact of digital divide.

Students with visual and hearing problems also should have culture of interpersonal relationship with students, instructors and lab assistants. This can help them to minimize challenge of digital divide and facilitate the information sharing process. Additionally they should also better self-esteem that can help them to be active in teaching and learning process.

4.11.1. Frame work for the strategies

For this study, technology acceptance model is adopted. According to [38], based on information system innovation strategy, there are three contexts that should be considered at the time of studying technological innovation and adoption of technology. These are technological, organizational and environmental contexts. In other words, in selecting model that help the given organization or individuals to adopt technology, considering factors relating to technology, organization and environment is good culture.

There are several types of technology adoption models. Some of them are technology acceptance model (TAM), theory of planned behavior (TPB), unified theory of acceptance and use of technology (UTAUT), diffusion of innovation (DOI) and technology-organization-environment framework (TOE) [38]. However, since Extended TAM 2 is directly related with aim of this study, it is customize only by using its basic considerations or attributes. Majority of the attributes are modified based on the context of this study. Also the variables included in new customized TAM frame work are the results obtained from the study. Additionally, the customized frame work has two new attributes; i.e. **the actual use of technology** and **evaluation**.
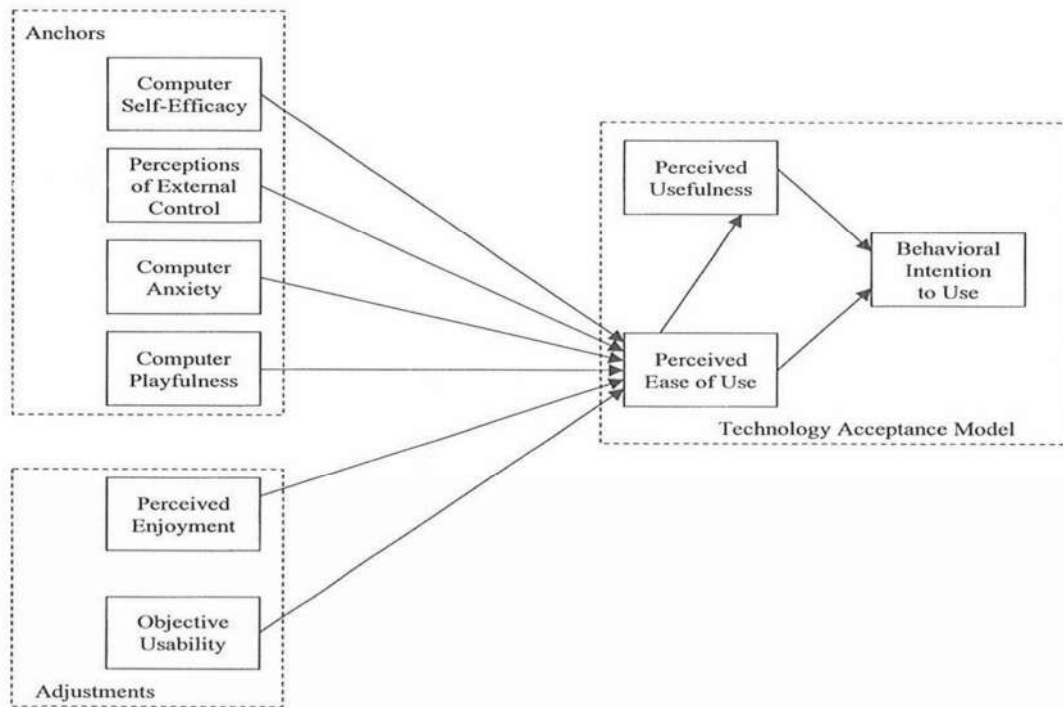
Figure 4.4. Extended TAM 2 model adopted from Venkatesh [40]

The Extended TAM 2 model is better in having clear boundary for innovation, environment, organization and users' perception or attitude. And these attributes are mainly grouped under two classes; i.e. anchors and adjustments. Anchors are the general beliefs about computer and computer usage. Adjustments are the shaped attitude or perception of users, organization and environment because of the direct experience with the system or technological innovation [38]. Therefore, Extended TAM 2 model is considered for this study to put strategies in order to help students with visual and hearing problems. Adopting the right technological innovation is one of the factors that can contribute for quality of education. However, the considered model is slightly modified (customized) based on the background of the study. Also, the aim of the customized model is considered issues of computer, internet and Assistive technologies.

Each of the attributes found on extended Technology Acceptance model 2 are customized based on the result obtained from the study. However, the objectives of the attributes are not missed.

The first two clusters of the extended TAM 2 are Anchors and adjustments. Anchors are the general belief about computer and computer usage [38]. But, for this study, Anchor is all about computer, internet and Assistive technology and usage of them.

Computer self-efficacy is about the belief one has the capacity or ability to do a particular thing. For this study, computer self-efficacy is replaced by computer, internet and Assistive technology self-efficacy. The main role players of this section are students with visual and hearing problems. The factors that enhance the capacity of these students are the image they have about themselves (self-esteem) and attitude (the perception and understanding students have about themselves) to scan their environment effectively.

