ACCESS AND USE OF VIRTUAL LEARNING ENVIRONMENTS BY BLIND STUDENTS AT UNIVERSITY OF RWANDA

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DECLARATION

I declare that this thesis is my original work and has not been presented in any other University. This research has been complemented by other works and they have been acknowledged through referencing.

……. …….

Jean Damascene Bikorimana **Date**

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This achievement is a result of the contribution of different people and institutions. It is not possible to mention all of them here, but I am grateful for their direct and indirect contributions. My sincere gratitude goes to the Almighty God, who gave me heath and strength to do whatever I did to the completion of this step.

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Abstract

The purpose of the study was to investigate the Access and use of Virtual Learning Environments by blind students at University of Rwanda. The objective of the study was to identify learning content accessibility requirements for the blind students using Learning Management System and to investigate extent to which learning content offered to blind students meets the accessibility requirements. The research also identified the skills gap for the teaching staff as one the factors that hinder the creation of accessible learning content to all learners. Participants were selected using purposive sampling techniques. To collect data, we used questionnaires and a semi-structured interview guides. The findings of the study showed that the Use of Virtual Learning Management at the University of Rwanda is still at the initial stage but on a good trend considering the initiatives in place to emphasize the use of Information Technology in learning online to give quality education to all learners. However, Virtual Learning cannot take place when teachers are not trained on creating accessible learning content and when learners do not have the required materials to access online platforms. Particularly blind students need special materials and software that remove barriers to learning. The issue of internet access also is a major challenge to students when they are out of campus. It was recommended that all teachers should be trained in Special Needs Education to be able to cater for students who are blind and others who have Special Educational Needs, to have knowledge on the use of assistive technologies that blind students use in their learning, to vary their mode of delivery to meet different learning styles of learners on VLEs.

Table of Contents

DECLARATION ..... **I**
AKNOWLEDGMENT ..... **II**
ABSTRACT ..... **III**
TABLE OF CONTENTS ..... **IV**
LIST OF TABLES ..... **VI**
LIST OF FIGURES ..... **VII**
ABBREVIATIONS **8**
CHAPTER ONE: INTRODUCTION AND BACKGROUND INFORMATION **1**
1.0 INTRODUCTION 1
1.1 BACKGROUND INFORMATION 1
1.2 STATEMENT OF THE PROBLEM 3
1.3 THE HISTORY OF INCLUSIVE EDUCATION 3
1.5 RESEARCH QUESTIONS 4
1.6 SIGNIFICANCE OF THE STUDY 4
1.7 LIMITATIONS AND DELIMITATIONS OF THE STUDY 5
1.7.1 Limitations of the study *5*
1.7.2 Delimitations of the study *5*
CHAPTER TWO: REVIEW OF THE RELATED LITERATURE **6**
2.0 INTRODUCTION 6
2.1 LEARNING AS A BLIND PERSON IN HIGHER EDUCATION 6
2.2 BLIND LEARNER'S RIGHTS TO EDUCATION 7
2.3 BARRIERS TO INCLUSIVE EDUCATION 8
2.4 THE CONCEPT OF VIRTUAL LEARNING ENVIRONMENT 9
2.5 VIRTUAL LEARNING ENVIRONMENT FOR BLIND STUDENTS 10
2.6 POLICIES, GUIDELINES, AND LEGISLATIVE GUIDING EDUCATION IN RWANDA 10
2.7 INCLUSIVE EDUCATION AT UNIVERSITY OF RWANDA 11
CHAPTER THREE: METHODOLOGY **13**
3.0 INTRODUCTION 13
3.1 RESEARCH DESIGN AND STUDY SETTING 13
3.3 POPULATION 14
3.4 SAMPLE SIZE AND SAMPLING PROCEDURES 14
3.4.1 Sampling procedures *14*
3.4.2 Sample size *15*
3.5 RESEARCH INSTRUMENTS 15
3.6 DATA COLLECTION PROCEDURES 16
3.7 VALIDITY AND RELIABILITY OF THE INSTRUMENTS 17
3.7.1 Validity *17*
3.7.2 Reliability *17*
3.8 ETHICAL CONSIDERATIONS 17
3.9 LIMITATIONS OF USED METHODS 17
3.10 SUMMARY OF THE CHAPTER 18
CHAPTER FOUR: FINDINGS, INTERPRETATION AND DISCUSSION **19**

