



ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

SCHOOL OF INFORMATION SCIENCE

**Assessing visually impaired students' intention to
use ICT Based assistive technology for learning:**

The case of Addis Ababa University

By

Bethelhem Eshetu

October, 2016

ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

SCHOOL OF INFORMATION SCIENCE

**Assessing visually impaired students' intention to
use ICT Based assistive technology for learning:
The case of Addis Ababa University**

By

Bethelhem Eshetu

A Thesis Submitted to the School of Information Science of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Information Science

ADDIS ABABA UNIVERSITY
COLLEGE OF NATURAL SCIENCES
SCHOOL OF INFORMATION SCIENCE

**Assessing visually impaired students' intention to
use ICT Based assistive technology for learning:
The case of Addis Ababa University**

By

Bethelhem Eshetu

Approval by Board of Examiners

Advisor

Signature

Date

Examiner

Signature

Date

Examiner

Signature

Date

Declaration

I declare that the thesis entitled “assessing visually impaired students intention to use ICT Based assistive technology in learning: the case of Addis Ababa University “is my own work and has not been presented for a degree in any other before to the best of my Knowledge. All the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Bethelhem Eshetu

Candidate

Signature

Date

This is to certify that the above declaration made by the candidate is correct to the best of my Knowledge.

Temtim Assefa (PhD)

Advisor

Signature

Date

Acknowledgement

First and most of all, I would like to thank Almighty God for giving me the strength and ability to understand, learn and complete this study.

Next, I would like to express my sincere appreciation to my adviser Dr. Temtim Assefa for his constant guidance, encouragement and patience as well as for his support on providing necessary information regarding the research and in completing this study.

Special thanks go to Kaleab Mintesnot, for his encouragement and support through the entire process. Deepest gratitude is also to Hanna Tesfamicheal for her dedication to read my draft thesis, give me supportive comment and helped me a lot in finalizing this study. I am also very indebted to Ruth Adisu who helped me on editing the document.

I also would like to express my love and gratitude to my beloved families, especially to my mother and father, sisters, brothers and cousins for their endless love, understanding and support through the duration of this study.

Finally, many thanks go to my friends and colleagues for their encouragement and moral support, and to all respondents for all their full cooperation that make them a big part of this study.

Abstract

Information Technology is one of the tools used in the process of creating an integrated countries and people of the world interaction. It has become an essential and accepted part of everyday life by providing communication network through information service and information delivery. This facilitates the expansion of products, ideas and resources among people regardless of geographical location. This enables active communication by opening learning opportunities that were previously not available. Information delivery has both audio and audio-visual dimension, so that one can actually communicate without visualizing. In today's knowledge based society, use of information technology has become universal phenomena in education. Education is the stepping stone for every human being to build a successful life and career. This applies to everyone including people with disabilities.

E-learning provides many advantages to visually impair students. Students must adapt the extensive use of e-learning to get educational advantage out of it. E-learning is one of the learning opportunities that information technology provides. However, assistive technology access by visually impaired students to improve their academic competency was overlooked. And visually impaired students are not embracing e-learning at the same rate as the rest of the sighted society.

Therefore, the purpose of this study was to assess visually impaired students intention to use ICT based assistive technology for learning and to assess which factors affect the adoption of ICT based assistive technology for learning in Addis Ababa University.

Case study was conducted in Addis Ababa University visually disabled students to assess their intention to use assistive technology for e-learning and technology adoption. The study was conducted using quantitative and qualitative methods. Questionnaire, interview and document analysis were used to collect data. A total of 109 questionnaires were collected and analyzed using SPSS Standard multiple regression. Purposively chosen respondents from academic staff, administrative officers and students were interviewed.

Quantitative results of the study showed most of students have a year experience working with computers. Students are not comfortable with their ability to use computer and ICT based assistive technologies. Students' technological experience and their attitude on adopting assistive

technology is explained by their awareness about assistive technology. Visually Impaired students awareness about assistive technology is fair. In addition, most of the students have positive attitude on using assistive technology to use computers to access e-learning materials. However, overall students' confidence on using windows operating system as well as built in or free version of assistive technology is less. Multiple regression analysis result revealed; the independent variables, students' awareness on Assistive technology and their experience on it explain 61% of the variance of the dependent variable, the adoption of Assistive technology by students. Among these independent variables, students' awareness on Assistive technology has significant contribution on explaining students' assistive technology adoption.

The findings of qualitative analysis clearly identified specific problems including issues relating to assistive technology such as inaccessibility of local software and hardware and also websites; issues on accessing PDF, Amharic document, graphics and mathematics formulas using current assistive technology mentioned. In addition, limited access to resource, lack of management, department as well as IT professional's awareness about assistive technology, and absence of existing assistive technology policy were implied as a barrier for the level of assistive technology awareness by students. This implies that need of visually impaired students need was not properly managed due to various limitations and addressing the issue in these area will significantly reduce the problem of visually impaired students problem related to assistive technology to their learning effectiveness in today's learning process.

Therefore based on the result, recommendations were subjected to improve awareness level of students and concerned bodies.

Acronyms

AAU – Addis Ababa University

AT – Assistive technology

ATMs – Automated Teller Machines

CCTV – Closed-circuit television

E-learning – Electronic learning

FDRE – Federal Democratic Republic of Ethiopia

ICT – Information and Communication Technology

IDEA – Individual with Disabilities Education Act

IT – Information Technology

JAWS – Job Access with Speech

LMS – Learning management System

MOODLE – Modular Object-Oriented Dynamic Learning Environment

NVDA – Non visual Desktop Access

OCR – Optical Character Recognition

SwDs – Students with Disabilities

TVET – Technical and vocational Education and Training

UDL – Universal Design for learning

UNCRPD – United Nations Convention on the Rights of Persons with Disability

UNESCO – United Nations Educational, Scientific and Cultural Organization

VI – Visually impaired

WCAG – W3C's Web Content Accessibility Guidelines

List of Figures

Figure 1. Conceptual framework of the sstudy 34

Figure 2. Respondent students computer experience..... 37

List of Tables

Table 1. List of free and commercial assistive technology source.....	14
Table 2. Computer Technologies for Students Who Are Blind	15
Table 3. Computer Technologies for Students with low visual	16
Table 4. Survey Instrument	28
Table 5. General Reliability of the instrument.....	29
Table 6. Overall reliability coefficients for each set of variables Item-total Statistics	30
Table 7. Demographic characteristics of respondent student.....	36
Table 8. VI respondent over all AT Awareness	38
Table 9. Perception of Assistive Technology usefulness.....	39
Table 10. Attitude towards ICT based Assistive technology	40
Table 11. Working with computer and operating system familiarity	41
Table 12. Students confidence level on use of built-in or free based AT products	43

Table of Contents

Declaration.....	4
Acknowledgement	5
Abstract.....	6
Acronyms	8
List of Tables	10
Chapter 1.....	1
1.1 Introduction and Background.....	1
1.2 Statement of the Problem.....	2
1.3 Objective of the research.....	4
1.3.1 General objective	4
1.3.2 Specific objective	5
1.4 Significance of the study.....	5
1.5 Scope of the study	5
1.6 Limitation of the Study	6
1.7 Organization of the Study.....	6
Chapter 2.....	7
Literature review.....	7
2.1 Vision Impairment, Inclusive Education, and ICT in Ethiopia.....	7
2.2 Concept of Assistive technology	10
2.2.1 Definition of Assistive technology.....	11
2.2.2 Assistive technology tools.....	11
2.3 Concept of E-learning.....	17
2.3.1 Type of e-learning	19
2.3.2 E-learning Platform	22
2.3.3 E-learning Tools.....	23
2.3.4 E-Learning and visual impairment	23
Chapter 3.....	25
Research Methodology	25
3.1 Research Design.....	25

3.2 Target population	26
3.3 Sampling technique	26
3.4 Research Instrument	27
3.5 Validity and Reliability	29
3.6 Data processing and analysis	31
3.7 Conceptual framework of the study	31
Chapter 4.....	35
Data Analysis and discussion of the research findings	35
4.1 Quantitative data analysis	35
4.1.1 Response Rate.....	35
4.1.2 Demographic and impairment type characteristics of student profile.	36
4.1.3 Computer use experience and assistive technology awareness	37
4.1.4 Computer, operating system familiarity, and ICT-based assistive technology knowledge and experience.....	40
4.1.4.1 Working with computer and Operating System familiarity.....	40
4.1.4.2 Assistive technology familiarity	42
4.1.5 Multiple regression	43
4.2 Qualitative data analysis	45
4.2.1 Interview with VI students	45
4.2.1.1 Respondent of the Interview	45
4.2.1.2.1 Computer for e-learning access in the school and assistive technological theme	45
4.2.1.2.2 Challenge related to computer, Assistive technology, and e-learning access.....	48
4.3 Discussion of the findings and addressing the research questions	50
Chapter 5.....	55
Conclusion and Future research	55
5.1 Conclusion.....	55
5.2 Recommendation.....	57
5.2 Future Work.....	58
References.....	59
Appendix.....	64
Appendix A: Model summary of Assistive technology adoption	64
Appendix B: The ANOVA of Assistive technology Adoption	64
Appendix C: The coefficient of Assistive technology Adoption	65

Appendix D: Research Questionnaire..... 66

Appendix E: Research Interview Questions 72

 Interview question with visually impaired students..... 72

 Interview question Administrative supporter 72

Chapter 1

Introduction and Background

Information Technology is one of the tools used in the process of creating an integrated countries and people of the world interaction. It has become an essential and accepted part of everyday life by providing the communication network through information service and information delivery. This facilitates the expansion of products, ideas, and resources among people regardless of geographic location. This enables active communication by opening both social and learning opportunities that were previously not available (Osagie, 2011). Information delivery has both audio and audio-visual dimension, so that one can actually communicate without visualizing. Information service is an exchange of information between sender and receiver about ideas, feelings, attitudes and beliefs (Lucky & Achebe, 2013).

In today's knowledge based society, use of information technology (IT) has become universal phenomena in education(Catherine et al., 2009).Education is the stepping stone for every human being including people with disabilities to build a successful life and career. Information technology helps on obtaining new skills. Technological advancement in IT contributes to integrate and narrow the distance. According to Ruchi et al.,(2013) IT also offer opportunities to visually impaired learners to engage in interaction with others and learning Materials. Technological advancement also creates new modalities of distance education. One of the new modalities of distance education are considered as e-learning (Ulbricht, 2012).

E-learning is one of the learning opportunities that information technology provides. It enables access to online learning resources. It has also the potential to progress people with disabilities from outer edges of educational opportunities to the leading edge of educational innovation (O'Connor, 2000).This day's e-learning is being introduced as a fundamental part of learning experience in higher education (Ruchi et al., 2013;JSRPD, 2007).Use of e-learning such as using PowerPoint presentation delivered in class, the use of web based discussion board and course delivered completely over the internet by instructors to teach courses has been increasing both in colleges and universities(Jennison et al., 2010).Thus students must adapt to extensive use to e-learning to be beneficiary of this technological opportunities(Catherine et al., 2009).

The UNCRPD (Article 24) recognizes the disabled people right to access education. Recent increase in higher educational institution in Ethiopia is creating an opportunity for many disabilities and increased numbers of students with disability are joining higher educational institution (Teferra , 2005). Addis Ababa University is one of higher educational institute that an increased number visually disabled students joining. Addis Ababa University, established in 1950, is one of the oldest and largest higher institutions contributing as being the source of highly qualified professionals in Ethiopia. It works to advance knowledge and community services through innovative and creative teaching, and research. The university has a center for students with disability called Special Need Support office with a mission to enrich the academic performance of SwDs in this institute. The center has six objectives. And creating inclusive education and expanding assistive technology is one of the objectives (AAU, 2013).

The experiences of students with visual impairments on using information and communication technologies, and e-learning materials have changed over the years for a variety of reasons such as an increasing use of electronic technologies and computer-based tutorials, the growing presence of hardware and software assistive technologies on campus, and the increasing compatibility of assistive software with ICT (Catherine et al., 2009).

However, people with disabilities depend on all information contained in ICTs being converted into hearing and touch stimuli. The conversion of static and dynamic images into audio and touch stimuli is a complex and yet developing process (Ulbricht al., 2012). Considering the e-learning opportunities and benefits offers to students for a greater access to higher education in mind, it is necessary to emphasize not only access to education but also access to technology as computers are an indispensable elements of effective e-learning courses (Ribiero, 2002).

1.1 Statement of the Problem

Adoption of E-learning in education, especially in higher educational institutions has several benefits and considered as one of the best methods in education (Arkorful & Abaidoo, 2014) . E-learning tool along with assistive technology is the best tool in case of inclusive learning to enhance the learning level of the students. Visually impaired students can access educational materials posted on e-learning sites through the help of ICT based assistive technologies to improve their learning experience. Using assistive technology, they can also take note, study for the tests, research and accomplish variety of other academics activities-learning along with

assistive technology also increase Visually Impaired students learning access and improve their academic competency. It also facilitates student centered and self-directed learning (Vidhya & MeenaKumari, 2015).E-learning adoption also provides many advantages in education such as enhancing the qualifications of teachers via ease of access to a huge amount of information, permits the exploration of much flexible learning materials with much reduced need for travel to go to classes and without the need to implements learning center.

However, students with partial or low vision impairment need support to convert and decoding visual information into e-learning format for reading and taking notes. The conversion process also requires great contribution of information technology field. In addition assessing the issues they come across associated with using currently available ICT based assistive technology in relation to IT factors while they accesses digital documents and online e-learning materials is significant in order to provide a solution for their problem.

Though some studies (for example Tessentu (2014) & Abdo (2009)) were conducted aiming on assistive technology in Ethiopian, these studies were focused only on the provision and physical accessibility of assistive technology to visually impaired students. In addition this study was from addressing issues related to technological aspect such as students personal intention on towards using ICT based assistive technologies, their experience as well as concerns and challenges encountered on using different operating systems and available free, built-in or commercial ICT based assistive technologies to provide them an alternative option to access computer, electronic document, online and e-learning material; and contributions expected from IT professionals ,web developers and electronic document developer as well as benefits students will get on using the new modality of IT based learning using ICT based assistive technologies in e-learning so as to support visually impaired students to make e-learning and assistive technology accessible and available to visually impaired students to improve their academic competency is remarkably overlooked. For that reason they are not embracing e-learning as the same rate as the rest of the sighted students.

Adopting e-learning is becoming a requirement and significant for learning effectiveness in today's learning process. Therefore, this research was intended to fill the gap of this widely ignored area and to address the problem related to ICT based assistive technology need of visually impaired students in order to provide appropriate assistive technology to help them be equally competent.

Thus, the research has the following research questions.

1. What are students with visual impairment awareness level related to using different ICT based available free, built-in or commercial assistive technologies and operating systems platforms?
2. What ICT based assistive technology is used by visually impaired students for e-learning access?
3. What is a role of e-learning towards visually impaired students while accessing it using ICT-based assistive technologies?
4. What are technological challenges of visually impaired students on using ICT-based assistive technology to access e-learning material using ICT based assistive technology?