The second variable under Anchors cluster is perception of external control. It is about the factors and constraints like time and money to hinder the user not to be effective as it is expected. This variable is customized as organizational culture and constraints of the user on the new model. In order to make the students with visual and hearing problems active and competent of digital era, universities as organization should take part and recheck their organizational culture. If the organizational culture of universities is rigid not to be flexible, these students cannot get the right technological innovations. This in turn can has negative impact on the quality of education.

The organizational culture can include the implementation of education related strategies at the level of Ministry of Education and Ethiopian government. Therefore, to have better culture that motivate and enhance the capacity of students with visual and hearing problems, universities, Ministry of Education and FDRE government should actively participate and implement the inclusion policies properly.

Another consideration should be identifying the constraints of students with visual and hearing problems that hinder them not to access current and updated information. Some of the problems that should get solution are absence or lack of flexible Assistive technology, shortage of technological tools in number and kind, lack of awareness, digital divide and lack of understanding the information behavior of students with visual and hearing problems.
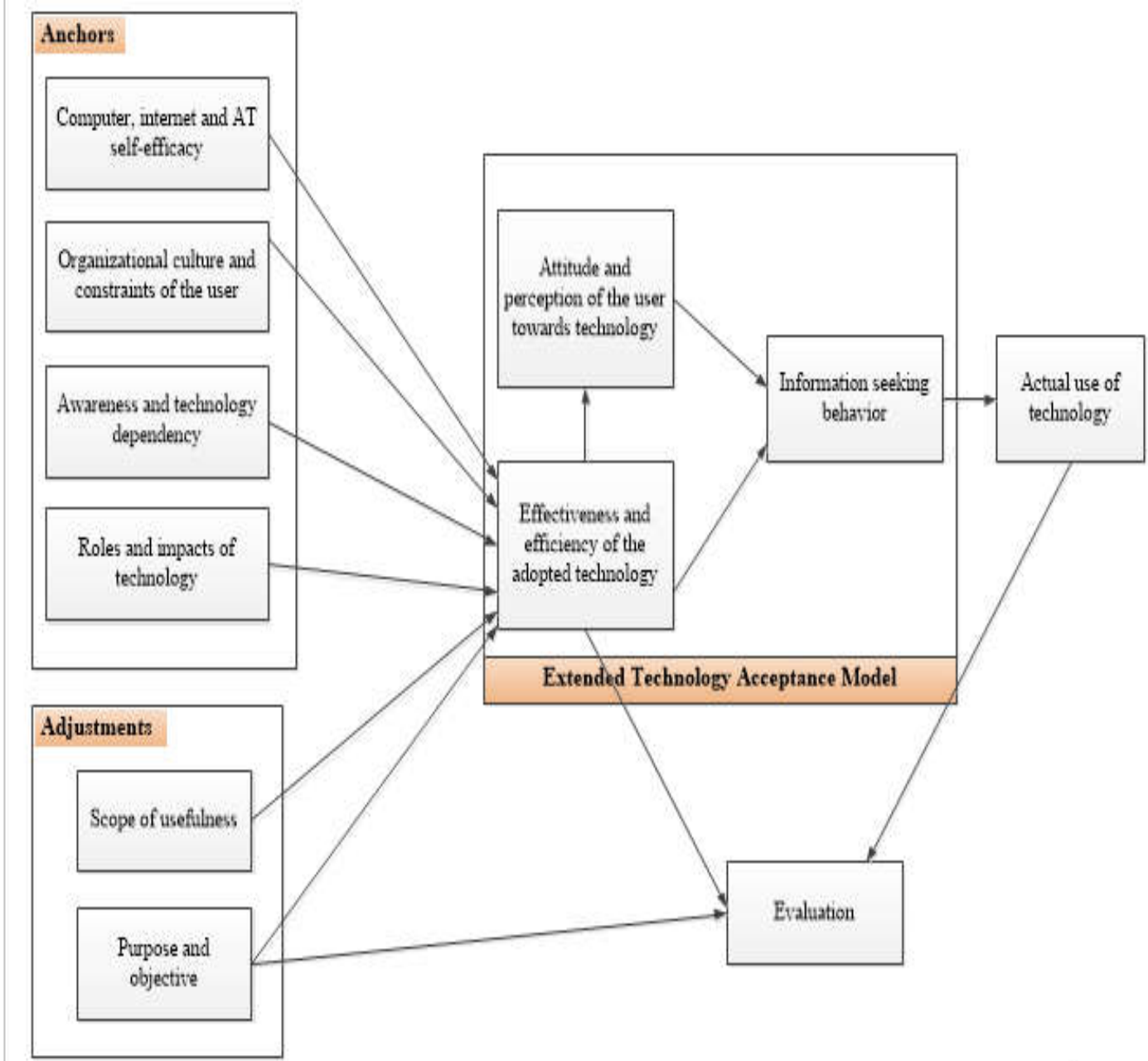
Figure 4.5. The customized Technology Acceptance Model for students with Visual and hearing problems

The third variable under the Anchors section is computer anxiety. It is the gap one individual has to use the technological tools. One of those gaps or limitations might be fear. This variable is customized as awareness and technology dependency. In this study, majority of the respondents have limitation of using both computer and internet services because of lack of awareness to use them. In order to make students with visual and hearing problems familiar with the progress of

current technology, universities, lab assistants and other responsible bodies should actively participate.