4.2.1 Demographic data for blind students 19
4.2.2 Demographic data for lecturers 21
4.3 Experience of lecturers 22
4.4 Level of Experience in using digital technology 23
4.5 Learning content accessibility requirements 24
4.6 Make all functionality available from a keyboard 29
4.7 Titles that describe the topic of study 32
4.8 Possibility to detect and correct mistakes 34
4.9 Descriptive headings and section labels 35
4.9 Accessible content creation skills and competence needs 37
4.10 Training in special needs education 37
4.11 Knowledge on digital technology tools that are used by blind students to read content on Moodle 38
4.12 Challenges faced in teaching blind students virtually 38
4.13 Accessibility challenges blind students face in using the learning content on Moodle at UR 39
4.14 Transmission of a file or data from one computer to another 42
4.15 Guidelines for increasing learning content accessibility 43
4.16 Summary of the chapter 44
CHAPTER FIVE: DISCUSSIONS AND CONCLUSIONS 44
5.1. Summary of the findings 44
5.1.1. Learning accessibility requirements 45
5.1.2. Maximize compatibility with current and future user tools 45
5.1.3. Provision of text alternatives for non-text content 45
5.1.4. Creating content that can be presented in different ways without losing the meaning 46
5.1.5. Making all functionalities available from the keyboard only 46
5.1.6. Making the text readable and understandable 46
5.1.7. Making sure that the content pages have titles that describe the topic of the study 47
5.1.8. Possibility of detecting and correcting errors 47
5.1.9. Description of headings and labels 47
5.1.10. Training and competencies to create learning content that is accessible to blind students 47
5.2. Conclusions 48
CHAPTER SIX: RECOMMENDATIONS AND FUTURE WORK 49
6.1 Recommendations 49
6.2 Suggestion for Further Research 49
APPENDICES 51
Appendix A: Informed consent letter 51
Appendix B: Questionnaire for blind students 52
Appendix C: Questionnaire for lecturers 57
APPENDIX D: INTERVIEW SCHEDULE FOR BLIND STUDENTS 61
APPENDIX E: RESEARCH RECOMMENDATION LETTER FROM UNIVERSITY OF RWANDA 63
REFERENCES 64

List of tables

TABLE 4. 1 GENDER AND AGE OF BLIND STUDENTS WHO PARTICIPATED IN THE RESEARCH 19
TABLE 4. 2 HOW LONG RESPONDENTS HAVE BEEN BLIND 20
TABLE 4. 3 YEAR OF STUDY 20
TABLE 4. 4 AGE OF THE RESPONDENTS 21
TABLE 4. 5 GENDER OF THE RESPONDENTS 21
TABLE 4. 6 EXPERIENCE OF THE RESPONDENTS 22
TABLE 4. 7 AREA OF SPECIALIZATION OF THE RESPONDENTS 23
TABLE 4. 8 **LEVEL OF EXPERIENCE IN USING DIGITAL TECHNOLOGY** 24

List of figures

FIGURE 4. 1 MAXIMIZE COMPATIBILITY WITH CURRENT AND FUTURE USER TOOLS 25
FIGURE 4. 2 PROVIDE TEXT ALTERNATIVES FOR NON-TEXT CONTENT 26
FIGURE 4. 3 ALTERNATIVE TEXT FOR NON-TEXT CONTENT 27
FIGURE 4. 4 CREATE CONTENT THAT CAN BE PRESENTED IN DIFFERENT WAYS, INCLUDING BY ASSISTIVE TECHNOLOGIES, WITHOUT LOSING MEANING 28
FIGURE 4. 5 MAKE ALL FUNCTIONALITY AVAILABLE FROM A KEYBOARD 29
FIGURE 4. 6 ALL FUNCTIONALITY OF THE CONTENT IS OPERABLE THROUGH A KEYBOARD INTERFACE 30
FIGURE 4. 7 MAKE TEXT READABLE AND UNDERSTANDABLE 32
FIGURE 4. 8 CONTENT PAGES HAVE TITLES THAT DESCRIBE THE TOPIC OF STUDY 33
FIGURE 4. 9 RESPONSES OF BLIND STUDENTS ON PROVISION OF PAGE TITLES 34
FIGURE 4. 10: OPINIONS OF STUDENTS ON THE POSSIBILITY TO DETECT AND CORRECT ERRORS 35
FIGURE 4. 11 LECTURERS' RESPONDENTS ON HEADINGS AND SECTION LABELS 36
FIGURE 4. 12 STUDENTS RESPONDENTS ON HEADINGS AND SECTION LABELS 37
FIGURE 4. 13 TRAINING IN SPECIAL NEEDS EDUCATION 38
FIGURE 4. 14. CHALLENGES IN TEACHING BLIND STUDENTS VIRTUALLY 39
FIGURE 4. 15 LEVEL OF EXPERIENCE WITH USING DIGITAL TECHNOLOGY SUCH AS SMARTPHONES AND COMPUTER 40
FIGURE 4. 16 OWNERSHIP OF DIGITAL TECHNOLOGY DEVICES 41
FIGURE 4. 17: TYPES OF DEVICES USED TO INTERACT AND USE A COMPUTER 41
FIGURE 4. 18 POSSIBILITY TO DOWNLOAD FILES FROM MOODLE TO OTHER DEVICES TO ACCESS THE FILE WITHOUT INTERNET 42