1.2 Objective of the research

1.2.1 General objective

The major objective of this study is to investigate visually impaired students' intention to use ICT Based assistive technology, AT role on their e-learning along with what factors affect assistive technology adoption by students as well as challenges students encounter related to assistive technology use in Addis Ababa University. In addition the research intended also to study what assistive technology and e-learning system are available to students in the university; and to make recommendation based on the research findings for the design and implementation part of e-learning such as electronic documents, webpages and in addition to e-learning solutions to narrow the gap.

1.2.2 Specific objective

- Assess visually impaired students of awareness level related to on using different available free, built-in or commercial ICT based assistive technologies and operating systems platforms.
- Identify visually impaired students challenge on using and accessing electronic documents, Webpages and e-learning material using ICT based assistive technology.
- Identify the benefit of e-learning towards visually impaired students while using ICT based assistive technology to access it.
- Inform and recommend concerned bodies based on the research findings and proposed conceptual model about the current picture of ICT based assistive technology for e-learning by visually impaired students.

1.3 Significance of the study

The research has significance to understand current awareness and knowledge gap of visually impaired students related to use of assistive technology for e-learning in Addis Ababa University, so as to works to avoid barriers that are likely hinder their e-learning process. The research also has significance on adopting appropriate assistive technology for visually impaired students. The discovery of the study will also be used by higher institutions to understand factors that contribute and influence assistive technology adoption by visually impaired student on implementing e-learning. The research will also be an insight for IT professionals' to understand current assistive technology status and to resolve it. It will also be an input for policy and theory developers.

1.4 Scope of the study

The scope of the study was limited on studying visually impaired regular program students intention to use assistive technology on their learning to access different e-learning materials along with identifying main challenges and factors that have roles on e-learning adoption by them in Addis Ababa University main campus (6kilo).

1.5 Limitation of the Study

Every effort was made to ensure the quality of the research finding. Although the research was reached its aim, there were limitations because the research was conducted only on undergraduate students because there were no records by the special need support office of the institute to know how many post graduate students are pursuing their education in the university. Therefore, to generalize the result for large group of visually impaired student, the study should have involved more participants at different levels.

1.6 Organization of the Study

This report of this thesis is organized in five chapters.

Chapter One: Covers an introduction part of the study which includes background of the study area, statement of the problem, significance of the study, objective of the study and the scope and limitation of the study.

Chapter Two: deals with reviewing of the literature that provide detail information related to inclusive education, ICT and vision impairment in Ethiopia; Concept of E-learning and concept of assistive technology.

Chapter Three: this chapter presents research design and methodology which includes the research design, target population of the research, sampling technique, research instrument, data processing and analysis, and conceptual from work of the study.

Chapter four: focuses on the result and discussion of findings of the study.

Chapter five: deals with the conclusion and recommendation of the study.

Chapter 2

Literature review

2.1 Vision Impairment, Inclusive Education, and ICT in Ethiopia

According to UNESCO (2009), visual impairment clarified as low vision or blindness. Blindness; A person who is blind has a total or high degree of vision Loss and cannot distinguish between light and darkness. Low Vision; A person with low vision has severely reduced visual Acuity, a significantly obstructed visual field, contrast sensitivity, or all the three.

The concept of inclusion could be understood from various points of view such as schools understanding the human right of the diverse society, identifying and removing the barriers and also offer a high quality education (Bishaw, 2013).

Likewise UNESCO's action in the field of inclusive education says: *“Schools should accommodate all children regardless of their physical, intellectual, emotional, social, linguistic or other conditions.”*

A number of nations assert that people with impairment should have equal access to the same opportunity like other part of the society. In relation to this, Constitution of the Federal Democratic Republic of Ethiopia (FDRE, 1995) Article 41.5 says: *“The State shall, within available means allocate resources to provide rehabilitation and assistance to the physical and mentally disabled people”*. Similarly the Constitution under article 9.4 also says all international agreements ratified by Ethiopia are an integral part of the law of the land and all legislative, executive and judicial organs have the responsibility to respect and enforce what is embodied under that section which should be done in conformity with human right considerations. This indicates that all international agreements that have been ratified by Ethiopia should be realized and the responsible bodies should also play an important role for its implementation (Wondowosen et al., 2014).

MLSA (2012) also says that the ability of people with disability are recognized and their independence is ensured in this inclusive society nation action plan. Education is a human right which every part of society including people with vision impairment should get and it is one of the

main factors on reducing poverty. Education is a cornerstone and should be supported with ICT to achieve quality education and, developing special ICT training programs for disabled is fundamental in order to address social inequalities FDRE(2009). Like other part of the society, visually impaired people also strive for a better life and have the right to expect the same standard of education access including ICT based ones as equal as their peers Stefan et al.(2007).

But in previous days, education was mainly in classrooms which mostly depend on vision in terms of the ability to read information on a board and the ability to view textbook. Vision was also primary sense and necessary part for successful learning. Being able to see gave great access for learning. However, the rapid development of computer and also the advancement of technology as well as internet create another way of learning, referred as e-learning, that provide opportunity including visually impaired. E-learning bridged the geographical gap with the use of tools. It makes people feel as if they are inside the classroom Emery (2007).

According to Becta(2007) ICT facilities variously support in teaching, learning process and ranges of activities in education. Computer and information communication technologies have the potential to improve the lives of people with disabilities as well as to deny them equality of access to education, employment, and social life (Fichte& Barile,2003).

Even if, ICT brought opportunity to visually disabled inclusion, the dependence on vision based learning continues with the extensive adoption of computer technology. As a result, people with disabilities and specifically people with vision impairment are not embracing ICT based technology as the same rate as the sighted population Emery(2007). So that according to Lewis(2010) accessibility of ICT educational tools still is considered major universal issue.

Bishaw(2013) discuss people with visual impairment achieve success just like their peers with the aid of proper assistance. In order to guarantee equal opportunities to all, Lewis(2010) asserts that clearly specified policy on special need of education for inclusive education guides the implementation of educational change.

Nowadays e-learning is mostly delivered through the internet using computer-based methods. Gradually higher educational institutes are also using Webpages and internet resources for essential learning material. To take the advantage of e-Learning, embracing information technology and computer skill is the key to better academic success.

FDRE(2009) says that the government of Ethiopia recognizes the importance of ICT development and has adopted ICT policy and designed a strategy to make every aspect of Ethiopian life assisted with ICT to achieve national ICT vision, and unhindered access to ICT by the disabled is one of the national ICT policy object. FDRE (2009) also says that the government is offering ICT education and training in secondary and tertiary educational institutions with the objective of creating ICT literate society.

However Tessentu (2014) argue that even though there is progress on making higher education barrier free in recent years in the nation, people with disability still have challenges to get barrier free education in learning process and people with disability is given little consideration. FDRE(2012) also recognize limited support in education, training, access to education and other basic services are some of challenges for the people with disability in Ethiopia.

Providing Education for all requires identifying barriers and then reducing or removing that hinder learning O'Connor(2000). Similarly Wondowosen et al.(2014) argues that the current Ethiopia inclusive education policy ETP (1994) confirmed the importance of education for child with disability however practically there is no effort made in the country to enable them learn based on their need and potential. Gebreegziabher (2008) also says that although there is a lot of worldwide change over recent year's relation to disability and higher education, the situation of students with disability in Ethiopia seems still very poor and is facing continuous hindrances in their effort to access, persist in and complete their higher education.

Gebreegziabher(2008) also indicated that, to overcome barriers of education for disabled part of the society, formulating policies and strategies plus providing adequate assistive technology enabling computer lab accessible to disabled students is important to address their need. Gebreegziabher(2008) also says policy makers and higher institution should work to improve the situation and remarks specific points allied to technology that higher educational institution to consider.

2.2 Concept of Assistive technology

Computer and information technologies have the ability either to allow students with disability equal opportunity or deny them to take advantage of this new technology in access of education, job or social life to enhance their life Fichten & Barile(2003).

Fichten & Barile(2003) and Catherine et al.(2001) says that in parallel with the evolution of both adaptive hardware and software, the integration of computer mediated online learning into the curricula is the top priority of most higher educational institutes. These trends have the potential to balance playing field for individuals with disability to equal access as their non-impaired peers.

The accessibility of ICT educational tool is the major concern in an attempt to assure equal opportunity to all students because visually impaired students come across different accessibility and usability challenges while using electronic materials to take advantage of effective assistive technologies for learning purpose. The reason for this is because of the term visually impaired includes different range from blindness to a number of other multifaceted, although less severe, visual impairments. Therefore considering the actual specific need of the user and the nature, specific features and the functionalities of the technological tools is important (Stefan et al., 2007).Similarly Gebreegziabher(2008) said that identifying appropriate and affordable technology specific to students need crucial.

Universal Design for Learning (UDL) is an approach to developing curricula with flexible options to meet the need of the students with different requirement that can be adjusted for individual student need. By planning for students varying capability, need and interest, it is possible to reduce the need for special service, because following UDL accommodate different learning challenges be integrated into the curriculum. Furthermore, the use of universally designed curriculum tools and materials can reduce the time need to spend in modifying the curriculum to need students' need (Burgstler, 2002).

Technology can help to simplify the process of creating a universally designed curriculum. And universal design curriculum together with assistive technology work to meet the need of students with different requirement. Assistive technologies major solutions that enable students with disabilities to be more independent and productive, also help students with disabilities participate more fully in the academic and social activities(Carlson & Nat, 2005).

2.2.1 Definition of Assistive Technology

The Individual with Disabilities Education Act (IDEA) defined Assistive technology both as device and a service:

Assistive technology device are identified in the IDEA 2004 as

“Any items, 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 children with disabilities.”

Assistive Technology service is also identified in the IDEA 2004 as

“Any service directly assists a child with a disability in selection acquisition or use of an assistive technology device.”

Assistive technology includes technology solutions that are generally considered instructional technology tools. AT devices ranges include middle technology to high technology. Assistive technology is term that also referred as adaptive device for people with disabilities and also includes the process used inspecting and using them.

2.2.2 Assistive technology tools

Assistive technology devices have important role in supporting individuals to be independent and live better life. For people to get the best advantage of assistive technology, different factors should be considered since each individual is unique, and what works well for one student may not work well for another. Ahmad (2015) said that involvement of assistive users is necessary to ensure users requirement of assistive technologies maintain easy to use and effectiveness.

There are many factors such as educational goals, personal preference, social needs, environmental reality and practical concerns that need to be studied when assistive technology devices and services planned for students to ensure benefit of students from using assistive technology. When exploring assistive technology devices for a student, it is important to consider the full range of devices that are available beginning with less expensive to high-tech options which are easy to use, maintain and learn MDESE (2012).

Assistive technology devices are available in a variety of categories to address functional capabilities of individuals with disabilities. Computer access and Visual Aids are among these categories. Computer Access devices are for Input and output access aids, such as modified or alternative keyboards, special software, and other devices and also software solutions that enable students with a disabilities to use the computer. Visual Aids are Electronic and non-electronic aids such as magnifiers, Braille writers, screen reading software applications for the computer, and Braille note-taking devices that assist students with visual impairments or blindness in accessing and producing information that is typically present in visual. A range of assistive technology devices and technology products are currently available for different purpose. Some are relatively “low technology” and inexpensive. According to RMSDT (2004) there are three main ways to make materials accessible to students with visual impaired. These are Magnification, speech output and Braille. These three ways can be categorized as input and output tools depending on level of visual functionality Pal et al. (2011).

Input tools are a way in which people with visual impairment interact with the computer interface. Such as Braille keyboard which used to type in Braille alphabet which allows visual impaired to type into a computer like a standard keyboard. Output tools are assistive technologies which helps visually impaired students to access information from their computer such as magnifiers, tactile readers which allow users to perceive through touch and screen readers. Screen Reader assistive technology products are software solution which reads text on the screen aloud using speech output to help students ‘interact with material on computer Screenplay et al. (2011).

Speech output comes as synthesized speech type which is generated by the computer using complex set of rule with near human-quality speech or digitalized speech type which is recorded speech, similar to a tape recorder and the quality of speech depend on recording and play back conditions RMSDT (2004).

Screen magnifier assistive technologies are used to enlarge images or text to suitable size to the student to receive and process information on the screen based on individual visual requirement. There are three type of magnification: relative-size, relative-distance and angular. Relative-size magnification encompasses making the material larger while maintaining the same working distance. Relative-distance magnification involves maintaining the original size of the material by moving the material closer to the student. And angular magnification is using lens to enlarge the material depending upon the power if the lens or the system RMSDT (2004).

Braille is a way for totally blind person to read. Small hand-held Braille note taker mostly used by many students which have a Braille keyboard and speech output and in addition to speech output a computer send text out in hardcopy embossed format or refreshable Braille. A refreshable Braille display attached to a computer and shows up to a line at time in Braille as the user moves around the computer screen RMSDT (2004).

In addition, according to Pal et al.(2011) Optical character recognition (OCR) is another mechanism to making materials accessible for people with visual impairment which can be either mechanical. It can also be a way electronic translation of scanned text such as handwritten and typewritten or any other into mechanical encoded text. OCR technology is useful technology to process digital text materials available in image or scanned materials to have processed as text or synthetic speech format.

All type of assistive technology tools such as screen reader, magnifier, Braille or OCR can be acquired as Built-in and free or commercially bought. Built-inaccessibility option is included in operating system as standard accessibility feature that include magnification for people with visual impairment, on-screen keyboard for one handed typing, speech to text and lot more. For example: Voiceover screen reader is an accessibility options for Maceio's devices, Apple watch and Apple TV which help users who are blind or have low visuals know what is happening on their device. And Narrator, one of windows built-in ease of access center feature, is basic screen reader that read aloud text that appears on the screen to help people with visual impairment. Free assistive technology tools such as NVDA (Non Visual Desktop Access) screen readers and Microsoft speech Engine, Text Talk Speech synthesizers, which can be get freely on the web and can be used, modified and distribute and be an alternate solution. In contrast commercial assistive technology tools, like JAWS (Job Access with Speech) and Microsoft-Eyes are high rank functionality screen readers, which can be purchased and gives many features that won't find in a free options (Catherine et al., 2001; Pal et al. 2011)

Category of Assistive Technology for Computer access	Free (Open Source)	Commercial
Screen Reader	<ul style="list-style-type: none"> • NVDA • Windows-Eyes • Read Tome • Clip Talk • Omni Page • PagisPro • Lynx • Opera • Pine e-mail 	<ul style="list-style-type: none"> • JWAS • Windows-Eyes • Artic • Windows Bridge • ZoomText(Level 2) • DecTalk • Kurzweil • OpenBook • Arkenston Unbound
Screen Magnifier	<ul style="list-style-type: none"> • The Magnifier • Microsoft Magnifier • Loupe • Magnifixer 	<ul style="list-style-type: none"> • ZoomText(Level 1) • Lunar • LPWin/DOS
Braille		<ul style="list-style-type: none"> • Freedom Scientific's PAC Mate • Duxbury • HotDots • VersaPoint • Rome

Table 1 - List of free and commercial assistive technology source (Catherine et al., 2001; Pal et al., 2011)

According to catherine et al.(2001), assistive technology need of people with visual disabilities categorized into assistive technology for the blind and low visual functionality category based on visual functionality of an individual as summarized on below tables.