Another challenge that should be observed is the students' dependency on the current technological products and tools. Majority of the respondents who have experience of using computer, internet and Assistive technologies are dependent on these tools and services. This can influence the students for the tendency of copying others' work without adding value or acknowledging the authors. So, responsible bodies should take part to help these students in order to see also other alternatives for their information needs.

The fourth variable under Anchors cluster is computer playfulness. Computer playfulness is the degree of cognitive change because of interaction with computers. However, the cognitive change might be with wrong attitude or on the right track. This variable is modified as roles and impacts of technology. In adopting new technology or in the process of customizing it based on the users' interest, identifying the roles of that technology and evaluating the negative and positive impacts of it is selective procedure.

Generally, the first cluster is discussing about the users self-esteem and attitude, the role of organizational culture and constraints in using technology, the dependency of students on technological services, as well as the procedures that should be followed in order to adopt or adapt technology for students with disabilities. The role players of this cluster are different organizations, technology and students with visual and hearing problems.

The second cluster is about adjustments. Adjustment is the belief or understanding that are reshaped based on direct experience with the available system or technology. Under it, there are two main variables; i.e. perceive enjoyment and objective usability. Perceive enjoyment is about the extent to which the usable system achieve its goal. And objective usability is the effectiveness of the system in order to complete its specific task [38]. Both of them are customized as scope of usefulness, as well as purpose and objective respectively.

Scope of usefulness is to measure the scope of the digital technologies that they can address. In this study, it is observed that there is no equal consideration for both students with visual and hearing problems. Most of the time, students with hearing problems are victims of digital divide because of lack or absence of technological tools or services for them. So, in adopting technology,

clearly identifying the capacity and scope of these products should be mandatory. Purpose and objective section of this model plays great role in examining and identifying the objectives of these technological tools and services.

Another section of Extended TAM 2 is perceived ease of use. It is the degree to which the potential user expected the target technology to be effective [38]. This section is modified as effectiveness and efficiency of adopted technology. It has relation with all attributes within the model. The organizational culture, users' self-esteem and attitude, challenges and roles of the adopted technology, as well as scope and objective of these technologies have direct relationship with the effectiveness and efficiency of technology. Therefore, this section should be managed and evaluated frequently and properly.

Perceived usefulness is another section and it means that the perception of the potential user towards the available technology. This is slightly modified as attitude and perception of users towards technology. Its aim is observing the attitude of users towards technological tools and services as well as identifying the factors that influence the users to have such kinds of perception.

Behavioral intention to use is the last attribute of the extended TAM 2. It is aimed to identify the information seeking behavior of the users.so, for this study, it is modified as information seeking behavior of the user. This section can be influenced from both users' perception towards the available technology and from the status of the technology itself.

For this study, the section of actual use of technology and evaluation are the two attributes which are new. The aim of the actual use of technology is to see the relationship of the real capacity of computers, internet services and Assistive technologies with information seeking behavior of the users. Also this section is helpful to evaluate whether the users get the right information based on their information needs or not.

The evaluation section is considered to see whether the aim of achieving quality of education for students with visual and hearing problems is succeeded or not. In addition to this, evaluation section has the capacity to evaluate the objective of technology and status of the technology.

Generally, the new customized Technology Acceptance model is composed of two sections; i.e. Anchors and Adjustments. Both of them have direct relationship with effectiveness and efficiency of the technological products and services. The perception or attitude of the user towards

technology can be reshaped by the awareness creation mechanism or status of the digital technologies. Effective and efficient technology can has the capacity to fulfill the information behavior of the user. Objective and status of technology, as well as the actual use of it should be evaluated frequently and properly.

CHAPTER FIVE

Conclusion and recommendation

5.1. Conclusion

The study shows the issues related to impact of using technological products and services for students with visual and hearing problems. The main aims of this study were to identify information seeking behavior of students with visual and hearing problems, to explore the available digital technologies for students with visual and hearing problems and digital divide, to investigate challenges of students with visual and hearing problems in using the available technological tools and services, and also to explore the role of digital technologies in delivering quality of education for students with visual and hearing problems.

Students with visual and hearing problems have different information seeking behavior. Out of total number of respondents 62, of them use internet. From these respondents 26 of them use it for the purpose of education, 20 of them for the purpose of entertainment and 16 of them use internet for personal and private case. Again out of 121 respondents who use Assistive technologies, 104 of them use it for educational purpose and 17 of them use it for personal cases. However, shortage of computer in laboratories, limitation of Assistive technologies in kind and number as well as not having better awareness how to use technology are major challenges that hinder them not to be effective.