Abbreviations

CASS: College of Arts and Social Sciences

CE: College of Educcation

ESSP: Education Sector Strategic Plan

ICT: Information Communication Technology

IE: Inclusive Education

LMS: Learning Management System

MINEDUC: Ministry of Education

NST1: National Strategy for Transformation

ODeL: Open Distance and e-Learning

PWDs: People with Disabilities

REI: Regular Education Initiative

SNE: Special Needs Education

SEN: Special Educational Needs

UiA: University of Agder

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNICEF: United Nations International Children's Emergency Fund

UR: University of Rwanda

VLEs: Virtual Learning Environments

WHO: World Health Organization

WIPO: World Intellectual Property Organization

CHAPTER ONE: INTRODUCTION AND BACKGROUND INFORMATION

1.0 Introduction

This chapter will briefly present the background to the study, it will introduce the topic and aims. This chapter will also give an overview of the research objectives, research questions, significance of the study, limitations, and delimitations.

1.1 Background information

These days, there is a rapid growth of using learning Management systems in academic institutions worldwide and their importance can be seen by everyone. The use of internet in teaching is making it easy to learn without the need to move from one place to another. One teacher can teach many students in different places, different countries and with different learning styles. However, regardless the advancement of using ICT in education, there are still barriers that hinder some students to access to this development in teaching.

Studies that have carried in evaluating educational websites and courses have revealed that some users face different accessibility issues. Kurs, Serhat (2011) in his research paper on the accessibility of university websites, he concluded that the educational and course websites have nevertheless detected accessibility-limiting barriers for certain users (Kurt, 2011). in particular, learners with visual imparement meet nemerous barriers when navigating the internet when it comes to links that have almost the same format. Visually impaired people cannot perceve the images that do not have descriptions.

The Virtual learning environment refers to the educational technology that is web-based platform for the digital aspects of course of study, usually with educational institutions. Virtual learning Environments are learning management software systems that synthesize the functionality of computer-mediated communications software and online delivering course materials(Britain et al., 2003). The virtual learning environment gives learners and teachers digital solutions that enhance the learning experience. It harnesses technology to supplement in-class experience (tophat, 2019). The outbreak of COVID-19 has proved that the transition from traditional approach of teaching to the modern teaching where technology is mostly relied on should be quickened to be able to continue teaching and learning process even when face-to-face teaching is not possible. This transition should not leave anyone behind regardless of their disability. There is a rapid increase

of visually impaired people in need of Assistive Technology to be able to access and use Virtual Learning Environments.

Every person has the right to education, including those with disabilities. Inclusive education is a fundamental human right for a person with disability, it accommodates all students regardless of their abilities or requirements and at all levels (UNICEF, 2017).

Successful access and use of Virtual Learning Environments is possible; however, blind students have difficulties due to several factors including the content which do not meet the accessibility requirements, the lack of skills to use computer and other electronic devices, access to internet and many other challenges.

Blind students learn better when the instructional materials are presented in tactile formats. In a blended learning approach where VLE is involved, blind students rely on assistive technologies that help them access online content, hence the need for the learning content to meet accessibility requirements to be accessed through assistive devices used by blind students.

With the advancement of the use of technology, assistive devices have captured the attention of learners with visual impairment. Visually impaired students can explore more learning materials thanks to the computer assistive technology. It is obvious that today, to access information, they must be computer literate (Islam, 2017).

The government of Rwanda through the Ministry of Education is putting in place the requirements to implement the Marrakesh treaty. The Marrakesh treaty was signed in 2013 and Rwanda is among the countries that signed that treaty. The aim of the treaty is to advance education for visually impaired people by making digital textbooks and make them accessible and affordable (WIPO, 2016). For the learners with visual impairment to access these textbooks, they need computer assistive technology that enables them to read those textbooks. Assistive technology refers to any equipment, software or product that serves to improve or increase the functional capacity of an individual with disability (Zhou et al., 2011).

With e-learning, courses are accessed via the Virtual Learning Environments which are platforms where the content is uploaded to be accessed by the learners. Apart from the course content, the Virtual Learning Environments include spaces where students can have discussions, do assignments and assessments. But when the course contents are not designed with accessibility in mind, blind students experience challenges to access and use them. In other words, there is lack of

inclusion which normally involves modifications in the content, structure and strategies with common vision, whereby different abilities and difficulties experienced by learners are recognized. This study will therefore help to examine the access and use of Virtual Learning Environments by blind students at UR with the aim of investigating to what extent the accessibility requirements are observed in creating accessible content for blind students.