Computer based Assistive technology	Description	Commonly Known
Screen Reader	Text-to-Speech software that uses synthesized to read text, menus, buttons, dialogue boxes	<ul style="list-style-type: none"> • JWAS • Artic • Windows Bridge
Document reader	Text-to-Speech software that uses synthesized speech to read what is on the screen but fewer features that screen reader has.	<ul style="list-style-type: none"> • ZoomText • ReadToMe • Clip&Text
Voice Synthesizer	A hardware which produces speech output for text to speech program	<ul style="list-style-type: none"> • DECTalk
Reading Synthesizer	Standalone equipment that scans pages and reads content using synthesized speech	<ul style="list-style-type: none"> • Kurzweil
Optical character recognition (OCR) software (used with a scanner)	A software that converts a printed page that has been scanned into electronic text file format for speech output or storage	<ul style="list-style-type: none"> • OpenBook • Arkenston unbound • OmniPage,PagisPro
Text based browser, Web and e-mail	Software based	<ul style="list-style-type: none"> • Lynx, • Opera • Pine e-mail
Portable Braille note taking device	A portable hardware note taking device with a Braille keyboards and speech output	<ul style="list-style-type: none"> • Braille'nSpeak • Braillemate
Portable QWERTY keyboard note taking device	A portable hardware note taking device with a QWERTY keyboard and speech output	<ul style="list-style-type: none"> • Type'nSpeak • Magnum
Braille translation software	A software that converts electronic text into Braille code and format text for printing in Braille	<ul style="list-style-type: none"> • Duxbury • HotDots
Braille printer	Hardware	<ul style="list-style-type: none"> • VersaPoint • Rome • BrailleBlazer
Refreshable Braille display	A hardware add-on to computer that gives a one line Braille display of what is on the screen	<ul style="list-style-type: none"> • Navigator • PowerBraille

Table 2-Computer Technologies for Students Who Are Blind (Source (Catherine et al., 2001))

Computer based Assistive technology	Description	Commonly known
Document reader	Text- to-speech software that uses synthesized speech to read what is on the screen but fewer features that screen reader has.	Zoom Text ReadToMe Clip&Talk
Screen reader	Text- to-speech software that uses synthesized speech to read what is on the screen but fewer features that screen reader has.	JAWS, Artic, Windows Bridge
Reading machine	Standalone equipment that scans pages and reads content using synthesized speech	Kurzweil
Optical character recognition (OCR) software (used with a scanner)	A Software that converts a printed page that has been scanned into electronic text file format for speech output or storage	OpenBook, Arkenston unbound, OmniPage, PegisPro
Document manager Program	A software which is visionary Solution to Document Conversion and Management	PegisPro
Large monitor	Hardware used for enlarge what is on the screen	17-21 inch monitor, CCTV screen
Screen magnification	A software used for enlarge what is on the screen	ZoomText, LPWin/DOS, The Magnifier, Loupe, Microsoft Magnifier
Portable QWERTY keyboard note taking device	Portable hardware note taking device with a QWERTY keyboard and speech output	Type'nSpeak, Magnum
Voice control of menus and toolbars	A Software which allows voice commands such as	Dragon Dictate Classic Edition, Kurzweil VoicePad for Windows, Voice Direct, Aptiva computer

Table 3 -Computer Technologies for Students with low visual (Source (Catherine et al., 2001))

2.3 Concept of E-learning

Scholars define the word education as a learning process implemented in some educational institute; where research are carried out, lecture and discussion takes place with the leading of teachers who plays a significant role in process. However, beside the traditional ways of learning, rapid growth of ICT has provide new opportunity on how people can acquire knowledge regardless of their location based on their choice, pace and Time Anohina(2005). E-learning is one of the opportunity created with the advancement of ICT.E-learning has changed and brought significant output for learning process in current information society-learning accessibility and usability by people who have visual impairment are the main objective of this study. Therefore, it is important to understand what is meant by E-learning-Learning understood and defined in different way on different materials. For example Anohina(2005) define e-Learning as learning process which takes place through any electronic media including online learning and non-networked computer-based. Similarly different authors presents e-learning as learning process using electronic application and processes via internet, network or standalone computer. On the other way Arkorful & Abaidoo(2014) defined e-learning as the learning process that use digital tools in teaching-learning process to deliver knowledge and motivate learners interaction by facilitating easy way of communication to improve relations that sustain learning anytime anywhere. Mousa et al.(2006) also describes e-learning as a means of education that combine self-motivation, communication, efficiency, and technology accessed from properly equipped computer terminals and other means of internet technology by eliminate geographical distance.

According to Berhe (2011), research conducted on current status of e-learning access in developing countries like Africa shows different e-learning practices across the continent. However it is in infant stage in Africa. E-learning introduced for the first time in Ethiopian by CivICT project of the World Bank institute in 2003 was called “Governance in the Hands of Youth”. This first e-learning in Ethiopia able students to communicate with the world using email, the project further encouraged students to be able to participate in other areas of knowledge sharing with other African students organized by World Bank institutes ATN (2004). E-Learning Ethiopia is another e-learning initiative in the country-Learning Ethiopia was started and being administered by the Ethiopian Engineering capacity Building program and open to anyone who is

interested in ICT-supported education .It was working on introducing e-learning technology and methods to Ethiopian higher and TVET colleges in Ethiopia.

According to ISLAM & Sadeque(2006), e-learning is getting popular in educational institutes in developed countries. But it is also a dream for many developing countries because of poor ICT infrastructure and other so many reasons: such as, very high initial cost for infrastructure development.

To increase public access to internet and in order to getting benefit from e-learning, developing countries should consider below main points before introducing e-learning in the countries.

- Reliability of the technology: - e-learning democratization will be challenging until technology becomes more reliable.
- Sustainability of technology: - rapid evolution of technology is another concern for e-learning providers and learners.
- The interface and its ease of access: - the level of technology accessibility for all user and should be available to everyone.
- Cost of the equipment and access: - the market and cost has impact on the equipment and access to the network.
- Maintenance cost and infrastructure :-constant attention of hardware and software infrastructure is required for e-learning
- Direct cost: - estimating and managing the direct cost of investment is required to determine the worthwhile of the investment.
- Conversion cost (equipment, skill):- planning the implementation of new system and skill is risky because of the state of technological and economical rapid change.

E-learning is being implemented more and more in different parts of the world and creating new plus exciting views for students. Successfully adopted e-learning system in the educational system is an indication of positive contribution of technology in facilitating learning. Arkorful & Abaidoo(2014) asserts adoption of E-learning in education has several advantages and benefits. Similarly Virginio et al. (2004) also said the main reason for e-learning implementation is for its numerous advantages than its disadvantage. E-learning with accurate planning, monitoring and control makes it effective. E-learning provide benefit for different bodies such as educational institutions, corporations, organizations and individual learners interim of cost, time, flexibility

and also accommodate different types of learners and gives them opportunity to learn in their own pace.

In contrast, despite the claims that e-Learning has when adopted in education, Virginio et al.(2004) and Arkorful & Abaidoo(2014) also has discusses some e-learning disadvantages. For example Virginio et al.(2004) and Arkorful & Abaidoo(2014) argues that e-learning may cost more to develop, and enabling technology might also be costly. In addition it also requires more responsibility and self-discipline for the learner to keep up with a more free and unconstrained learning process; schedule and also lack of interaction between learners and instructor; plus it cannot be apply to all discipline or fields for education techniques.

2.3.1 Type of e-learning

Organizations are currently transforming their learning and development programs to e-Learning. However, choosing the right e-learning delivery method for their business based on their needs is another challenge. Because the right delivery methods directly impact the effectiveness and cost benefit of an organizations.

There are different ways to classifying types of e-learning. According to Epignosis LLC(2014), e-learning categorized into Synchronous and a asynchronous based learning environment. Both type of learning have its own approaches, advantages disadvantages plus techniques that is appropriate for students. Basically, effective e-learning should include both type of learning.

- **Synchronous learning** carried out in real-time, and let learners interact with each other and teachers during the lesson and allow students to avoid isolation feelings since they are communicating with others throughout learning process, however it is not flexible in terms of time, and students cannot complete the course on their own and at their pace.
- **Asynchronous learning** takes place without the need of both the student and teacher being online. Students complete the lesson with their own pace and time usually using internet as a supporting tool but it is not interactive and students who lack the motivation to complete the lesson don't receive significant benefit and its leads to isolation.

In the other way, based on means of communication, schedule, class structure and technology used, Mousa et al.(2006) classify e-learning into four as described below.

Means of communication

There are different means for individuals to communicate for the student to communicate to their instructors-learning can be conducted only through online application or if the distance is not a factor, face to face communication can also include creating blended e-learning which include web interaction and in-person interaction.

Schedule

Based on schedule, e-learning is classified as Synchronous and Asynchronous same way as Epignosis LLC (2014)

Class structure

Addresses how the teaching is managed. E-learning can be self-paced instruction where learners given the material they need to complete the training or can be instruction-led where the training guided by instructor to complete the training or can be self-study with an expert which is the combination of self-paced and instruction-led.

Technology used

Technology is the most flexible element in e-learning and e-learning achieved by utilizing any form of technology that sustains information yielding media and not limited to web-based materials. The more the technology advanced, the more options there are for e-learning and more means to deliver the information and aids the learning experience. For example, the creation of internet consequently creates e-learning, the quality of online learning improved in relation to computer technology advancement, the device become smaller and more mobile, an increase in speed and bandwidth lead the training become more flexible and boost popularity of e-learning.

In other way, oye et al.(2012) said e-learning has diverse view that can be perceived from different perspectives defined below.

1. **Course**

In order to achieve more motivated courseware, courseware designers have begun to add innovative presentation such as simulations, storytelling and various unique traits into the materials.

2. **Informal learning**

Our information need and our strategy to use it drive our search. In workplace we acquire more knowledge during break time through informal learning using Search engines like Google attached with information storage tools like Furl and personal knowledge management like wikis and blogs and progress more in our job.

3. **Blended learning**

An integrated learning which is a combination of face to face and online learning that employs best of classroom learning and online learning and combine different delivery methods such as delivery software, web based courses and computer communications that provides a good transition from classroom learning to e-learning.

4. **Communities**

As learning is social, in this global age, community contribution is high in flow of tacit knowledge that helps to in solving frequent challenges in business daily through dialogues with other members of the same organization or network globally to solve sophisticated and unstable business problem.

5. **Knowledge management**

E-learning is one of the focuses of globalization because it has the potential to bring improved learning opportunity to a large number of people that was previously not possible. For nation's becoming successful knowledge economy, sits ability to become a learning society. Therefore knowledge management is an essential process to create atmosphere for people to share knowledge in an organization. Appearance of Knowledge Management and e-learning reveals powerful relationship in search and retrieval field and the development of e-learning tools for communities practices.

6. Learning Network

A process of developing and maintaining relationship with people to share knowledge and expertise in support each other in learning.

2.3.2 E-learning Platform

E-learning is a growing area in higher education and this teaching exercise embraces great potential to be an opportunity of inclusion for people with disabilities to help students with disabilities in their studies in higher education. These e-learning potential benefits for students with disabilities can be applied in a variety of different e-learning contexts. Most universities make use of some form of formal learning management system to facilitate both blended and fully online learning and teaching. In order for this potential to be realized the e-learning platforms need to be as accessible as possible for students with a range of different impairments (Kent, 2015).

Moodle Platform is one of the most widely used open-source e-learning platforms that enable the creation of a course website, ensuring their access only to enroll students this platform allows the exchange of information among users geographically Cole & Foster(2008).Moodle Platform allows the exchange of information between geographically dispersed users through synchronous and asynchronous communication mechanisms Costa et al.(2012).In Moodle platform, each person design a course out of their own Moodle web interface and this lead to accessibility problem preventing assistive technology such as screen readers being able to navigate the page Kent(2015). According to López et al.(2011), accessibility of Moodle is difficult using assistive technologies such as JAWS and NVDA. According to Kent(2015), the reason often is designing a course set without an existing accessible template. On the other hand Blackboard is one of the leading commercial learning management system platform for delivery and management of all electronic learning materials, across a student that provide a password protected environment. It has an administration tool that makes teaching online easier. Blackboard LMS primarily was inaccessible and become disability-friendly after ten years of its lurching (Kent, 2015).

Both Moodle and blackboards learning management systems have the potential to be able to provide a more accessible platform. However in both cases, the course content that is hosted through these sites have its own accessibility issues such as problems on accessibility of websites and learning management systems; the accessibility of digital audio and video content the accessibility of PowerPoint presentations and also course material; inaccessible PDF formats and

lack of access to required assistive technologies. For these reason disabled students can only access to the e-learning platform but not the contents, resources, activities, collaboration and interactive tools. This problem stems from challenges to making university material accessible due to growth in complexity of digital media in recent years Kent (2015).

2.3.3 E-learning Tools

Mousa et al., (2006) asserts that there is no single tool that brings e-learning to existence and says three different required tools ,i.e. access, offer and create ,for e-learning success along with software to meet these three categories.

On the other way oye et al. (2012) discussed other three e-Learning tools:

1. **Curriculum tools:** provide a systematic and standard environment to support classroom learning and helpful in starting and learning stage.
2. **Digital library tools:** facilitate effective and efficient access to resources to support exploration and collection.
3. **Knowledge representation:** focuses on formulation and representation of knowledge and assistance learners visually review, capture or develop knowledge.

2.3.4 E-Learning and visual impairment

The use of information and communication technology, including internet on campus and distance education is global and students must adopt e-learning to succeed in college. In today learning environment students are expected to download course materials from internet or dedicated course website. E-learning facilitates an environment in the inclusion of students with visual impairment in higher education. The experience of students with vision impairment in the use of information technology and e-learning has gradually changed for many reason such as the increase use of electronic technology and course material in higher education; high use of computer technology for test and lectures with the presence of hardware and software assistive technology compatibility with the general use of information technology Catherine et al. (2009).

However, Anjali et al.(2013) asserts that student with visual impairment faces various type of challenges to full access of e-learning materials. In addition only very few numbers of e-learning tools that is available for visually impaired learners.

To address the barriers of students with visual impairment on accessing e-learning, Stefan et al. (2007) says that consideration of visually impaired students specific need is critical to provide appropriate solution based on type and nature of impairment. Analyzing specific features and functionalities of the technological tools at hand is also significant because different type of visual impairments have different needs.

Several researches show that achievement of a person with visual impairments low at secondary and tertiary level. This is often the result of lack of accessibility of learning materials. Education is a vital factor to prepare students for better life. And it is therefore important to make sure that those with vision impairments are able to have complete education access as much as possible so that they can get useful employment and participation in the society Ruchi et al. (2013).