There are different Assistive technologies and other technological tools for both students with visual and hearing problems within universities. About 108 respondents with visual and hearing problems responded that they can access relevant information with short period of time if they use Assistive technologies. But, the reason why this number becomes more is that in addition to the tope Assistive technologies like computer, internet and application software, the study include also the students who use Assistive technologies like eye glasses, hearing aids, voice recorders and other simple devices. Still the respondents have the gap to understand and use computer, internet, scanners and some application software related to their education.

Some of these students are smart in using technology. However, majority of the students with visual and hearing problems have challenge related to digital divide, interpersonal relationship that can help them for information sharing and lack of skill in using computer, internet and Assistive technologies. More than half of the respondents have no skill how to use computer and internet. For students who can use technology, there is a challenge of dependency on the system. These students think that it is difficult for them to be effective without using this technology frequently.

The study shows that the digital technologies like computer, internet and Assistive technologies are effective for smart users who have awareness or skill to use technology. However, for most of the respondents, the digital technologies have limitation in order to help them access current and relevant information. Also there are several Assistive technologies that cause pain or discomfort while used by students with visual and hearing problems. But, compared to computer and internet usage, majority of the students with visual and hearing problems have the culture of using different Assistive technologies.

There are several limitation factors that hinder the above mentioned students not to access information for their education. Some of the identified problems are lack of flexible Assistive technology, shortage of sufficient lab equipment, digital divide, lack of awareness to use technology, limitation of understanding the information behavior of students with visual and hearing problems, lack of good self-esteem from students side and lack of well-organized curriculum that motivate these students by applying different inclusion policies.

Currently, digital technologies are helping some of the students with visual and hearing problems who have skill and awareness. They use technological tools and services mainly for educational purpose, information sharing and personal cases. However, there is still limitation to help the rest of the students with similar disability types.

5.2. Recommendations

Universities should pay more attention for delivering quality of education for students with visual and hearing problems. Especially, in giving them awareness and training related to technology usage, assigning qualified lab assistants, fulfilling lab materials by considering the information behavior of students with visual and hearing problems should be responsibilities of Ethiopian Higher Educational Institutions.

Students with disabilities should have good self-esteem that can motivate them to do more. Success is related with the image individuals give for themselves. The one who has better self-esteem in his/her responsibility area can achieve their goal. Even though being disabled person has its own negative impact on perception of individuals who are disabled, thinking about the capacity they have will make them competent and winner. So, every students with visual and hearing problems should believe that as they have mind that can reshape the world and should struggle to do more.

Lab assistants should treat all students with visual and hearing problems equally. And assistants who are not related with the work they are doing currently, should update themselves.

The researcher strongly recommend Ethiopia Ministry of Education (MoE) to design well-organized curriculum that create the way to teach ICT related courses starting from elementary schools.

Also, Federal Democratic Republic of Ethiopian (FDRE) government should take responsibility to check the implementation of inclusion policies which are signed and drafted for disabled societies, especially for students with visual and hearing problems. Especially, in giving assignment for universities how to disseminate relevant information for these student should be responsibility of federal government. Also, monitoring whether the rules and regulations of universities are strong enough to consider all students with equal manner or not should be assignment of federal government of Ethiopia.

Instead of totally adopting (accepting as it is) the current Assistive technologies for students with visual and hearing problems, universities should adapt (customize the technology based on information seeking behavior of users) technology.

REFERENCES

[1] Disabled world (2018). Disabilities: definition, types and models of disability. Retrieved on 2nd September 2018 from https://www.disabled-world.com/disability/types/.

[2] Teferra, T. (2017). Psychosocial and educational profile of students with disabilities in Addis Ababa University. *The Ethiopian Journal of Health Development (EJHD)*, *8*(1).

[3] World Bank and World Health Organization (2011). World Report on Disability, Washington, D. C.

[4] Kindergarten Parents (2012). Inclusion and Equity Policy. Retrieved on 2nd September 2018 from https://hdka.com.au/Docs/inclusion%20and%20equity%20policy.pdf.

[5] International Labour Organization (2013). Inclusion of People with Disabilities in Ethiopia.

[6] Federal Democratic Republic of Ethiopia. (2011). National Plan of Action of Persons with Disabilities (2012-2021). Addis Ababa.

[7] Federal Democratic Republic of Ethiopia Ministry of Education (2015). *Annual report*; Addis Ababa.

[8] Budd, J., Fichten, C. S., Jorgensen, M., Havel, A. & Flanagan, T. (2016). Postsecondary students with Specific learning disabilities and with Attention Deficit Hyperactivity Disorder should not be considered as a unified group for research or practice. *Journal of Education and Training Studies*, *4*(4), 206-216.