1.2 Statement of the problem

According to the report released in 2012 by World Health Organization (WHO), 1% of Rwandan population are blind, that is almost 400, 000 (WHO, 2012 as cited in Binagwaho et al., 2015) Very few of these people attend higher learning education, and if they attend, not all of them have computers so that they master the use of computer assistive technology. Thus, when they graduate from the University, they do not get jobs because employers think that they are not able to use computers and other technological work.

Education is a fundamental to human right, the constitution of the Republic of Rwanda of 2003 as amended in 2015, stipulates that every Rwandan has the right to education. Freedom of learning and teaching is guaranteed in accordance with conditions determined by law (MINEDUC, 2018a). This project will therefore be intended to identify the challenges that blind students face in accessing and using virtual learning environments and recommend ways out of those challenges. Different studies have been carried out on the subject of accessibility on LMS for disabled people but they did not tackle the particularity of blind students for this matter. The present study will focus on blind students.

1.3 The history of Inclusive Education

Inclusive education started to appear in literature back in the 1980s. Framed as an alternative to special education, inclusive education expanded the responsibilities of schools and school's systems to increase access, participation, and opportunities to learn for marginalized populations of students (*Inclusive Education - Education - Oxford Bibliographies*, n.d.). Inclusive Education involves changes and modification of content to meet the needs of all learners. The principle that all learners are different, but they can learn and develop differently is what inclusive education is based on. So, it is up to the education system to be flexible to cater for all learners despite their differences (Cleveland-Innes, 2018).

The education of learners with visual impairment especially the education for blind students has been progressing in Rwanda, when you look to the development of good policies on Inclusive Education, but more work needs to be done to address the digital divide.

1.4 Objectives

This research seeks to achieve its general objective of investigating the Access and use of Virtual Learning Environments by blind students in accessing information on e-learning platform with a view to identify the learning accessibility requirements, to which extent the accessibility requirements are considered in learning content and identify challenges blind students face and what might be viable solutions by focusing on the following specific objectives:

1. To identify learning content accessibility requirements for the blind students using learning management system.
2. To investigate the extent to which learning content offered to blind students in an undergraduate program at University of Rwanda meets the accessibility requirements.
3. To identify skills-gap for the teaching staff responsible for creating accessible learning content
4. To develop guidelines for increasing learning content accessibility for blind students at University of Rwanda.

1.5 Research questions

1. What are the accessibility challenges blind students face in using the learning content available on Moodle at University of Rwanda?
2. What are the skills gaps for teaching staff to create accessible learning content for blind students?
3. How can instructional designers effectively create accessible learning content for blind students?

1.6 Significance of the study

This research is important because teaching blind students at the University level in Rwanda started not a long ago and the use of Virtual Learning Environments in teaching and learning is still under development in Rwanda in general and at the University of Rwanda in particular. This study will fill an important research gap in the design and development of learning content in Virtual Learning Environments considering the accessibility requirements. The information that this study will reveal may contribute to the development of guidelines to increase learning content accessibility for blind students.

1.7 Limitations and delimitations of the study

1.7.1 Limitations of the study

The research will have a limitation on accessing some of the participants given the time to do the research. At the time of data collection, the students will be on their holidays waiting for the start of the new academic year which is to start in the middle of May 2022 according to the UR academic calendar. The researcher will overcome this limitation by accessing the participants via emails and the questionnaires will be answered electronically. Interviews will be conducted virtually either on phone, teams or zoom.

1.7.2 Delimitations of the study

The study on the access and use of Virtual Learning Environments by blind students at the University of Rwanda focused only on blind students at University of Rwanda in the College of Education and College of Arts and Social Sciences. In fact, the University of Rwanda has 6 colleges that are distributed in 9 campuses but only two colleges admit blind students in 3 campuses.

CHAPTER TWO: REVIEW OF THE RELATED LITERATURE

2.0 Introduction

A literature review is the presentation of other documents and materials about a specific topic. It provides an overview of what is already known on that topic and allows the researcher to identify relevant theories, methods, and gaps in the existing research (Efron & Ravid, 2019).

Edinburgh University defines literature review as a piece of academic writing demonstrating knowledge and understanding of academic literature on a specific topic placed in context (Edinburgh, 2021).

In this chapter, the researcher is making a review of literature on virtual learning environment in teaching blind students; the Moodle for this matter; the online platform used by most of the universities and higher learning institutions. The chapter will discuss earlier use of e-learning approaches and the gaps that are there in terms of research.