E-learning has many advantages for students however people with visual impairment have barriers in accessing and using of e-learning. For example Ruchi et al.(2013) define some of common problems faced by students with vision impairment as follows

- Inaccessibility of websites, learning materials and different learning needs due to their disabilities
- E-learning IT courses are not specifically designed for their need and e-learning models are commonly designed for sighted students and don't incorporate consideration of students with vision impairment
- They are not able to Utilizing complex visual image and interactive features.

Chapter 3

Research Methodology

3.1 Research Design

Research design refers to the structure of the research framework which provides the glue that holds the study used to structure the study to show how all of the major parts of the research project fit together. Research design from content analysis point of view describes as a strategy for collecting and analyzing data in order to answer the research questions. Research design is the design or blue print on how to do the data collection and analysis to provide answer to the problem under study Mcchester & Ihedigbo(2014). Research design is an action plan from getting initial set of questions to be answered to some set of conclusion or answer following major steps including the collection and analysis of relevant data Yin(1999).

The research design of this study follows descriptive strategy using case study approach in order to achieve the research objective. Descriptive case studies is selected because it describes the natural phenomena which occur within its context Zaidah(2007).The case study method is useful to addresses descriptive questions of the research and goals to produce a first-hand understanding of people and events Yin(2004).

The main data collection techniques used in this research study was with a structured questionnaire and, semi-structured interviews with VI students as well as management/administrative individuals and document review. Both quantitative and qualitative methods were used. The combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than a single approach Creswell(2014).Quantitative method will be used to analyze statistical data for the research while qualitative method will be used to describe the awareness and challenges of people with visual impairment in using assistive technology for e-learning.

In order to facilitate the validation of data and research findings, data triangulation and methodological triangulation method were used. Triangulation is a strategy that aids in the elimination of bias for improving the validity of research findings Mathison(1988). Data

triangulation refers use of several data sources at a particular time, and space. Methodological triangulation refers to the use of multiple methods to gather data, such as interviews, observations, questionnaires, and documents in the examination of a social phenomenon Mathison (1988).

3.2 Target population

The target population for this study were regular undergraduate program visually impaired students and administrative officers in Addis Ababa University main campus who works in the socio-economic empowerment of the visually impaired individuals in creating awareness and equal opportunities for training and education chosen as a target population based on their role they have to strengthen the role of visually impaired people.

3.3 Sampling technique

Sampling is related with the selection of a subset of individuals or entities from within a population to estimate the characteristics of whole population. The selection of sampling methods and determination of sample size are very significant to draw correct conclusions Singh & Masuku(2014).The sampling frame concentrated in Addis Ababa University undergraduate students. Random sampling, in which each individual in the population has an equal probability of being selected, was used to choose respondents among students with visual impairment from Addis Ababa University to gather data about their awareness, perceived usefulness of AT, computer and ICT based Assistive technology and technology adoption. Based on the data obtained from Addis Ababa University (AAU)'s disability center, numbers of visually impaired students enrolled for this academic undergraduate program are one hundred forty (140). Sample size determination is the method of electing the number of observations to include in a sample. The sample size is an important feature of any study in which the aim is to make inferences about the population from a sample. Different approaches applied to determine the appropriate sample size and using formulas to calculate a sample size is one of the methods Singh & Masuku(2014).

Cochran (1977) formula used to determine the sample size of one hundred three (103) with the maximum variability equal to 50% ($p = 0.5$) and taking 95% confidence level with $\pm 5\%$ ($e = 0.05$) precision and normal curve that cuts an area $z = 1.96$ for this study.

$$n_0 = \frac{(Z_{\alpha/2})^2 Pq}{e^2}, \quad n = \frac{n_0}{1 + \frac{n_0 - 1}{N}}$$

Where n_0 is the sample size

n = calculated (actual sample size) e = the desired level of precision

p = is estimated proportion of an attribute in the population

$q = 1 - p$

z = normal curve that cuts an area α

Interview was also conducted with Six VI students who were willing and available in order to understand the challenge of VI students on using assistive technology for e-learning. Interview was also conducted with purposively chosen respondents from academic staff, administrative officers who are knowledgeable about ICT and assistive technology for e-learning access from the school and Ethiopian National Association of the Blind.

3.4 Research Instrument

Questionnaire and interview were used in order to gather information on students experience, challenge and opinions of respondents to explore and understand how people with visual impairment perceive assistive technology to access e-learning. Closed form or structured self-administered questionnaires were used to collect from randomly selected students with visually impaired students from Addis Ababa University. The instruments were adopted from different published journals to measure all variables of the research. Some items of the scales were modified to the context of the study. The questionnaires were divided into four parts. Part 1 focuses demographic data and general information of the respondent. Part 2 focuses on respondent awareness on Assistive technology. Part 3 focuses to collect data on technology context experience and knowledge of students on computer use and ICT based Assistive technology. Part 4 focused on collection of data on students view on adopting assistive technology. The data collected from VI students using non-disabled students as a data collector and also by the researcher. The data collector students were trained and supervised by the researcher during data collection to get reliable information and to minimize error during data collection. Unstructured personal interview

were used with the visually impaired students to understand challenges relate to assistive technology. Unstructured personal interview were also used with decision-makers from target population who has significant influence on assistive technology adoption to access e-learning by people with vision disabilities and key individuals who have knowledge about subject matter of the study. Interview was chosen because it can help to collect in depth data and it is more reliable way to collect a wide variety of data that does not require formal testing (Geoffrey et al., 2005). And Interview will also help to collect casual relationships and the contexts for the causes.

No	Constructs that influences actual use of Assistive technology	Variables	Source
1	Assistive Technology Awareness	Student Awareness on Assistive technology existence	
		Perceived usefulness	Davis (1989)
		Attitude Toward Using AT	Davis (1989)
2	Assistive technology Context	Assistive Technology knowledge and experience	Casidy & Eachus (2002)
3	Policy	School Management/administrative support	Igharia et al.(1997)
		School ICT and Assistive technology Policy	Shah et al(2014)
4	Assistive technology adoption	Assistive technology adoption	Davis(1989)

Table 4- Survey Instrument

3.5 Validity and Reliability

Reliability and validity are important concepts related to assessing research meets standards to produce results that inaccurate (validity) and consistent (reliability). Reliability refers to the consistency or dependability of a measurement technique, and it is concerned with the consistency or stability of the score obtained from a measure or assessment over time and across settings or conditions. Validity refers to what the test or measurement strategy measures and how well the measurement approach measured it Geoffrey et al. (2005). Content validity is a type of validity that address how well the items developed to measures the content they were intended to measure Creswell(2014).Because there is no statistical test to determine whether a measure adequately converse a content area or represent a construct content validity usually depends on the judgment of experiment in field Carole & Almut (2008). Construct validity defines how well a test or experiment measures up to its claims Creswell (2014). To insure the content validity of the instrument, detailed literature review was made prior the design of the questionnaires and pre-test was distributed to three VI students and five peers IT professionals. This assisted to check instrument items measured the content it were intended to measure.

Reliability is the scale internal consistence. One of the most commonly used indicators of internal consistency is Cronbach's Alpha Coefficient. The Cronbach's Alpha is 7 or higher value indicates the reliability of the scale (Pallant, 2005).Reliability test was also checked using Cronbach's Alpha Coefficient in order to measure the internal consistency of the instrument. As the result presented on table 5 shows the Cronbach's Alpha value greater than 7 indicates the internal consistency and reliability of the scales. Table 6 also shows the overall reliability coefficients for each set of variables.

Reliability Statistics

Cronbach's Alpha	N of Items
.862	22

Table 5- General Reliability of the instrument

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
AT Familiarity for E-learning Access	69.99	119.747	.401	.809
Over All ICT based AT Awareness	69.96	116.039	.567	.802
AT Usefulness in E-Learning	67.76	111.578	.684	.795
AT For Productivity at School	67.66	114.469	.651	.799
AT For enhancing Effectiveness	67.63	113.751	.651	.798
AT for Independence	67.75	111.462	.726	.794
I like the idea of using AT for learning activity to access e-learning	67.88	106.309	.758	.787
I believe use of AT in learning to access e-Learning material	67.71	112.067	.680	.796
I have generally Positive Attitude towards using AT	67.70	112.071	.590	.798
I find Working with Computer is easy	69.15	107.725	.524	.799
I find working with Computer gets in way of Learning	67.74	114.720	.479	.803
I find working with Computer makes learning more interesting	68.85	111.119	.439	.805
I am familiar working with Windows OS Familiarity	68.99	110.757	.391	.808
I am familiar working with Other OS Familiarity	70.97	129.666	-.253	.826
I am familiar working with Windows free or Built AT	69.72	118.769	.287	.812
I am familiar working with Other free ICT based AT	69.84	124.116	.044	.823
I am familiar working with Text-to- Speech AT A	68.05	108.371	.577	.796
I am familiar working with Screen Magnifier AT	70.65	131.624	-.255	.836
I am familiar working with braille input /out AT devices	70.87	131.084	-.337	.829
Adopting AT is Good	67.94	106.279	.667	.791
I believe Adopting AT ensure Better e- learning for VI	68.01	105.505	.648	.791
Cost of AT Hardware & Software will not be prohibitively expensive	70.12	138.874	-.406	.857

Table 6- Overall reliability coefficients for each set of variables Item-total Statistics

3.6 Data processing and analysis

Data were checked manually for completeness. The quantitative data was entered into SPSS software for data analysis and presented using frequency, percentages and graphs. The qualitative data collected from interview was analyzed by hand using inductive open coding analysis method and key findings presented, using appropriate verbatim under theme or category.

3.7 Conceptual framework of the study

The conceptual framework develops a relationship between assistive technology to embrace e-learning by visually impaired students, and factors that influence such assistive technology awareness, technology context, administrative/management support and government for the adoption.

Assistive technology Awareness

Assistive technology awareness Technology dissemination which often appears to occur as a continuous and slow process ultimately determines the step of economic growth and rate of change of productivity unlike the single event of invention of new technology. New technology may contribute little until many users adopt it. Dissemination can be seen as the cumulative or combined result of a series of individual calculations that consider the incremental uncertainty of the benefits of adopting a new technology against the limited information about both the benefits and costs, and even about the very existence of the technology (Hall, 2002) . Public awareness is important to increase interest and support, stimulate self-mobilization and action, as well as mobilize local knowledge and resources for the adoption of a new technology. Awareness rising requires strategies of effective communication to reach the desired outcome. The aim of awareness raising campaigns differs between circumstances but generally includes increase concern, informing the targeted audience, creating a positive image, and attempts to change their behavior (ACBC, 2016). Awareness raising means making a group of people aware of something and with the word “campaign”. The concept of awareness rising refers in concrete terms to a communication, a promotion and/or information promotion. When planning awareness-raising campaigns, it is critical that audiences that might needs special considerations such as those with physical disabilities are not overlooked (Sayers, 2006).

On the other hand, Davis (1989) also indicated that attitude of user and perceived usefulness are important to accept certain technology is the key determinant. Davis (1989) defines perceived usefulness as the degree to which an individual believes that using a particular system would enhance his or her job performance. Perceived usefulness was also considered one of the major influences for the attitude of the user. Users attitude towards computer, prior information and communication technology experience and state of technology readiness, had a significant effect on the adoption of e-learning system. Al-alak & Alnawas (2011) also said that people who have positive attitudes towards information technology will have higher acceptance of the use of the technology in question, compared to those who have negative attitudes toward that technology. To promote technology enhanced education, it is important to investigate how students perceive the technology. Furthermore, it is important to examine student knowledge, skills as well as attitudes towards the technology plus how students could use the technology in education to more likely integrate it in learning (Rana, 2012).

Assistive technology context

Computer technology creates access to information and assists to overcoming barriers caused by specific physical impairment. Fichten et al. (2000) stated that computers are best enabling technology that allows students with disability to prepare and participate in knowledge based-economy for tomorrow. However the need for training is one of the most prominent problem preventing students from using computer technology.

Similarly, accumulative memory process of an individual experience with the use of technology which has been defined as the amount and type of computer skills a person acquires over time influences their ability to learn new concepts. Individual prior experience is an initiator for learning process and making new technology easy to be adopted (Al-Alak & Alnawas , 2011).

An evidence-based understanding of students' technological experiences is vital in informing higher education policy and practice. An in-depth understanding of students' technological experiences will have clear implications for areas such as student access, equity, and transition. Institutional decision making associated with the management and administration of information and communications technologies, technological infrastructure support, resource investment, student and staff support would also benefit from evidence about students' existing experiences with technology. Mainly, an investigation of students' current technological experiences will have implications for ways in which technology could possibly be connected in pedagogically sound

ways to improve teaching and learning (Kennedy et al., 2008). These benefits can be achieved through the promotion of national innovation systems that foster public-private collaboration, as well as development and diffusion of knowledge, accessible products and content as well as assistive technologies. It is important to raise awareness of policy and decision makers on the need for elaboration of interlinked normative frameworks regarding the use ICTs and assistive technologies by persons with disabilities (BCDD,2013).

Planning for campus-wide technology purchases and computer infrastructure improvements in post-secondary educational institutions is currently an active process. As educational institutions rush to design and implement campus-wide computer systems and networks, consideration for the requirement needed for the adoption to ensure accessibility for students with different impairments is rare and not on their top priority list. It is important to ensure that the needs and concerns of learners with all types of disabilities are represented in planning decisions from their inception. (Fichten et al., 2000).Governments can play a key role in stimulating the introduction of ICT-enabled solutions adapted to the needs of persons with disabilities, increasing the availability of accessible ICTs and promoting the affordability of assistive technologies in social, educational, economic and other domains (BCDD,2013).Management support is one of the most critical and important factors which contributes to the adoption of technology (Al-Alak & Alnawas , 2011). Accessibility and use of ICTs by persons with disabilities should be seen as an integral part in enabling them to enjoy all human rights and fundamental freedoms. Accessibility entails the removal of environmental barriers that prevent persons with disabilities. Introducing mandatory policies that incorporate accessibility, availability and affordability facilities; promoting economic and social inclusion through the use of accessible ICT (BCDD,2013).