[9] Edgar, P., Pak, Y. & Miriam, L. (2017).The Role of ICTs in Students with Vision Impairments' Transition to University. http://aisel.aisnet.org/confrm2017/34.

[10] Hasselbring, T. S. & Glaser, C. H. W. (2015). Use of computer technology to help students with special needs. *The Future of Children*, 102-122.

[11] Sanaman, G. & Kumar, S. (2014). Assistive Technologies for People with Disabilities in National Capital Region Libraries of India. *Library Philosophy and Practice*, 0_1.

[12] Awais, S. & Ameen, K. (2015). Information accessibility for students with disabilities: An exploratory study of Pakistan. *Malaysian Journal of Library & Information science, Vol. 20, no. 2, 2015: 103-115*.

[13] Beyene, G. & Tizazu, Y. (2010). Attitudes of teachers towards inclusive education in Ethiopia. *Ethiopian Journal of Education and Sciences*, *6*(1).

[14] Mutanga, O. (2017). Students with disabilities' experience in South African higher education a synthesis of literature. *South African Journal of Higher Education*, *31*(1), 135-154.

[15] Zahid, M., Ashraf, M., Malik, B. & Hoque, M. (Feb, 2017). Information Communication Technology (ICT) for Disabled Persons in Bangladesh: Preliminary Study of Impact/Outcome.

[16] Argentin, G., Comi, S., GUI, M., Origo, F. & Pagani, L. (2015). Is it the way they use it? Teacher, ICT and student achievement. University of Milano Bicocca.

[17] Khan, M. S., Khan, I., Din, S. U., Ismail, H. M., Khattak, R. & Jan, R. (2015). The impact of ICT on the students' performance: A review of access to information. www.iiste.org.

[18] Almadani, F. M. & Alandejani, J. A. (2016). ICT adoption impact on students' academic performance: evidence from Saudi Universities.

[19] Ul-Amin, S. N. (n.d). An effective use of ICT for Education and learning by drawing on worldwide knowledge, research and experience: ICT as a change agent for education.

[20] Meenakshii (2013). Importance of ICT in education. *IOSR Journal of Research & Method in Education (IOSR-JRME)*. Vol. 1, Issue 4, PP 3-8. www.iosrjournals.org.

[21] Okoro, C. O. & Ekpo, E. E. (2016). Effects of information and communication technology (ICT) application on academic achievement of students in Christian religious studies in cross river state. *International Journal of Interdisciplinary Research Method*. Vol.3, No.2, pp.14-24. www.eajournals.org.

[22] Gillwald, A. (2017). From digital divide to digital inequality: The connectivity paradox.

[23] Alam, K. & Salahuddin M. (2015). Assessing Digital Divide and its Determinants: A Case Study of Households' Perception in the Western Downs Region of Queensland, Australian Centre for Sustainable Business and Development, University of Southern Queensland, Toowoomba.

[24] Grigg, A. T. (2016). Evaluating the effect of the digital divide between teachers and students on the meaningful use of information and communication technology in the classroom.

[25] OECD. (2011). *Understanding the Digital Divide* (p. 32). Paris: OECD Publications.

[26] Canberra, Australian Bureau of Statistics (2004).Disability, ageing and cares: summary of findings, 2003. (http://tinyurl.com/ ykbapow).

[27] Gupta, M., & Manjrekar, P. (2012). Using mobile learning to enhance quality in higher education. *SIES Journal of Management*, *8*(1).

[28] World Health Organization (2011). World report on disability.

[29] The board of Rabbis of southern California (n.d). Famous Figures from History and Today With Disabilities. http://boardofrabbis.org/Disabilities-Awareness.

[30] Addis Ababa University (2014). Assessment of the situation of students with disabilities in the Ethiopian universities.

[31] Australian national university (2018). Different types of disabilities. Retrieved on 5th September 2018 from https://services.anu.edu.au/human-resources/respect-inclusion/different-types-of-disabilities.

[32] Abera, T. & Koester, L. S. (2015). An assessment of factors affecting the education/inclusion of deaf and hard-of-hearing students in north and south Gondar zone integrated primary school classes. *Ethiopian renaissance*, *2*(2), 37.

[33] O'Rourke-Lang, C. & Levy, R. V. (2016). The Global Context of Disability. *Global Education Review*, *3*(3).

[34] Wu, T. F., Chen, M. C., Yeh, Y. M., Wang, H. P. & Chang, S. C. (2014). Is digital divide an issue for students with learning disabilities? *Journal of Computers in Human Behavior.* (39) (2014) 112–117. www.elsevi er.com/locate/comphumbeh.

[35] Fong, Michelle W. (2009). *Digital divide: The case of Developing Countries*. Victory University, Melbourne, Australia. Vol. 6, 472-477.

[36] Scherer, M. J. (2002). The change in emphasis from people to person: Introduction to the special issue on Assistive Technology. *Disability & Rehabilitation, 24*(1-3), 1-4. doi: 10.1080/09638280110066262.