There has been a vast improvement in universal access to technology, however, Visually Impaired individuals still struggle with poorly designed computer interfaces that continue to lag in some web design features" (Pro, 2005).

2.1 Learning as a blind person in higher education

It is not easy to know when the first blind student attended higher education, but according to the story by Jana L. Schroeder about Martha B. Hays, blind students were attending higher education in 1920s (Bedny, 2013). Attending school for blind students was not only to further their education but also to increase independence from their families.

Education for people with disabilities has been a load history because resources and technologies were slow to come due to societal stigma around disability. This was no different for blind people (Sylvester, 2020).

Many writers and researchers prefer not to use the term blind or blindness as a separate category of disability, they use visual impaired to refer to both blind and low vision persons. Then, the phrase "visual impairment" refers to a range of diseases, some existed from birth and others resulted from the progressive loss of vision. Low vision is a diminution of visual acuity with a remainder vision while blindness is a total loss of vision. So, people referred to as legally blind have residual vision (Rabello et al., 2014).

Blind students at universities or higher learning institutions experience different challenges, some related to the environment, social integration and learning challenges. At the university, a student must read and write a lot. Reading is not to read any document you come across but selecting what is relevant to the subject you want to read about. Whereas sighted students use highlighters, rulers, and pencils to underline the most important thing they read, blind students must read the entire article or document with many pages even if the information they are looking for is not in that document. It requires more concentration for blind students compared to their sighted peers (Lourens & Swartz, 2016).

Many people ask themselves how a person who does not see can learn and even go to the level of attending University and get higher degrees.

People who are blind face two major problems: One is to learn skills that make them live a normal life and contribute to society as any other person without disabilities. Another problem they face is the attitudes of other people who consider a blind person as someone who is not normal, who cannot do what others do. According to Kenneth Jernigan (1970), when a blind person gets proper training and opportunity, he can do any job in any place and do it as well as his sighted neighbor. Blindness is just lack of vision that may be caused by several factors like diseases and accidents. It is inappropriate to link the word "blind" with connotations of inferiority and helplessness. A person's environment has a huge effect on the experience and extent of disability. Inaccessible environments create barriers that often hinder the full and effective participation of persons with disabilities in society on an equal basis with others (WHO, 2021).

According to Johnsen(Johnsen, 2013) adaptation of teaching and learning environment contribute much to success of inclusive education. The environment in which teaching, and learning take place must be supportive to students with visual impairment, otherwise their learning will be interrupted.

2.2 Blind learner's rights to education

Blindness has been there since the existence of humanity, but educators started thinking of unique educational methods that could help to improve the ability of blind people to function late in the 18th century. In 1824, a French student Louis Braille who was blind developed a system that allowed blind people to read (Roth & Fee, 2011).

The children act of 1975 (Public Law 94-142) stated that all children, regardless of their disabilities, have a right to free and quality education. People with disabilities are entitled to access schools as their peers without disabilities do, except when the nature or severity of disabilities requires special attention that could not be possible in general education (Rebell & Hughes, 1996). It is the obligation of all education and training providers to ensure that the right to access and participate in education and training free from discrimination are upheld through the provision of an inclusive learning environment and practices.

To ensure the rights to education for blind students, Universities and higher learning institutions should practice reasonable accommodations to meet the specific needs of learners with disabilities. Article 24 of the United Nations convention on the rights of persons with disabilities (2006) says that schools should make sure that students with disabilities receive individualized support. Again, 193 countries signed the Sustainable Development Goals (2015) that say that all children including children with disabilities have the rights to inclusive and equitable quality education and lifelong learning (MINEDUC, 2018b)

2.3 Barriers to inclusive education

Inclusive education occurs when learners can go to their local schools and learn in a stimulating, supportive and accessible environment in which they receive an education of decent quality (Le Fanu et al., 2018).

Blind people can be successful in learning and in life. But they often face different barriers that make it difficult for them to maximize their potential. Some of the challenges that these students face include but not limited to: Negative attitudes, lack of home-based educational support, lack of school/university-based educational support, lack of sufficient and adequate Assistive Technology, barrier of inaccessible environment and many other barriers.

The inclusive education was introduced after realizing that special education promotes exclusion of many students who need special support, and it was regarded as stigmatization by segregating these students from their peers and general school activities (Hallahan & Kauffman, 1982, Beth Mukarwego Nasiforo, 2015). The inclusion movement started in the United States of America with the advent of Regular Education Initiative (REI) with the general aim of eliminating the divide between the general education and special education. However, the divide between general and special education still exists. The concept of inclusive education continued to expand and in 1994

in Salamanca (Spain) held a World Conference on special Needs Education and they established principles that set the foundation for understanding the importance of inclusive education.