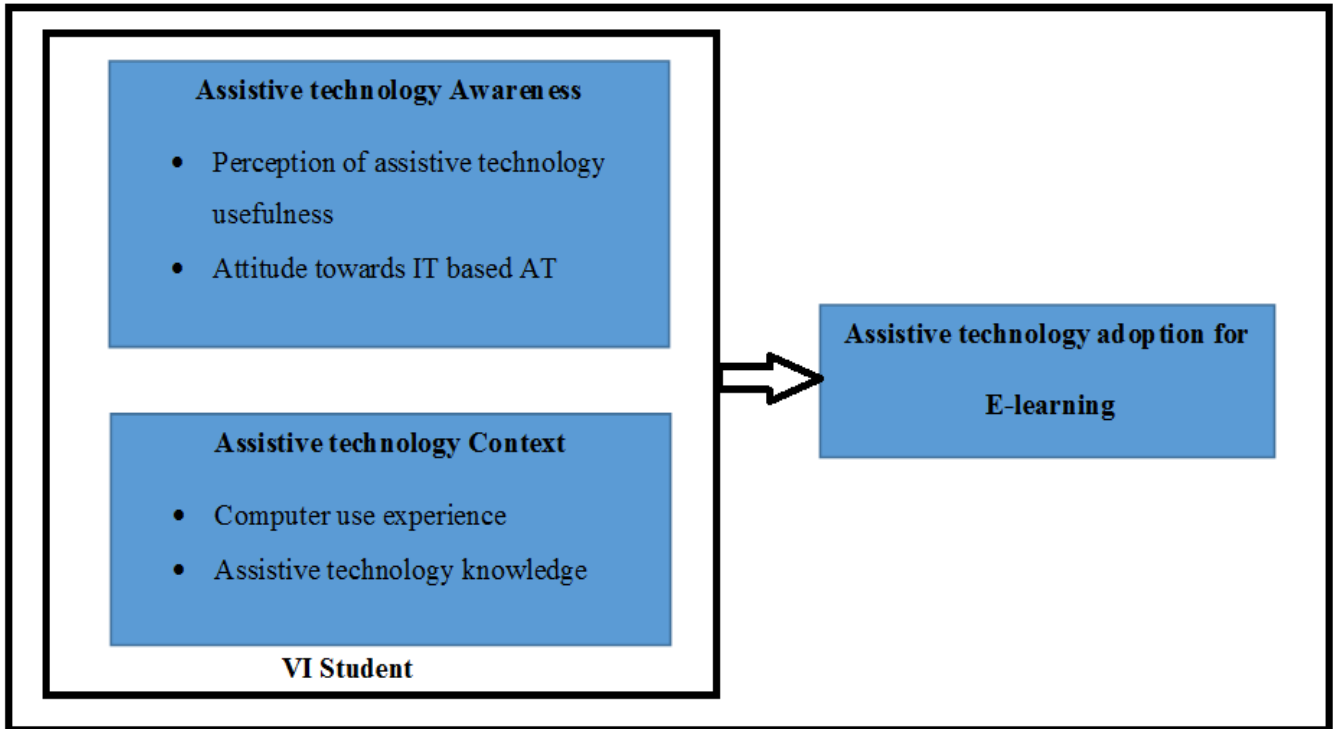


Figure 1- Conceptual framework of the study

Chapter 4

Data Analysis and discussion of the research findings

This chapter presents the results of data analysis involving the quantitative and qualitative techniques.

Section 4.1 of this chapter present a quantitative analysis of the data obtained from the questionnaires to answer research question one, two and five. This section discusses the basic information derived from analysis of each variable presented through descriptive statics and the cross analysis using ANOVA and correlation analysis. The quantitative data collection instrument has four parts .Part one of were designed to collect demographic information of the respondent. Part two was designed to collect data about student assistive technology awareness. Part three was designed to elicit data on student experience on computer use and ICT-based assistive technology. Part four was designed to collect data on assistive technology adoption .The questionnaire has a total of 22 items. All items(except part one and part two awareness) were measured on a five-point Likert-type scales ranging from "strongly disagree", "disagree", "neutral", "agree" ,and "Strongly agree".

Section 4.2 presents and interprets the findings of qualitative data analysis obtained from the interview to answer research question two, three and four. Section 4.3 discusses the finding of the research result.

4.1 Quantitative data analysis

4.1.1 Response Rate

Sample size of one hundred three (103) was calculated using Cochran (1977) formula to distribute the questionnaires however data is collected from a total of one hundred nine (109).

And response rate were also calculated using:

$$\frac{\text{Number of responses to the questionnaires}}{\text{Number of questionnaires sent to the survey}} \times 100 = \frac{109}{109} \times 100 = 100\%$$

To check the validity and accuracy of data collected using below formula. As the result shows the response rate were 100% the response and rate is high to be considered valid to proceed with the analysis using the data obtained.

4.1.2 Demographic and impairment type characteristics of student profile

Table 7 below shows the demographic characteristics of the respondent with their vision impairment type. Out of the total of 109 respondents, 73% of respondents were male and 28% were female. 29% of the respondents were low vision and 70% were blind. This indicate that ICT-based assistive technology implementation in the school should consider both types of student impairment in order to benefit all students equally.

		Impairment type		Total	
		Low vision	Blindness	Total	Percent
Gender	Male	22	57	79	72.5
	Female	10	20	30	27.5
Total		32	77	109	100

Table 7-Demographic characteristics of respondent student

4.1.3 Computer use experience and assistive technology awareness

4.1.3.1 Visually Impaired students computer use experience

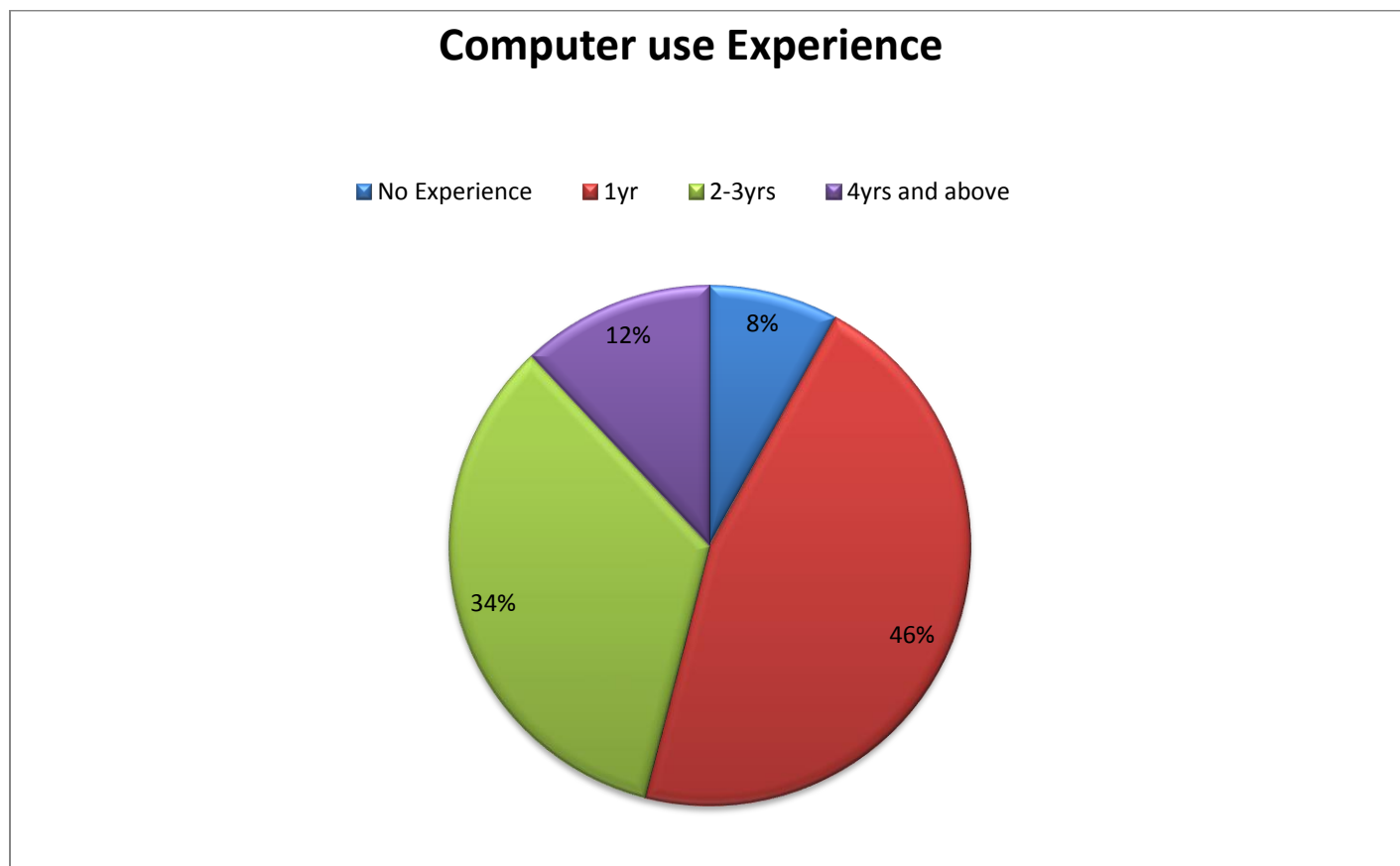


Figure 2- Respondent students computer experience

According to the result obtained in figure 2, 46% of students have only one year experience working with computers, 34% of the respondents have 2 to 3 years of experience and 12% of students have 4 years and above experience in working with computers. This indicates that students who have more than 4 years and above experience are less in number than those who have no or 2-3 years of experience. This may be because of the fact that there were no low-level computer courses for the visually impaired students and their experience on working with computers acquired through their stay in the university. This confirms the need to include ICT skills as equal as the sighted students and ICT-based assistive technology as a module in lower and higher institution curriculums in order to help them to be benefited from of e-learning advantages as equal as their peers sighted competitor on their academic performance since computer skill is

one of the basic means to access e-learning materials. On the contrary, 8% or 9 students have no experience working with computers. These 8% or 9 number of students are excluded from further analysis since these students have no experience working with computer and as this implies to the assumption of those who don't have experience working with computer will not have ICT based assistive technology awareness as well as experience. Therefore, the rest of the analysis is calculated out of a total of 100 students on those who have a year or more experience working with computer.

4.1.3.2 Visually impaired students over all assistive technology awareness

The study also sought to find out respondents awareness on assistive technology. Table 8 below presented the outcome of the result that shows 22% of respondents believed that they have good or very good overall awareness on assistive technology and 14% of students believed that their overall awareness on assistive technology is poor. On the other hand, 56% of the students believed that their overall awareness on assistive technology is fair. This signifies that majority of visually impaired student assistive technology awareness is fair. This implies that work should be done to raise student awareness because as Ahmad (2015) stated, assistive technology devices have an important role in supporting individuals to be independent.

Response	Frequency	(%)
Poor	15	13.7
Fair	61	55.9
Good	15	13.7
Very Good	9	8.2

Table 8- VI respondent over all AT Awareness

4.1.3.3 Perception of Assistive Technology usefulness

Table 9 illustrate about the perception of assistive technology usefulness by visually impaired students. As the result indicates, 62% to 69% respondents answered strongly agree on the

usefulness of assistive technology to increase productivity at school, to enhance effectiveness and to improve independence. Similarly 17 % to 21% responded agree on the usefulness of assistive technology to increase productivity at school, to enhance effectiveness and to improve independence. On the contrary, between 2% to 5% of students responded disagree on the usefulness of assistive technology to increase productivity at school, to enhance effectiveness and to improve independence. And only 1 % of respondent answered strongly disagree on the usefulness of assistive technology. On the other hand 8% to 13% of students are not sure about assistive technology usefulness on e-learning, to increase productivity at school, to enhance effectiveness and to improve independence and responded neutral. This shows that majority of student perception on the usefulness of assistive technology to increase productivity at school, to enhance effectiveness and to improve independence is positive.

	Responses				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Assistive Technology will be useful in my learning process for computer and e-learning access	1	5	13	17	64
Using Assistive Technology will increase my productivity at school.	1	2	8	26	63
Using Assistive Technology will enhance my effectiveness	1	3	9	18	69
Using Assistive Technology will improve my independence	1	4	12	21	62
Total	1	3.5	10.5	20	64

Table 9- Perception of Assistive Technology usefulness

4.1.3.4 Attitude towards Assistive technology

As table 10 shows, students were asked if they like the idea of using Assistive Technology on learning activity to access e-learning material and 14% and 65% answered agree and strongly agree respectively and 10% and 4% responded disagree and strongly disagree idea of using

Assistive Technology on learning activity to access e-learning material. Similarly, students were also questioned if they believe using assistive technology is a good idea on learning activity to access e-learning material. And 22% and 64% responded agree and strongly agree respectively and 1% and 3% replied disagree and strongly disagree. For general positive attitude toward using assistive technology question, 11% and 73% of student answered agree and strongly agree. In contrary, 11% and 1% responded disagree and strongly disagree. This indicates that majority of VI students like the idea of using assistive technology on learning activity to access e-learning materials. Most of students also believe that using assistive technology is a good idea on learning activity for e-learning access. The result also revealed that maximum number of student attitude on using assistive technology is positive.

	Responses				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
I like the idea of using Assistive Technology to my learning activity to access E-learning material	4	10	7	14	65
I believe it is (would be) a good idea to use Assistive Technology in my learning activity to access E-learning material	3	1	10	22	64
I have generally positive attitude toward using Assistive Technology	1	11	4	11	73
Total	2.7	7.3	7	15.7	67.3

Table 10- Attitude towards ICT based Assistive technology

4.1.4 Computer, operating system familiarity, and ICT-based Assistive Technology knowledge and experience

4.1.4.1 Working with computer and Operating System familiarity

As table 11 illustrate, about working with computer and assistive technology familiarity. The result on table 11 shows 22% to 67% of students responded strongly agree on working with computer very easy, computers are getting in the way of learning and working with computer

makes learning more interesting. However, 2% and 23% of students responded strongly disagree on working with computer very easy, computers are getting in the way of learning and working with computer makes learning more interesting. On the other hand, 35% of respondents answered strongly agree on their familiarity working with windows operating system and 20% responded strongly disagree on their familiarity working with windows operating system. On contrary the result shows that almost all or 92 % of students responded strongly disagree on their familiarity on non-windows OS such as Mac. This shows that, almost for half percent of students, working with computer is not an easy task. And majority of students strongly agree on the presence of computers on their learning process. Therefore, providing computer training and support to visually impaired students should be consider to help them improve their skill to work with computers. In addition, the result also indicated that majority of students are familiar working with windows operating system. Almost all students are not familiar with other OS such as Mac. Thus support providers should mostly focus on exploring and providing Microsoft OS compatible free and built-in Assistive technology product as most of students are familiar with windows OS.