[37] Statistical Solutions (2018). Theoretical Framework. Retrieved on 1st October 2018 from https://www.statisticssolutions.com/theoretical-framework/.

[38] Hoti, E. (2015). The technological, organizational and environmental framework of IS innovation adaption in small and medium enterprises. Evidence from research over the last 10 years. *International Journal of Business and Management*, Vol. III(4), pp. 1-14., 10.20472/BM.2015.3.4.001.

[39] Lai, P. (2017). The literature review of technology adoption models and theories for the novelty technology. *JISTEM - Journal of Information Systems and Technology Management,* Vol. 14, No. 1, pp. 21-38., 10.4301/S1807-17752017000100002. www.jistem.fea.usp.br.

[40] Chuttur M.Y. (2009). Overview of the Technology Acceptance Model: Origins, Developments and Future Directions, Indiana University, USA. *Sprouts: Working Papers on Information Systems*, 9(37). http://sprouts.aisnet.org/9-37.

[41] Herselman, Marlien & Britton, K.G. (2002). Analyzing the role of ICT in bridging the digital divide amongst learners. *Journal of Education of South Africa*. Vol. 22(4). P. 270-274.

[42] Cerna, P. (2018). Mobile Computing Framework for Student Engagement System in Ethiopian Higher Educational Institution. *International Journal of Wireless Communications and Mobile Computing*, *6*(1), 10.

[43] Chand, B. (2018). Challenges of ICT by Using AT (Assistive Technology) for Inclusive Education of Visual Impairment. *Current Educational Research*, *2*(1), 85-90.

[44] Maphie, E. I., & Possi, M. K. (2017). Challenges of Educating Students with Disabilities in Tanzania secondary school inclusive education settings.

[45] Bala, M. (2018). Use of ICT in higher education. *Multidisciplinary Higher Education, Research, Dynamics & Concepts: Opportunities & Challenges For Sustainable Development (ISBN 978-93-87662-12-4)*, *1*(1), 368-376.

[46] Kumar, R. (2011). Research methodology: a step by step guide for beginners. 3rd ed. www.sagepublications,com.

[47] Tefera, B. and Ahmed, A. (2015). Research methods. Mega printing press, Addis Ababa.

[48] Stat Trek (2018). Statistics Dictionary. Accessed on 15th July from https://stattrek.com/statistics/dictionary.aspx?definition=stratified_sampling.

[49] Kothari, C. R. (2004). Research Methodology: Methods and Techniques. Second Revised edition.

[50] Kumar, R. (2011). Research Methodology: a step by step guide to beginners. Third edition.

[51] Minitab express (2017). Interpret the key results for Correlation. Accessed on 25th July 2018 from https://support.minitab.com/en-us/minitab-express/1/help-and-how-to/modeling statistics/regression/how-to/correlation/interpret-the-results/.

[52] Mohamadali, N. A., Oun, C. T. C., Ahmad, M., & Mohammed, S. A. (2018). Information Needs and Seeking Behavior of Patients and Carers in Palliative Care: A Case Study from Public Hospital Malaysia. *Indian Journal of Science and Technology*, *11*(20).

[53] Zia, N., Ilahi, M., & Khan, N. A. (2018). The Role of ICT (Information & Communication Technology) in Higher Education. *Multidisciplinary Higher Education, Research, Dynamics & Concepts: Opportunities & Challenges For Sustainable Development (ISBN 978-93-87662-12-4)*, *1*(1), 204-212.

[54] Yadav, B. S. & Poddar, A. (2014). ICT at university level management education-one step forward in shaping right human resource of tomorrows India.

[55] Buttar, S. S. (2016). ICT in Higher Education. *PEOPLE: International Journal of Social Sciences*, *2*(1).

[56] Rahatgaonkar, M. S., & Parmanand, M. K. (2017). ICT in higher education: Opportunities and challenges.

[57] Sreekanth, R. (n.d). Usage of Technology in Higher Education in India.

[58] Khan, U. R., Khan, S., Aslam, S. M., Mateen, S., & Punhal, N. (2018). Total Quality Management in Education. *dalam International Journal of Science and Business*, *2*(2), 182-197.

[59] Arshad, M., Ahmad, S., & Siddiqui, F. A. (2018). Social media technologies and their benefits in higher education institutions: a survey of Jazan University. *Information Technologies and Learning Tools*, *65*(3), 91-102.

[60] Pavel, A. P., Fruth, A., & Neacsu, M. N. (2015). ICT and E-learning–catalysts for innovation and quality in higher education. *Procedia economics and finance*, *23*, 704-711.

Appendix A

Questionnaire

Dear Respondent

My name is Solomon Alemu and I am a graduate student at Jimma University, college of Natural Sciences, department of Information Science, in specialized area of Information and Knowledge Management (IKM). This questionnaire is prepared to gather information on the research title **Impact of ICT in enhancing quality of education for students with visual and hearing problems in selected higher educational institutions of Ethiopia**. I am inviting you to participate in this research study by completing the questionnaire. Please answer all questions as honestly as possible and return the completed questionnaires promptly. Participation is strictly voluntary and you may refuse to participate at any time. Thank you for taking your time to assist me in my educational endeavors. The information you provide will be used only for research purpose and will remain highly confidential.