The goal number 4 of the Sustainable Development Goals is about ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all (Johnston, 2016).

Inclusive education meets numerous barriers among others: The insufficient number of qualified teachers is one of the major barriers to inclusive education, negative attitudes from the community where some of the society members still consider PWDs to be pitied for, people who cannot do or learn on their own (MINEDUC, 2018b)

2.4 The concept of Virtual Learning Environment

The concept of Virtual Learning Environment started to appear in the literature around 1960s with the establishment of the equipped classroom system that was linked by computer terminals. Through this system, students could access informational resources on a given course while listening to the lectures (Mwanza et al., 2021). In the following years, researchers from different universities notably contributed to the development of computer-based learning. The improvement of internet functionalities and the increase of its speed enabled the introduction of new communication methods that involve multimedia, interactive materials, and the use of webcams.

When learning is functionally and effectively happening in the absence of traditional classroom environments that is Virtual learning (Bulman & Fairlie, 2016).

Virtual Learning has been used in education since a long time ago. Since 2010, most large institutions adopted teaching online, and Virtual learning Environment became more interactive, where students can collaborate between themselves and between them and their instructors [1]. Not only schools and universities, but also some companies use Virtual Learning Environments to train their employees to improve their qualifications.

The VLEs aim at eliminating the barriers that would be in education and create motivating and self-learning experiences for students. VLEs have potential in providing learners with independence in learning, but to realize this potential of VLEs depends on several factors, such as: The types of activities to be done, the amount of support from the teachers, the situation in which the learning is taking place and students' perceptions (Asztalos, 2015).

VLEs are commended for their ability to be applied in student-centered and personalized learning to be able to accommodate different learning styles.

2.5 Virtual learning Environment for blind students

Learning in a blended learning environment has been a desire for many universities in Africa since early 2000. After realizing the increase uptake of the technology in many aspect of life, public and private universities in Uganda have started using VLEs to support delivery of blended learning and the befits of blended learning and e-learning continues to increase. Baguma R and Walters MK (2021) argue that e-learning is of particular benefit to students with disabilities, since these students may find it difficult to attend classes on campus (Baguma & Wolters, 2021). Learning via VLEs where traditional teaching is supplemented by online learning gives learners to increase the ability to learn collaboratively, increase creativity, study independently and develop their own learning experiences to meet their individual needs (Cleveland-Innes, 2018). The use of technology in learning for blind students increases their reading and writing skills and it increases their ability to communicate with others. This justifies the need to use VLEs in learning for blind students.

2.6 Policies, guidelines, and legislative guiding education in Rwanda

Article 20 of the constitution of the republic of Rwanda of 2003 revised in 2015 states that every person has the right to education. In the same constitution, art. 11 states that all Rwandan are born and remain equal in rights and freedoms. It continues that discrimination of any kind, or its propaganda is prohibited and punishable by law.

Rwanda has developed many policies to ensure education for all including people with disabilities. After the Genocide of 1994, Rwanda has made a remarkable progress in education sector reform, many strategies and policies have been put in place to strength this sector which is considered to be one the backbones of the development of the country. In the government document "Vision 2020", education is one of the pillars to achieve the goal of human resource development and a knowledge-based economy (Government of the Republic of Rwanda, 2000). This document continues saying that the admission rate to the tertiary education had increased but the gap was still in enrolling people with disabilities in higher learning education. The government of Rwanda through the Ministry of Education (MINEDUC) has put in place a Special Needs and Inclusive Education policy in line with promoting equalization of opportunities for all its citizens. The government of Rwanda mandated MINEDUC to educate and train all the marginalized groups of

children and Youth (MINEDUC, 2018b). This policy emphasizes the equal access to learning and opportunities for all learners with special educational needs. This policy was put in place as implementation of the provisions of the Rwanda constitution of 2003 revised in 2015 (article 20). In its seven-year government program: National Strategy for Transformation (NST1) (Rwanda, 2017) the government of Rwanda committed to strengthening the skills and increasing the number of professionals in Special Needs Education (SNE) and Inclusive Education (IE), scaling up assistive devices and other educational resources and continue to support and involve people with disabilities (PwDs) to participate all decisions making. Another important document that Rwanda has put in place to strengthen education, is the Education Sector Strategic Plan (ESSP). In this strategic plan, the government of Rwanda commits to improve science and technology by putting emphasis on the Information Communication Technology and digital competencies (MINEDUC, 2018a). The attention is also put on alleviating all causes and obstacles that can lead to any form of disparity in education by making sure that education is available and accessed by to all people. In 2016, the cabinet of the government of Rwanda approved the ICT in Education policy. This shows how the government of Rwanda is concerned with advancing ICT in education. The curriculum should be revised to incorporate ICT in education and this has to go hand in hand with the training of teachers on delivering ICT-enabled teaching and learning (Government of the Republic of Rwanda, 2016)