	Responses				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
I find working with computer Very easy	23	22	10	23	22
I find working with computer gets in the way of learning	2	8	5	18	67
I find working with computer makes learning more interesting	14	19	21	16	30
I am familiar working with Microsoft Windows operating System	20	24	12	9	35
I am familiar working with non-windows OS such as Mac	92	2	4	1	1
Total	30.2	15	10.4	13.4	31

Table 11- Working with computer and operating system familiarity

4.1.4.2 Assistive Technology familiarity

Students were asked on their confidence to make use of different windows and other vendor built-in or free assistive technology products. As the result shows in table 12, 18% to 14% responded strongly disagree and 52% to 58% responded disagree (i.e. the highest percentage) about their ability to make use of built-in or free information technology based assistive technology product of Microsoft Windows or other vendor product. Only 6% to 7% students responded strongly agree on their ability to make use of built-in or free information technology based assistive technology product of Microsoft Windows or other vendor product. And 10% replied agree about their confident to make use of built-in or free information technology based assistive technology product of Microsoft Windows or other vendor product. Similarly, 63% of students strongly agree on their ability to make use Text-to-speech (screen reader) Assistive Technology software such as JAWS, NVDA, Window-Eyes, Open Book assistive technology and only 8% strongly disagree on their ability to make use of Text-to-speech (screen reader) Assistive Technology software. In addition, from a total of 32 low vision students, only 17% of Visually Impaired students are familiar working with Screen Magnifier assistive technology products. 81% of Visually Impaired students disagree or strongly disagree on their familiarity working with Screen Magnifier assistive technology low vision people. In like manner, almost all respondents or 84% of students strongly disagree or agree on their familiarity working with Braille input-output assistive technology devices and 2% of students believed that they are familiar working with Braille input-output Assistive technology devices.

	Responses				
	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
I am very confident in my ability to make use of built-in or free information technology based AT product of Microsoft Windows OS	14	52	18	10	6
I am very confident in my ability to make use of built-in or free information technology based Assistive technology product of other vendor product	18	58	7	10	7
I am confident in my ability to use Text-to-speech (screen reader) Assistive Technology software such as JAWS,NVDA, Window-Eyes, Open Book	8	8	14	7	63
I am confident in my ability to use Screen Magnification Assistive Technology Software Such as Zoom Text, The Magnifier, Windows Magnifier(Low vision Students only)	70	11	0	7	15
I am confident in my ability to use Braille input-output devices Assistive Technology device	83	9	6	2	0
Total	40.6	26.4	10	7	16

Table 12- students' confidence level on use of built-in or free based AT products

4.1.5 Multiple regression

Multiple regression is a technique that can be used to explore the relationship between variables. It can be used to test the predictive power of independent variables to assess the relative contribution of each individual dependent variable and it also tells how well a set of variables able to predict a particular outcome (Pallant, 2005). Standard multiple regression analysis was done in order to check relationship and also the implication of independent variables of students awareness on

assistive technology and students experience on computer and also assistive technology use on the assistive technology adoption, with two awareness components.

4.14.1 The relationship between independent variables with dependent variable

As shown on the model summary on appendix A, the coefficient of .781, R value shows the strong positive relationship between the independent variables (Students AT awareness and AT experience) and dependent variable (AT adoption). R Square value 0.610 confirms that the independent variables explained 61% of the variance of the dependent variable, Assistive technology adoption for e-learning by students. Therefore, there is a positive relationship between the dependent variable and the independent variables. According to ANOVAs able on appendix B, F value 75.752 and $p=0,000$ shows that the model was statistically significant. According to coefficient table on appendix C, the beta value 0.782 value under Standardized coefficients column and the Sig value 0.000 shows that the variable awareness makes the strongest and significant unique contribution on explaining the dependent variable when the variance explained by both independent variables in the model. The beta value .029 under Standardized coefficients column for AT Experience was slightly low, indicating that it made less contribution for the adoption of assistive technology. The tolerance value .756 and the VIF value 1.323 under Co linearity Statistics on coefficient also confirms the absence of multi co linearity.

In summary, the result from the standard multiple regressions shows that the awareness of students about assistive technology has the greatest contribution for the adoption of the technology and student awareness are crucial for the adoption of assistive technology. Since awareness is the calculation that considers uncertainty of the benefit of adopting a new technology against limited information about both the benefit and cost. It is even information about the very existence of the technology. As Hall (2002) indicated, new technology may contribute little until many users adopt it. Therefore a lot of work should be done to create and raise assistive technology awareness in order to inform students the existence of assistive technology, the benefit and cost analysis in order to empower them adopt it for e-learning to make them participate in today's new learning phenomena. Thus visually impaired students adopt it. The reason for that is, as Ahmad (2015) stated, assistive technology devices have an important role in supporting individuals to be independent. In addition, supporting students to develop their experience on working with

computers and using assistive technology should also be considered along with awareness rising since it is the second most significant factor for the adoption of assistive technology by the student

4.2 Qualitative data analysis

4.2.1 Interview with VI students

4.2.1.1 Respondent of the Interview

The interview was conducted with six VI students, who were willing and available in order to understand VI student challenges on using assistive technology for e-learning in order to answer the second research question. Numbers of interviewed students were limited to six because of the time condition. These students were studying in social work, Law and special need Education department. Two students were female and four students were male. Among the six interviewed students, one of the students was a low vision. All interviewed students have two and above years of experience working with Computer and ICT based Assistive technology experience. Although the sample consisted of both gender, gender was not the important variable for the study.

4.2.1.2 Interview Summary

The interview questions, which found in Appendix Axis categorized into e-learning access and technological themes and challenges related to computer and e-learning access. The findings of the interview from all respondents compiled and presented in section 4.2.1.2.1 and 4.2.2.2.

4.2.1.2.1 Computer for e-learning access in the school and assistive technological theme

ICT makes dynamic changes in the society. It is also influencing all aspects of life increasingly at school. According to one administrator staff interviewees, the university is aware of ICTs powerful potential for educational changes and its role on strengthening the operational mission of the university learning-teaching process. According to Administrative IT interviewees, AAU is implementing Moodle Learning Management System that support and promote self-learning and creating learning opportunities for large number of students on and off campus. The university is also working to make ICT accessible to all students in order to give equal opportunity. The respondent also mentioned about special need support center which provide support for students

with disabilities to create a barrier-free environment. The objective of the center is to help visually impaired students to complete coursework independently and lead self-determined lives and also to embark on advanced education courses. The center is equipped with computers with assistive technologies such as speech recognition software that can give computer access to visually impaired students. Schmidt et al.(2014); Tarawneh et al. (2011); Lombardi et al. (2011) as cited in Fichten et al. (2014) described most instructors use some form of e-learning in their courses that includes PowerPoint, simulations blogs, digital text-books and faculty often make online materials available on a course web site or a course/learning management system that allows students to interact with learning materials outside of the classroom in addition to using e-learning platforms implemented in the school.

As stated by interviewees student, JWAS (Job Access with Speech) and an open source NVDA (No visual Desktop Access) screen reader are assistive technologies mostly used in the school work to complete and read assignments, to access e-learning materials such as referring from the internet or to use web-based discussion boards or courses delivered over the internet, reading PowerPoint presentation and browsing the school website or digital text-books given by instructors. Similarly, the interviewees also described that there are free screen readers that they are aware of such as Window-Eyes and Read Tome, and also built-in operating System accessibility features such as narrator and screen magnifier that may make the device easier to use. In relation to free and built-in assistive technology, one of respondent stated that:

“Even though free and built-in accessibility features do not provide adequate support as specialized commercial software, it can be an alternate for students like us who are living in developing country. Because affording the cost of commercial software and hardware is a nightmare for most us”

But according management interviewee, understanding and providing appropriate free or operating system built in assistive technology suitable for students needs IT professionals ‘technical as well as management support. Because the blind students assistive technology need is different from low vision students’ assistive technology. Low vision people use magnification software and/or large screen monitors or synthesized speech. They can also use a scanner and OCR software to turn the printed page into electronic text, can also use a variety of specialized software as well as built-in features of popular commercially available software packages to change the contrast and to enlarge

and otherwise make text, cursors, and other visual elements more visible on the screen. In relation to assistive technology for low vision students, the interviewee from AAU Disability center indicated her concern about low vision students saying that:

"I know that the technology for low vision and totally blind students are different. Considering that the center got technologies devices to help such students but we couldn't find IT professional to install these devices to make it ready for our low vision students therefore they are forced to use assistive technologies that are meant to be for blind students and low vision students felt excluded"

In relation to this low vision respondent student said that:

"Even though there exists different technologies such as large print, Zoom text, Braille ICT technology and CCTV is available for us, it appeared that it is only screen reader technology that is available in the school and I can say in country"

On the other hand, all interviewees student confirmed that using assistive technology assisted them to be independent and let them read the course materials without the need of others help. One student mentioned that using computer and screen readers helped him to study and read course materials on his own. On the same note, one respondent student narrated that:

" I had to pay for non-disabled students to read course notes for me per page. Sometimes it depends on who reads the note for me to understand it because some read fast or accent might be difficult to understand. And asking the reader to read it once again costs extra because that will be counted as another page. But thanks to the technology, I can read notes and power points prepared by instructors using my laptop without the need of anyone help. This technology also gives me an opportunity to study course materials with my own time and pace just like others"

Interviewees also suggested that provision of assistive technology in public services such as banks system to withdraw money from ATMs would be very helpful in their day to day life in order to help make their life easier.

4.2.1.2.2 Challenge related to computer, Assistive technology, and e-learning access

As indicated by the university special need support center interviewee, raising ICT accessibility awareness on new commercially and also freely available ICT assistive solutions is the main challenge for them. According to the interviewee, the main reason for that is the absence of trained IT professionals who are skilled in installing and maintaining ICT-based assistive hardware and software technologies, as well as the lack of IT professionals' assistive technology awareness.

Concerning that one interviewee student said that:

“It was said that I should have no problem and that the disability center in the compound can accommodate me regarding my need for computer use to access e-learning materials, but often it is not the case.”

Most of the interview respondent informed several problems in using assistive technology to access course notes and e-learning materials. The common themes were the inadequacy of training dedicated to them on using assistive technology software and hardware, and lack of awareness, skill, and experience on using Assistive technology. Concerning that one interviewee indicated that:

“I believe the reason for lack of skill, experience and awareness problem on using the assistive technology by VI students is the absence of low-grade-level computer and assistive technology education.”

The cost of Assistive technology software and hardware is another issue mentioned by the student as well as management respondent. Students specified that cost of Assistive technology software forced them to use cracked/pirated version of assistive technology software .However, cracked/pirated software has difficulties on getting full functionality of the software as well as updating the software whenever there is a new software update release. For that reason the interviewees indicated that price reduction for Assistive technology software and hardware products would be helpful but it would be more supportive if free and built-in products facilitated. The other barriers indicated by students were nonexistence of a local market to purchase AT technologies.

The other accessibility issue mentioned by respondents was the accessibility of Amharic documents. Most interviewed students specified that they mainly use JAWS to access a computer. However, one of the negative learning experiences of JAWS for students was image creation, reading Math equations correctly and reading Amharic documents. The other challenges listed by students were reading hard copy documents and books. The reason for that is the absence of Optical character recognition (OCR) technology service in the school library to convert text images printed materials into accessible electronic or digital text format. Interviewee additionally mentioned that electronic course notes prepared by instructors or found online and software and websites developed locally are not accessible for them. They believe the reason for that is a mostly program and web developers develop sites and codes without any consideration regarding visually impaired people. Reading PDF was another difficult revealed by students. The other difficulty stated by the respondent was the lack of Braille technology that can be used with a computer or other devices to display characters or image to allow them to read digital text through Braille.

Regarding Braille technology, one respondent student described that:

” I am blind and for someone who is blind like me, hearing organ is main sensory organ for us to accomplish most of our day to day activity. For that reason, I don’t want to use screen readers assistive technology frequently because the health of my ear is my main concern. Therefore, I think Braille technology should be given emphasis as it is the most important alternate for us.”

All respondents stated that management is mainly concerned on purchasing products. Installing and maintaining purchased products to makes it available and checking its effectiveness is less. Interviewee also indicated the unavailability of computers and assistive technologies based on student requirement. Getting technical support from academic staff is another difficult of VI students. Respondent students also said that assistive technology software installed on school computers is mostly outdated and not frequently upgraded.

In general, majority of the interviewees stated that academic and IT professional staffs of the school community are not aware of the available assistive technology in order to provide appropriate assistive technology based on students need.

4.3 Discussion of the findings and addressing the research questions

By analyzing the quantitative and qualitative data, the study investigated student awareness about assistive technology and also challenges encountered by visually impaired students related to computer and e-learning access. From the quantitative and qualitative data analysis presented, the finding of the research result aligned with each research question and presents as follows.

Research question 1

What are students with visual impairment awareness level related to using different ICT based available free, built-in or commercial assistive technologies and operating systems platforms?

Technology has become powerful. The usage of ICT based assistive technology tools according to various studies clearly reveals that it helps the visually impaired students to a great extent. Assistive technology equipment can also facilitate inclusion. The study conducted by Lucky & Achebe (2012) disclosed that with the help of ICT the visually impaired have been rendered special attention to fully participate in the world.

The result shows students with both low vision and blind type of impairment are in learning process in the university. Large number of students have only one year experience. Those who have over four year computer use experience are very few. As this study result shows maximum number of visually impaired students awareness over assistive technology is fair. This implies that most students had no experience working with computers before joining.

As the finding of the research also indicated on the assessment of perceived usefulness of assistive technology by students, majority of students recognize the usefulness of assistive technology for computer access, to increase productivity in school, as well as for their independence and effectiveness is very high. According to Davis (1989), this is a very important factor since high students perception on the usefulness of a technology have high correlate to that adoption of that technology. Similarly, the result shows positive students attitude towards assistive technology.

According to the research result, all students consent computers are involving and getting in their learning process. But for more than half percent of students working with computers is not an easy task and their experience to work with computers as well as different operating system such as

Microsoft windows and Mac is very poor. However comparatively they have better experience working with Microsoft operating system than any other operating system platform. Therefore, if computers are coming on visually impaired students learning process in the institute, increasing their experience should be parallel process to increase their capacity to work with computers.

In addition, from the assessment made on students knowledge and experience to work with free or built-in assistive technologies available, the result tells that most of students are not confident. And also, among those three available assistive technologies categories for computer access, all most all of visually impaired students are familiar only with well know JAWS software screen reader technology. This shows that students are not aware of other assistive technology. This influences them not to take advantage of other free or built in assistive technology products.

Generally, the research finding from multiple regression shows that both VI student awareness about assistive technology and their Assistive technology experience together explains 61% assistive technology adoption. However, among these two assistive technologies determinant variables, VI student awareness about assistive technology has the greatest influence and the most significant factor for the adoption of e-learning as described on the conceptual study of the research as stated by Davis (1989).

Research question 2

What ICT based assistive technologies are used by visually impaired students for e-learning access?

The result indicated that assistive technology installed on computers and available for students in the school the computer center mainly is JAWS screen reader software. And the study done by Abdo (2009) stated that using only one assistive technology is not a problem. However as described by resonant students and Mokiwa & Phasha (2012) study finding, JAWS screen reader has a problem on image creation, reading Math equations correctly and reading Amharic documents. Some students however describe that they also use freely available NVDA (Nonvisual Desktop Access) assistive technology to access electronic documents. In addition, according to (Calvo, Ana, & Moreno, 2011), both screen readers have different capability to work with different web browser platform. For example, JAWS has improved to read websites in internet explorer browser and other agents like Mozilla Firefox or Safari with limited support. However, NVDA able to surf

on the internet in different browser, this indicated that only one type of assistive technology available to students hinder them from accessing electronic documents from different source. Window-Eyes and ReadToMe, and also built-in operating System accessibility features such as narrator and screen magnifier are accessibility technologies that they mentioned they use in their learning process to access online and electronic documents for their school learning process.