Thank you for your cooperation!

Solomon Alemu

I. Demographic Information

1. Gender   [ ] Male   [ ] Female

2. Age (years)   [ ] 18-25   [ ] 26-30   [ ] 31-35   [ ] above 35

3. In which university you are attending your class?

   [ ] Addis Ababa   [ ] Jimma   [ ] Hawasa

4. In which field of specialization (department) you are attending your class?

   [ ] Law   [ ] Sociology   [ ] History   [ ] medicine   [ ] Information Science

   [ ] other (please mention) …………………………………………

5. I am   [ ] 1st year student   [ ] 2nd year student   [ ] 3rd year student

          [ ] other (please mention) ……………………………….

6. What disability best describes you?

   [ ] low vision problem   [ ] totally blind

   [ ] low hearing problem   [ ] totally deaf

7.

	Options				
Parameters	none	1 year	2 years	3 years	> 3 years
Experience of using computer					
Experience of using internet					
Experience of using assistive technologies					

II. Questions to know the information behavior of students with visual and hearing problems

- Information behavior is the broad term which indicates the characteristics of individuals to seek, ask and browse information from different information sources

1. Do you use internet?   [ ] yes, I do   [ ] No, I don't

2. If you use internet, for what purpose you use it?

   [ ] education/study   [ ] entertainment   [ ] personal/private   [ ] I don't know

   [ ] other (please specify) …………………………………………..

3. Do you use Assistive Technology?   [ ] yes, I do   [ ] No, I do

4. If you use Assistive Technology, why you use it?

    [ ] education/study   [ ] entertainment   [ ] personal/private   [ ] I don't know

    [ ] other (please specify) …………………………………………..

5. If you use Assistive technology, what types of assistive technology do you use most often?

…….

6. Why you choose this assistive technology? Because …………………………………………

……………………………………………………………………………….

7. Do you use Assistive technology when you do your project, assignment or group work?

   [ ] Yes, I do   [ ] No, I don't

8. If your answer for question number 7 is [Yes], how often?

   [ ] sometimes   [ ] always   [ ] usually

9. Do you use internet when you do your project, assignment or group work?

[ ] Yes, I do   [ ] No, I don't

10. If your answer for question number 9 is [Yes], how often?

[ ] sometimes   [ ] always   [ ] usually

11. Do you use any offline resources for your information need?

[ ] Yes, I do   [ ] No, I don't

12. If your answer for question number 11 is [Yes], how often?

[ ] sometimes   [ ] always   [ ] usually

13. Which information source satisfy you mostly?

[ ] power point   [ ] PDF   [ ] books   [ ] web sites   [ ] email

[ ] other (please specify) …………………

14. If you use internet, for what purpose you use it? (You can choose more than one)

[ ] blog on the internet   [ ] chat on the internet   [ ] copy learning material from the internet

[ ] download music and videos from the internet   [ ] play game   [ ] seek information

[ ] other (please specify) ……………………………

15. How often do you use Assistive technologies?

[ ] several times a day   [ ] about once a day   [ ] 3-5 days a week   [ ] 1-2 days a week

[ ] never

16. How often do you use internet?

[ ] several times a day   [ ] about once a day   [ ] 3-5 days a week   [ ] 1-2 days a week

[ ] never

III. Questions to identify the available technologies, services and digital divide between students with visual and hearing problems

- Digital divide is the difference of using the technological products in the given area.

1. What type of Assistive technology is available in your university?

[ ] Eye glasses   [ ] Braille systems for reading and writing   [ ] Screen reader for computer

[ ] Talking book player   [ ] Headphone   [ ] hearing aid amplified telephone

[ ] other (please) specify …………………………

2. Which of the above assistive technologies are related directly with your education?

[ ] Eye glasses   [ ] Braille systems for reading and writing   [ ] Screen reader for computer

[ ] Talking book player   [ ] Headphone   [ ] hearing aid amplified telephone

[ ] other (please) specify …………………………

3. Can you access the available technology without challenge?

[ ] yes, I can   [ ] no, I can't

4. If your answer for question number 3 is [no], please tell us the reason

………………………………………………………………………..

5. Do you think the available assistive technologies are sufficient for your educational purpose?

[ ] yes   [ ] no

6. If your answer for question number 5 is [no], do you think the problem is related with number of assistive technology?   [ ] yes   [ ] no

7. If your answer for question number 5 is [no], do you think the problem is related with type of assistive technology?   [ ] yes   [ ] no

8. Where you get service of assistive technology?

[ ] laboratory   [ ] library   [ ] dorm   [ ] never get service of assistive technology

[ ] other (please specify) …………………………………………..