2.7 Inclusive education at University of Rwanda

The University of Rwanda is currently accommodating students with disabilities including visually impaired. Through its College of Education, UR developed and implemented the inclusive education program since 2008 (Nsanzabiga, 2014). Generally, the system of education in Rwanda is considered to the most progressive in Africa when considering the general enrollment of students in primary education but again students with disabilities attending mainstream school seem to be few according to the 2012 education statistics yearbook (MINEDUC, 2013 cited in Nsanzabiga, 2014) most of them go to special schools and as they go higher in education the number keeps reducing and a few reach the university. To contribute to the promotion of inclusive education, UR in 1997 created the department of special education(Beth M Nasiforo & Ntawiha, 2021) and later on in 2014 the School of Inclusive and Special Needs Education was created whereby UR

train teachers in Inclusive Education so that they get knowledge and capacity to meet the needs of diverse learners with SEN.

The first ever blind students registered in Higher Learning Institution in Rwanda joined the University in 2008. As reported by the New Times (2020), the daily local newspaper, "The University of Rwanda has introduced resource rooms in 2008 in a view to assist learners with visual impairments, but as more visually impaired students join the University the resource rooms are not enough to cater for all learners in need". The article further reports that one of the blind students suggested that "*If teachers were qualified enough to support us daily, other challenges would not be as serious. We need their support more,"*

The University World News, a newspaper reported that the UR is the only higher learning institution in Rwanda that accommodates learners with different disabilities in an inclusive setting, whereby in 2020 UR was counting 500 students with disabilities (Mbonyinshuti, 2020). The newspaper further narrated that UR accommodates those students with disabilities in its campus of Huye, Nyarugenge, Rukara and Nyagatare where students are offered with on-campus accommodation to easy their mobility and access to facilities. However, thaoghr UR is doing tremendous work in providing the needed learning materials, there is a gap in providing blind students with the materials they can go with when they are not on campus to facilitate them have access to learning content online.

Inclusive education is defined as where all learners are accommodated in the same facility. It is part of the United Nations' Sustainable Development Goal 4, which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all".

The university has set up a special resource room that caters for students with a visual impairment. It has several computers with software that assists students in accessing the internet.

The enrollment of students with visual impairment in higher learning institutions in Rwanda started in 2008 grace to the initiative of Dr. Evariste Karangwa, who is now the Dean of the school of Inclusive and Special Needs Education. At that time, only 15 visually impaired students were admitted and enrolled to higher learning.

IE cannot be fully achieved in a short time, even at the University of Rwanda there is still a need to change the mindset at University level as people with disabilities need more support.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This study aims at accessing and use of Virtual Learning Environments by blind students to access course content on Moodle. Our concern is to gather information that would be used by the decision makers to make sure that they provide enough support to equip blind students with necessary skills to access the content through Virtual Learning Environments and to maximize the possibilities to create course content that are accessible to all learners. To identify the challenges that blind students face in interacting with Virtual Learning Environments, the researcher used different methods including but not limited to interviews to blind students, teachers, and other staff who are linked with the development and availability of learning content on Moodle, surveys, and document review.

3.1 Research design and study setting

This work presents a case study investigating the access and use of virtual learning environments by blind students in Rwanda. The case study research approach is used to explain, describe, or explore phenomenon in everyday context in which they occur (Yin, RK, 2009). It was selected based on the research questions formulated for this study that focuses on uncovering learning accessibility requirements and gathering insights into the available tools as well as the challenges that students face in their education.

In this study, descriptive research was adopted where collection of data was done by interviewing participants and administering questionnaires to sampled individuals. A descriptive research design provides worthwhile data that leads to the solution for identified problems in a particular area as well as data that can form the basis of research of an empirical nature (Orodho, 2004).

For Creswell John W, research design is the specific procedure involved in the research process: "Data collection, data analysis and report writing" (Creswell, 2014, as cited in Nasiforo, 2015)

This study applies mixed methods research to combine qualitative and quantitative approaches.

The study was carried out at the University of Rwanda, in two colleges namely the College of Education and the College of Arts and Social Sciences. The College of Education has two campuses: one in Rukara and another in Nyagatare in Kayonza and Nyagatare districts respectively in Eastern Province. The College of Arts and Social Sciences has the main campus at Huye in Huye district, Southern Province. The University of Rwanda has six colleges, but the study was carried in two colleges because they are the only ones that admit students with visual impairment in Rwanda.