Research question 3

What is a role of e-learning towards visually impaired students while accessing it using ICT-based assistive technologies?

Concents with the resualt of Ferraro et.al(2009) students are excited about the benefit of increase their productivity at school as well as to enhance their effectiveness. Student also noted that e-learning allow them to improve being independent ,ability to work or learn at own pace,feel more confident and less stressed,ablity to keepup with the rest of the class.They also menationed the benefit of e-learning the ablity to get online courses materials from all over the world at any time when they want.

Research question 4

What are technological challenges of visually impaired students on using ICT-based assistive technology accessing e-learning material using ICT based assistive technology?

The result indicated that students have both assistive technology accessibility and aviality problem.The finding consistent with findingsof Mokiwa & Phasha (2012), and Ferraro et.al. (2009). Inaccessiblity problem area identified by respondantswere both with software issues as well as with the absence of technical support.As the reualt indicated,eventhough there has been some initiatives by Addis Ababa University Special Needs Support to provide ICT basic computer skills and computer accesses to visually impaired students, the current practice of using assistive technology for e-learning by visually impaired people is at its early stage. This showthat students are influenced by institutional factor as it was confirmed on Ruchi et al. (2013) pervious research finding.

Additionally, the research finding shows, most of VI students in Addis Ababa University complained on the implementation of ICT-based assistive technologies without consideration of

their actual accessibility need. This make students challenges discussed in pervious chapter on this thesis and hinder them from computers use and e-learning access.

From the result of the analysis, visually impaired student learning experience using assistive technology doesn't show positive learning experience. The research result also demonstrates also consents with pervious finding by Mokiwa & Phasha (2012) students' inability to access pdf and Amharic documents, and also graphic learning materials. The influence of this barrier shows significant disempowerment on students and made them feel underprivileged. Generally, major VI students challenges identified on this research to access computers and e-learning using assistive technologies were:

- Lack of ICT based assistive technology experience because no low grade level education and continuous training ,
- Lack of knowledge about free or built in assistive technologies that could be an alternate solution for commercially available assistive technology,
- Access to the assistive technology compatible resource is limited,
- Reading or understanding of PDF, image and graph from electronic format is difficult mainly from locally prepared documents,
- Lack of awareness by the department as well as IT professionals,
- Cost of ICT based assistive technology,
- Lack of personal computers by most of VI students,
- Problem on reading Amharic documents with current assistive technology as well as inaccessibility of local software,
- Inaccessibility of websites since most of them were not designed to support assistive technology features,
- Absence of existing policy which could enforce schools starting from high schools to better support VI students to use and access computers in a better way,
- Lack of Management awareness as well as support on the design, analysis and implementation of ICT based assistive technology in the school and also in the country.

Therefore, from these identified VI students barriers, there are two issues of accessibility which requires immediate consideration for emerging of VI students' e-learning access to their educational benefit. The first is the conversion of print materials to accessible electronic formats. And the second is better accessibility of the computer, and internet/websites.

Research question 4

What e-learning systems are available to visually impaired students at AAU?

Most instructors use some form of e-learning in their courses. This includes PowerPoint, simulations blogs, digital text-books and faculty often make online materials available on a course web site or a course/learning management system that allows students to interact with learning materials outside of the classroom (Schmidt et al., 2014; Tarawneh et al., 2011; Lombardi et al. 2011 as cited in Fichten et al., 2014). According to the research finding, students mentioned that computer use in their university stay to access electronic learning document considered as e- learning documents such as power point, digital text-books as well as surfing the internet for supportive course material and is becoming mandatory and used frequently in the school by instructors.

According to the research finding the university is implementing Moodle Learning Management System that support and promote self-learning and creating learning opportunities for large number of students on and off campus. However, the finding of the research done by Calvo, Ana, & Moreno (2011), Moodle is not accessible and have difficulty on accessing it with JAWS and NVDA screen reader even though there is a difference of usability between these two screen readers on accessing it. If an e-learning system is not usable enough, it obstructs students learning: the learners would spend more time learning, how to use the software rather than learning the contents (Vidhya P & MeenaKumari, 2015).Therefore, in order to make Moodle accessible for everyone regardless of their circumstance to provide equal opportunities all students Calvo, Ana, & Moreno (2011) accisablity recommendation should be taken into consideration.

Chapter 5

Conclusion and Future research

5.1 Conclusion

Information Technology gives opportunities and facilitates the independence and active participation of people with disability as well as integration between the blind and the sighted. The purpose of this research is to investigate visually impaired students' intention to use ICT Based assistive technology in their learning process.

The proposed research question was:-

1. What are students with visual impairment awareness level related to using different ICT based available free, built-in or commercial assistive technologies and operating systems platforms?
2. What ICT based assistive technology is used by visually impaired students for e-learning access?
3. What is a role of e-learning towards visually impaired students while accessing it using ICT-based assistive technologies?
4. What are technological challenges of visually impaired students on using ICT-based assistive technology to access e-learning material using ICT based assistive technology?

A general observation that can be made from the result of the analysis that students' awareness about assistive technology and their technological experience affect students' e-learning adoption. The researcher also thinks that all hypotheses posed on conceptual diagram of this study have been confirmed. Though, these two factors express 61% of e-learning adoption by students, the result from the standard multiple regressions shows awareness of students about assistive technology has the greatest contribution for the adoption of e-learning technology by the student.

Generally, Students' have better experience to work with Microsoft windows operating system. General students experience working with different ICT based available free, built-in or commercial assistive technologies is poor. However, there can be also good built-in and freely available assistive technology tools that can be used to access e-learning materials that can be an alternative for commercial assistive technologies as the cost for this assistive technology is expensive. From the findings of the research, the general feeling of blind students is that ICT presents a great learning opportunity to all. Student also noted that e-learning allow them to improve being independent ,ability to work or learn at own pace,feel more confident and less stressed,ablity to keepup with the rest of the class.They also menationed the benefit of e-learning the abilty to get online courses materials from all over the world at any time when they want.

However, the research finding revealed that the current service in the institute should be more supportive and understanding towards their learning challenges Therefore, in order to make visually impaired students to have a chance in the information society, information technology knowledge and access to information is critical. Thus, for proper and optimum use of assistive devices, it is essential to consider the applicability of the technology and its effectiveness. In that case, accessibility is critical factor in ensuring students participation in learning process. Considering that, it is important to stress both the issue of accessibility and usability of assistive technology service implemented in the institute.

Therefore, researchers, and service providers as well as IT professionals should work to identify ways to encourage the development of tools and strategies for visually impaired student technology integration and strive to work together on issues surrounding the use of technology by visually impaired students for effective inclusion of students with disabilities within the general education environment to make them benefited from one of ICT contribution, e-learning. The ICT policy should also need to consider visually impaired students e-learning requirement and responsible body should put specific ICT and Assistive technology policy for their benefit to make them walk in ICT road as the other non-disabled students. Ensuring that they are entitled to the same high standard and effective instruction, that is available to non-disabled students.

5.2 Recommendation

Considering research result and conclusion, below are implication and recommendation to improve the situation.

- Awareness raising should be given emphasis

As Major finding of multiple regression model summary of discovered, student awareness has significant factor for assistive technology adopting in e-learning, therefore awareness rising by hosting educational events and discussion panels through different communication media must be one of all priority to improve assistive technology of students as well as IT professionals so that : VI Students will have a clear and better knowledge on using different free or built-in assistive solutions; And IT professionals will be better informed will make their important contributes.

- Documents, local software and website accessibility should consider

Electronic document designers, instructors or web designers should consider all PDF accessible characteristics such as logical structure and reading order, alternate text descriptions for figures, form fields, and links, navigational aids, security that doesn't interfere with assistive technology and fonts that allow characters to be extracted to text stated on (Adobe & AFB Consulting, 2016) when designing this most popular electronic file format in order to make it compatible with assistive technology such as screen readers to be accessible for the users. Web designers should also comply with World Wide Web Consortium's Web Accessibility Initiative accessibility guidelines on creating pages, course materials and digital text-books. Pictures in the document should also be explained in the text. Images posted on the website or electronic documents should have proper description to be addressable by visually impaired students. Tables and graph format information on the documents should be in any of the accessible formats such as large print, Braille or some other electronic format to insure documents compatibility with screen readers. Because these kind of special, documents usually cannot be interpreted by speech synthesizers easily. Therefore general guide lines should be followed. In addition, local software developers should also consider accessibility issues in mind and follow all above mentioned guidelines creating electronic documents.

- Consideration of free and built-in assistive technology

Each of different ICT based assistive technologies such as screen readers, screen magnification systems, and Braille displays are all expensive by themselves. Therefore, consideration of free, built-in and open source assistive software that can be an alternative is very essential to increase the capacity of students 'electronic material access.

- Government and assistive technology ICT policy

Finally, various studies clearly tell that the usage of ICT-based assistive tools helps the visually impaired students to a greater level on succeeding academic performance and being independent. Thus government support and developing ICT policy specific to assistive technology is important for its better adoption.

5.2 Future Work

This research was conducted to assess Assistive technology awareness of Students with vision-impairment to use computers for E-learning in Addis Ababa University. As a result of the research, the researcher learned that Assistive technology awareness and experience contributes are two factors which contribute 61% for the adoption of assistive technology for e-learning. Therefore, further research is needed to explore other undiscovered factors that contribute for the rest of 39% for assistive technology adoption.

Additionally, further research is also needed to explore the applicability of current ICT based assistive technology for e-learning and it would also be more interesting to look at the current available ICT based assistive technology effectiveness.

References

- Al-Alak , B. A., & Alnawas , I. A. (2011). Measuring the Acceptance and adoption of E-learning by Academic staff Basheer. *Knowledge Management & E-Learning :An international journal*, Vol 3, No 2.
- A resource Manual for School District Team. (2004). *Assessing students' need for Assistive technology 4th edition*. Wisconsin Assistive Technology Initiative,.
- AAU. (2013). *Addis Ababa University organizational Handbook*. Addis Ababa: Addis Ababa University.
- AAU. (2016, 6 9). *Special Needs Support*. Retrieved from http://www.aau.edu.et/offices/v_president-office/office-of-the-academic-vise-president/special-needs-support-office/
- Abdi, H., & Williams, L. J. (2010). Principal component analysis. *John Wiley & Sons, Inc DOI: 10.1002/wics.101 Volume 2*.
- African teacher Network. (2004). ICT clubs & e-learning in Ethiopian high schools. *African teachers Network(ATN)- Ethiopia & Menelik & Menelik II Secondary School ICT Club*.
- Ahmad , F. K. (2015). Use of Assistive Technology in Inclusive Education: Making Room for Diverse Learning Needs. *Transcience*.
- Al-alak, B. A., & Alnawas, I. A. (2011). Measuring the Acceptance and Adoption of E-Learning by Academic Staff. *Knowledge Management & E-Learning: An International Journal*, Vol.3, No.2.
- Anjali et al. (2013). A learning tool for visually impaired People. *International journal of Computer Applications*.
- Anohina, A. (2005). *Analysis of the terminology used in the field of virtual learning*. Educational technology & Society.
- Arkorful , V., & Abaidoo, N. (2014). The role of e-learning, the advantages and disadvantages of its adoption in Higher Education. *international journal of Education and Research*.
- Awareness campaigns for behavioural change* . (2016, 4 30). Retrieved from http://climate-adapt.eea.europa.eu/viewmeasure?ace_measure_id=656
- Adobe and AFB Consulting. (2016, April 24). *Adobe accessibility*. Retrieved from Adobe web site: <http://www.adobe.com/content/dam/Adobe/en/accessibility/pdfs/accessing-pdf-sr.pdf>
- Becta. (2007, January). *What is ICT?* Retrieved from http://schools.becta.org.uk/index.php?section=cu&catcode=ss_cu_skl_02&rid=1
- Berhe, H. (2011). *The Challenges and current status of eLearning in Ethiopian Higher Education institutions: case of Mekelle University*. Addis Ababa University.
- Bishaw, K. S. (2013). INCLUSIVE TEACHING INVOLVING VISUALLY IMPAIRED STUDENTS IN ENGLISH LANGUAGE TEACHING (ELT) SETTINGS. *ANDHRA UNIVERSITY, VISKHAPATNAM, INDIA*.
- Broadband Commission for Digital Development, G3ict,, IDA, ITU, Microsoft, Telecentre.org foundation, & UNESCO. (2013). *The ICT Opportunity for a disability-inclusive development framework*. International Telecommunications Union Place des Nations - 1211 Geneva, Switzerland.
- Burgsthler, s. (2002). Distance learning:Universal Design,Universal access,Educational Technology Review.

- C.S, F., & Ferraro. (2009). Disabilities and e-learning Problems and Solutions : An Exploratory Study. *International Forum of Educational Technology and Society*.
- Calvo, R., Ana, I., & Moreno, L. (n.d.). Is Moodle Accessible for Visually Impaired People.
- Carlson, D., & Nat, E. (2005). Assistive Technology and Information Technology Use and Need by Persons with Disabilities in the United States, 2001. *U.S. Department of Education National Institute on Disability and Rehabilitation Research*.
- Carole , K. L., & Almut , W. G. (2008). Research fundamentals: Validity and reliability of measurement instruments used in research . *Am J Health-Syst Pharm (American Society of Health-System Pharmacists, Inc. All rights reserved. 1079-2082/08/1201-2276\$06.00.)*, Vol 65 .
- Casidy, S., & Eachus, P. (2002). Developing the Computer User Self-Efficacy (CUSE) Scale: Investigating the Relationship Between Computer Self-Efficacy, Gender and Experience with Computers. *Journal of Educational Computing Research*, 26(2), 169–189.
- CASSIDY, S., & EACHUS, P. (2002). Developing the Computer User Self-Efficacy (CUSE) Scale: Investigating the Relationship Between Computer Self-Efficacy, Gender and Experience with Computers. *Journal of Educational Computing Research*, 26(2), 169–189.
- Catherine et al. (2009). Accessibility of e-learning and computer information technology for students with visual impairment in post-secondary. *Journal of Visual Impairment & Blindness*.
- catherine et al. (2001). Computer Technologies for Postsecondary Students with Disabilities II: Resources and Recommendations for Postsecondary Service Providers. *Journal of Postsecondary Education and Disability*.
- Chester, Mitchell . (2012). *Access to learning: Assistive technology and accessible instructional materials*. Massachusetts Department of Elementary & Secondary Education.
- Cochran, W. G. (1977). Sampling techniques . *John Wiley & Sons*.
- Cole, J., & Foster, H. (2008). Using Moodle – Teaching with the popular open source course management system. *O.R. Media, Editor: United States of America*.
- Costa, C., Alvelos, H., & Teixe, L. (2012). The use of Moodle e-learning platform: a study in a Portuguese University. *Procedia Technology 5 - Conference on ENTERprise Information Systems*.
- Creswell , J. W. (2014). *Research design qualitative, quantitative and mixed methods approaches*. Thousand Oaks, California 91320: SAGE Publications, Inc.
- Davis, F. (1986). A technology acceptance model for empirically testing new end-user information systems: theory and results. *Doctoral dissertation, Sloan School of Management, Massachusetts Institute of Technology*.
- Davis, F. (1989). Perceived Usefulness, Perceived Ease of use ,and User Acceptance of information technology User acceptance of computer technology.
- Denzin, N. (1978). A theoretical introduction to sociological methods. *New York :McGraw-Hill*.
- Developing the Computer User Self-Efficacy (CUSE) Scale: Investigating the Relationship Between Computer Self-Efficacy, Gender and Experience with Computers. (n.d.).