9. How often do you get the above service?

[ ] always   [ ] sometimes   [ ] usually   [ ] never

10. Where do you get service of internet?

[ ] laboratory   [ ] library   [ ] dorm   [ ] never get service of internet

[ ] WIFI   [ ] other (please specify) …………………………………………..

11. How often do you get the above service?

[ ] always   [ ] sometimes   [ ] usually   [ ] never

12. Can you get 24 hours service of Assistive technology and/or internet?

[ ] yes, I can   [ ] no I can't

13. Is there any kind of restriction that is proposed by university for services of assistive technology and/or internet?

[ ] yes, there is   [ ] no, there isn't

14. If your answer for question number 13 is [yes], please tell us the restriction

   ……………………………………………………………………………

15.

No	Parameters	Level of satisfaction				
		SA	A	N	D	SD
1	I can access reference materials by using assistive technologies					
2	I can access reference materials by using internet					
3	To use the available technologies training is given for us					
4	Assistants are qualified to help us					
5	The university maintain, update and repair its Assistive technologies on the right time					
6	There is a difference of treating between students with visual and hearing problems in the laboratory and/or library					
7	There is a difference of treating between students with visual problems in the laboratory and/or library					
8	There is a difference of treating between students with hearing problems in the laboratory and/or library					

SA= strongly agree; A= agree; N= neutral; D= disagree; SD= strongly disagree

IV. Questions to identify the status (effectiveness and efficiency) of assistive technologies

- Assistive technology device is "any item, piece of equipment, or product system whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain, or improve the functional capabilities of students with disabilities." An assistive technology device can be as simple as a rubber grip that enables a student to hold a pencil or as complex as a talking word processor program.

1. Please try to fill the following table:

No	Parameters	Level of satisfaction				
		SA	A	N	D	SD
	Importance of Assistive technologies (AT)					
1	AT can help me to learn content areas					
2	AT have limitation to help me to fully understand content areas					

		SA	A	N	D	SD
3	AT are important for academic achievements					
4	AT can help me to learn how to learn					
5	AT can fulfill the students' information need					
6	AT can motivate me to learn					
7	AT can fulfill students' specific academic need					
8	I can access information by using AT					
	Interactive and easiness of AT					
9	By using AT I can access information with short period of time					
10	AT can cause pain or discomforts					
11	The interface of the AT is efficient for the students					
12	AT are easy to understand					
	Dependency level of respondents on AT					
13	AT can help students to become independent					
14	AT can influence students to be dependent on the technology					

SA= strongly agree; A= agree; N= neutral; D= disagree; SD= strongly disagree

Thank you for your cooperation!

Appendix B

Checklist for observation

No	Available technology	Universities			Remark
		AAU	HU	JU	
1					
2					
3					

AAU= Addis Ababa University; HU= Hawasa University; JU= Jimma University

Appendix C

Interview questions

The following are interview questions that were used in Jimma, Addis Ababa and Hawasa Universities. The interviewees were students with visual and hearing problems, instructors who teach these students and assistants who work in the laboratories of students with visual and hearing problems.

1. How you describe the effectiveness and efficiency of digital technologies like computer, internet and Assistive technologies?

2. What are the challenges students with visual and hearing problems face in accessing information and using computer, internet and Assistive technologies?

3. What are the roles of mobile technologies digital technologies in enhancing quality of education for students with visual and hearing problems?

Appendix D

Sample related works

No	Title	Author/s	Date	Considered issues	Outcome of the study	Limitation
1	Accomplishments and Challenges Facing Students with Disabilities at the University of Dar es Salaam: Thirty Years of Navigating the Hill	Frida Tungaraza	2018	Challenges of students with disabilities in attending secondary and tertiary schools	Universities organizational structure influence the students with disabilities not to be effective	Did not consider the impact of technology
2	Information accessibility for students with disabilities: An exploratory study of Pakistan	Sania Awais & Kanwal Ameen	2015	Inclusion policy in the libraries	Students with disabilities have different information behavior To satisfy the information need of these students libraries should have different information sources and formats	The study did not consider lnking the traditional library system with current progress of technology
3	How graduate students seek for information: Convenience or guaranteed result?	Liyana & Noorhidawati	2014	Information seeking behavior of computer science students Challenges at the time of retrieving information	Computer sciences have different information seeking behavior Most of the students are not satisfied by search engines They tried to use digital libraries and institutional repositories	The study did not consider the students with special needs

4	The Role of ICTs in Students with Vision Impairments' Transition to University	Pacheco, Yoong & Lips	2017	The role of digital technologies like social media and ICT	ICT has enabling role In order to bring quality of education, the structure of curriculum should relate with progress of technology	The study only consider students with visual problems It did not include issues of flexible learning
5	Mobile Computing Framework for Student Engagement System in Ethiopian Higher Educational Institution	Patrick Cerna	2018	Developing mobile computing frame work in order to replace traditional information access	The frame work is effective in order to deliver information anywhere anytime	The interface is common for all users. The study did not consider students with visual and hearing problems