- Emery , S. H. (2007). The Disability Divide: A Study into the impact of computing and internet-related technology on people who are blind and vision Impaired. *GLADNET collection*.
- Epignosis LLC, V. 1. (2014). *E-learning: concept, trends, applications*. San Francisco California.
- Fichten et al. (2000). Access to Educational and instructional computer technology for Post-Secondary Students with disabilities: Lessons from three empirical studies. *Journal of Educational Media*.
- Fichten, C. S., & Barile, M. (2003). Computer Technologies and Postsecondary Students With Disabilities: Implications of Recent Research for Rehabilitation Psychologists. *Rehabilitation Psychology by the Educational Publishing Foundation*, Vol. 48, No. 3, 207–214.
- Fichten, C.S., Asuncion, J., Scapin, R. (2014). Digital technology, learning, and postsecondary students with disabilities: Where we've been and where we're going. *Journal of Postsecondary Education and Disability*, 27(4), 369-379.
- Gebreegziabher, Y. A. (2008). Policy and Provision for Students with Disabilities in Higher Education: The Ethiopian Case. *University of Oslo*.
- Geoffrey et al. (2005). *Essentials of Research Design and Methodology*. Hoboken: John Wiley & Sons, Inc.
- Hall, B. H. (2002). Adoption of New Technology. *New Economy Handbook: Hall and Khan*.
- Igbaria, M., Zinatelli, N., Cragg, P., & Cavaye , A. (1997). Personal Computing Acceptance Factors in Small Firms: A Structural Equation Model. *MIS Quarterly*.
- ISLAM , T., & Sadeque , A. (2006). Current Status and prospects for E-Learning in promotion of Distance Education in Bangladesh. *Turkish online Journl of distance Education*, Bangladesh.
- ILO. (2013). Inclusion of People with Disability in Ethiopia.
- Israel, G. D. (2015). *Determining Sample Size*. university of Florida IFAS Extension.
- Japanese Society for rehabilitation of person with Disability. (2007). *Access to information and communication technology for person with Disabilities with the special Reference to Biwako Millennium Framework*. Japanese Society for rehabilitation of person with Disability.
- Jennison et al. (2010). Multiple Perspectives on the Accessibility of E-Learning in Canadian Colleges and Universities. *Assistive Technology*, 22:187–199.
- Kennedy, G. E., Judd, T. S., & Churchward, A. (2008). First year students' experiences with technology: Are they really digital natives? *Australasian Journal of Educational Technology*.
- Kent, M. (2015). Disability and eLearning: Opportunities and Barriers. *Disability Studies Quarterly*.
- Lewis, I. (2010). Paper commissioned for the EFA Global Monitoring Report: Education for disabled people in Ethiopia,. *UNESCO*.
- López, L. M., Calvo Martín, M. d., & Maqueda, A. M. (2011). ACCESSIBILITY EVALUATION OF MOODLE CENTRED IN VISUAL IMPAIREMENTS. *International Conference on Web Information Systems and Technologies*.
- Lucky , A., & Achebe, N. (2012). Information Service delivery to the visually impaired: A case Study of Hope for the Blind Foundation Wusasa, Zaria (Nigeria). *Research Journal of Information Technology*.

- Lucky , A., & Achebe, N. (2013). Information Service Delivery to the Visually Impaired: A Case Study of Hope for the Blind Foundation Wusasa, Zaria (Nigeria). *Research Journal of Information Technology*, 18-23.
- Massachusetts Department of Elementary and Secondary Education. (2012). Access to Learning. *Massachusetts Department of Elementary and Secondary Education*.
- Mathison, S. (1988, MARCH). Why Triangulate.
- Mcchester, O., & Ihedigbo, C. (2014). Research Designs, Survey and Case Study. *IOSR Journal of VLSI and Signal Processing (IOSR-JVSP) Volume 4, Issue 6*, PP 16-22 e-ISSN: 2319 – 4200, p-ISSN No. : 2319 – 4197.
- Mikre, F. (2011). The Roles of Information Communication Technologies in Education Review Article with Emphasis to the Computer and. *The Role of Information communication*.
- Ministry of Labor and Social Affairs. (2012). *National plan of action of person with Disabilities*. Addis Ababa.
- Mokiwa, S., & Phasha, T. (2012). Using ICT at an Open Distance Learning(ODL) institution in South Africa: The Learning Experiences of Students with visual impairments. *Africa Education Review*.
- Mousa et al. (2006). *E-Learning Concepts and Techniques*. Institute for Interactive Technologies, Pennsylvania, Bloomsburg University.
- Natayi, A. B. (2009). Accessibility of assistive software and hardware technologies to people with visual impairment case of Addis Ababa University.
- O'Connor, B. . (2000). *E-learning and students with disabilities:from outer edge to leading edge*.
- Osagie, R. (2011). Globalization and human resource development in Nigeria. *AMERICAN JOURNAL OF SOCIAL AND MANAGEMENT SCIENCES*, 2156-1540.
- oye et al. (2012). E-Learning Methodologies and Tools. *International journal of Advanced computer and application*.
- Pal, J., Pradhan, M., Shah, M., & Bab, R. (2011). *Assistive Technology for Vision-impairments: An Agenda for the ICTD Community*. Hyderabad, India: International World Wide Web Conference Committee.
- Pallant, J. (2005). *SPSS SURVIVAL MANUAL*.
- Rana, N. (2012). A study to assess teacher educators attitude towards technology integration in classrooms. *MIER Journal of Educational Studies, Trends & Practices*, 190-205.
- Ribiero, T. (2002). *From a distance: Look at distance learning's increased following*. Education.
- Ruchi et al. (2013). E-learning for the vision impaired :A holistic Perspective. *International journal of Cyber Society and Education*.
- Sayers, R. (2006). *Principle of Awareness-Raising for information Literacy,a case study*. Communication and Information.

- Shah, A., Dhakal, T., Pandey, T., & Shah, D. K. (2014). *An Assessment of Public Awareness Regarding E-Waste Hazards and Management Strategies*. SIT World Learning – India: Sustainable Development and Social Change.
- Singh, A., & Masuku, M. (2014). SAMPLING TECHNIQUES & DETERMINATION OF SAMPLE SIZE IN APPLIED STATISTICS RESEARCH: AN OVERVIEW. *International Journal of Economics, Commerce and Management*, Vol. II, Issue 11.
- Stefan et al. (2007). ICT educational tools and visually impaired students: different answers to different accessibility needs.
- Teferra, T. (2005). *Disability in Ethiopia: issues, insights, and implications*. Addis Ababa: Addis Ababa University Print. Press,.
- Tessentu, D. (2014). Exploring Academic Barriers to Students with disability at Addis Ababa University Main campus. *Addis Ababa Univeristy*.
- The Federal democratic republic of Ethiopia . (2012). *Ethiopia implementation of the UN convention on the right of Persons with Disability initial report*,. Addis Ababa.
- The federal democratic republic of Ethiopia. (2009). the national information and communication technology policy and strategy.
- Ulbricht, V. (2012). A tool to facilitate including accessible content in Moodle to the person with visual impairment. *Proceedings of the 4th International Conference on Software Development for* (pp. 138 – 147). Elsevier B.V. Selection.
- UNESCO. (2009). Teaching Children with Disabilities in Inclusive Settings. *Bangkok 10110*.
- Vidhya P, & MeenaKumari. (2015). ICT based learning tools and its impact on students with visual Impairment. *International Journal of Computer Science and Information Technology & Security*, ISSN: 2249-9555.
- Vidhya, P., & MeenaKumari, J. (2015). ICT based learning tools and its impact on students with visual Impairment. *IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS)*, ISSN: 2249-9555 Vol. 5, No6,.
- Virginio et al. (2004). Perspectives and challenges in e-learning: towards natural interaction paradigms. *Journal of Visual Languages & Computing*.
- Wondowosen et al. (2014). Challenges and Opportunities to Implement Inclusive Education. *Asian Business Consortium | AJHAL*.
- Yin, R. (1999). *Case Study Research Design and Methods*.
- Yin, R. (2004). CASE STUDY METHODS. *COSMOS Corporatin*.
- Zaidah, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan bil.9*.
- Zemsky, R. (2007). E-learning: Successes and Failures. *Chronicle of Higher Education*. 53(18), 1–5.

Appendix

Appendix A: Model Summary of Assistive technology adoption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.781a	.610	.602	.449

a. Predictors: (Constant), AT_Experience, Awareness

b. Dependent Variable: AT_Adoption

Appendix B: The ANOVA of Assistive technology Adoption

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	30.604	2	15.302	75.752	.000b
Residual	19.594	97	.202		
Total	50.199	99			

a. Dependent Variable: AT_Adoption

a. Predictors: (Constant), AT_Experience, Awareness

Appendix C: The Coefficient of Assistive Technology Adoption

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
(Constant)	.371	.285		1.301	.196	-.195	.937					
1 Awareness	.782	.074	.766	10.500	.000	.634	.929	.780	.729	.666	.756	1.323
AT_ Experience	.040	.101	.029	.400	.690	-.159	.240	.407	.041	.025	.756	1.323

a. Dependent Variable: AT_ Adoption

Appendix D: Research Questionnaire

Addis Ababa University
College of Natural Science
School of Information Science

Dear Respondent

My name is Bethelhem Eshetu and I am a graduate student at Addis Ababa University. This questionnaire is prepared to gather information on the research title assessing visually impaired students intention to use ICT Based assistive technology in learning: the case of Addis Ababa University. I am inviting you to participate in this research study by completing the attached surveys. The following questionnaire will require approximately 20 minutes completing. If you choose to participate in this project, 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 data collected will provide useful information on addressing Information technology need of visually impaired people. The information you provide will be used only for research purpose and will remain highly confidential.

Thank you very much for your cooperation!

Sincerely,

Bethelhem Eshetu

Assistive technology (AT) 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 that enable students with disabilities to be more independent and productive and also help students with disabilities participate more fully in the academic and social activities.

Part 1 General Information about yourself

Q1. Gender

Male

Female

Q2. Your vision impairment best describes as:-

Low vision Blindness

Q3. Your experience working with Computers

None 1-2 years 3 years 4 Years or above

Note: - If your answer for question number 3 is **none**, please directly go to question number 26.

Part 2 Students Assistive technology Awareness and computer use experience

A. Awareness

Q4. How familiar are you with Information Technology based Assistive technology for e-learning?

I am aware but never used it

Use it only sometimes

Use it on a regular basis

Q5. Over all how you rate your awareness about different Information technology based Assistive Technology Products

Poor

Good

Fair

Very Good

Excellent

B. Perceived usefulness

Perception of Assistive Technology usefulness	(1)Strongly Disagree	(2)Disagree	(3)Neutral	(4)Agree	(5)Strongly Agree
Q6. Assistive Technology will be useful in my learning process for computer and e-learning access					
Q7. Using Assistive Technology will increase my productivity at school.					
Q8. Using Assistive Technology will enhance my effectiveness					
Q9. Using Assistive Technology will improve my independence					

C. Attitude towards ICT based Assistive Technology

Attitude Toward Using Assistive Technology	(1)Strongly Disagree	(2)Disagree	(3)Neutral	(4)Agree	(5)Strongly Agree
Q10. I like the idea of using Assistive Technology to my learning activity to access E-learning material					
Q11. I believe it is (would be) a good idea to use Assistive Technology in my learning activity to access E-learning material					
Q12. I have generally positive attitude toward using Assistive Technology.					

Part 3 Technology context

Computer use and ICT based Assistive Technology knowledge and experience

	(1)Strongly Disagree	(2)Disagree	(3)Neutral	(4)Agree	(5)Strongly Agree
Q13. I find working with computer Very easy					
Q14. I find working with computer gets in the way of learning(like softcopy from instructors ,eBook reading ,internet or website access from internet)					
Q15. I find working with computer makes learning more interesting					
Q16. I am familiar working with Microsoft Windows operating System					
Q17. I am familiar working with non-windows OS such as Mac					
Q18. I am very confident in my ability to make use of built in or free information technology based Assistive technology product of Microsoft Windows operating System(such as Narrator and screen magnifier)					

<p>Q19. I am very confident in my ability to make use of built in or free information technology based Assistive technology product of Other vendor product (like NVDA, ReadToMe)</p>					
<p>Q20. I am confident in my ability to use Text-to-speech (screen reader) Assistive Technology software such as JAWS,NVDA, Window-Eyes, OpenBook</p>					
<p>Q21. I am confident in my ability to use Screen Magnification Assistive Technology Software Such as ZoomText, The Magnifier, Windows Magnifier(Low vision Students only)</p>					
<p>Q22. I am confident in my information ability to use Braille input output devices Assistive Technology device</p>					

Part 4 Assistive technology Adoption

Assistive technology adoption	(1)Strongly Disagree	(2)Disagree	(3)Neutral	(4)Agree	(5)Strongly Agree
Q23. Adopting assistive technology is (would be) a good idea					
Q24. I believe that adopting assistive technology ensures a better e-learning access to people with visual impairment.					
Q25. Cost of Assistive technology equipment and software will not be prohibitively expensive					

Q26 Any Comment

Appendix E: Research Interview Questions

Interview question with visually impaired students

1. What technologies do you use to access computers and e-learning Materials?
2. Do you know other technologies that you do not use but useful for you?
3. What benefit do you think you will get using e-learning?
4. What are the problems that you encounter using ICT-based assistive technology on your e-learning process?
5. In your view, which e-learning materials are accessible to you?
6. Do you think that this technology help you in your learning?
7. What are the challenges for you to have access to Assistive technology technologies in your school/university?
8. Do you get good management and technical support from your school/university?

Interview question Administrative supporter

1. Is Management aware of the benefits that can be achieved with the use of Assistive Technology by visually impaired people?
2. Does Management provide most of the necessary help and resources (hardware and/or software) to enable visually impaired people to use Information technology based Assistive Technology?
3. Does Management provide necessary trainings in order to help visually impaired to use Assistive technology products to access computers and e-learning materials?
4. How often does the school update its technology to meet worldwide standards to the need of visually impaired students?
5. Do you assign technical staffs who support students in the computer lab? If not why?
6. What is the challenge to use assistive technology by students?
7. What do you suggest to improve the current services?