3.3 Population

The target population consisted of (1) all blind students in three UR campuses that accommodate those students, (2) lecturers that teach in the programs that blind students are admitted to, and (3) e-learning officers.

Table 1. Total target population

College	Blind students	Lecturers	E-learning officers
College of Arts and Social Sciences	9	10	2
College of Education	6	20	3
Total number of target population	15	30	5

3.4 Sample size and sampling procedures

3.4.1 Sampling procedures

Sampling procedures or techniques is a way of selecting a few individuals or things from which information is gathered and generalized for the target population. Given that the blind students' population is significantly low at UR, purposive sampling is adopted to involve as many participants as possible making representative samples. Purposive sampling, also known as judgmental, is a sampling technique by which researchers rely on their own judgement when choosing the members of the population to participate in their surveys (*Purposive Sampling*, n.d.). Purposive sampling technique was adopted because it is suitable for both qualitative and quantitative research. According to Tongco (2007), purposive sampling is a deliberate choice of

informant due to the qualities the informant possesses. He adds that purposive sampling is a nonrandom technique that does not need underlying theories or a set of number of informants. It allows the researcher to use the cases that have the required information related to the objectives of his/her study.

UR Colleges that admit blind students are limited, hence lecturers and students involved in the programs that accommodate blind students are known. This study applies a rolling ball approach to reach out to as many respondents as possible.

3.4.2 Sample size

All 15 blind students who are studying in undergraduate programs at UR, College of Education and College of Arts and Social Sciences on the campuses of Huye, Nyagatare and Rukara were selected because they are few in numbers. For the lecturers, 15% of the lecturers who teach in the programs where blind students are enrolled were selected. E-learning officers, campus administrators and human resources managers were all selected since they are few.

3.5 Research instruments

This research will use survey questionnaires to collect data from blind students, teachers, and e-learning officers. Given that respondents are in various parts of the country, the online platform Survey XACT[1] is used as it supports the creation and distribution of questionnaires through e-mail addresses.

The advantage of using online survey questionnaires was that it was easy to distribute the questionnaires and get the information automatically without waiting for the paper questionnaires to come back to the researcher. This saved the time it would take to distribute the questionnaires and get them back. It was also easy for blind students to access the questionnaire using the screen readers. If it were not that way, it would be time consuming and incur the cost to hire a person to transcribe the questionnaire and responses with braille, hence the original questionnaire loses its originality. Online survey questionnaire reduces the errors that could be made in entering the responses in the database, because the responses from the respondents were automatically entered in the system. Online surveys are also accurate; no one can change the responses from the respondents.

Analysis of the results on an online survey is easy and can be analyzed at any time. It is easy to create graphs for reports and you can export the results in real time for further analysis and share the results with others as you want.

On the other hand, online survey questionnaires require access to the internet, and it is sometimes not easy for people who are in remote areas where getting internet connection was an issue. Some responses are not accurate in the sense that some respondents fill the questionnaire just to get done with it. It was difficult to believe if the targeted respondents were the ones that responded to the survey.

To understand the respondents' opinions, the researcher used interviews as a way of collecting and arriving at qualitative data. An interview is a purposeful exchange of ideas, the answering of questions and communication between two or more people. It is a conversation for gathering information, where an interviewer coordinates the process and asks the questions, and an interviewee responds to the questions. The interviews can be done face to face or over phone/teleconference. In this work, the interviews were done using both phone calls and Microsoft Teams[2](Online videoconferencing tool) because the researcher could not meet face to face with the participants. Interview guide questions were used in semi-structured interviews where the researcher used predetermined questions.

3.6 Data collection procedures

After the selection of the respondents, the researcher proceeded with the collection of data. To collect data at UR requires a written ethical clearance and this was requested from the Research and Innovation Unit at University of Rwanda College of Education. The request was sent to this unit and the clearance letter was given to the researcher. The clearance was shown to the Principals and of CE and CASS to be allowed to access respondents in Huye, Rukara and Nyagatare campus. The questionnaire was sent to each respondents via email or phone number, where the link to survey-Xact was shared virtually. The link was accompanied by the brief introduction to the study. Afterwards, respondents (students) were contacted to schedule an interview. The interview was done virtually using WhatsApp call and voice notes. All students were blind and they were in their vacation where it was not easy to find an assistant to facilitate other ways of carrying out the interviews. WhatsApp was opted as an alternative after failing to use zoom or Microsoft teams as planned before. The respondents were requested to consent before collection of data from them.

3.7 Validity and Reliability of the instruments

3.7.1 Validity

The validity of the study instruments was ensured by sharing them with experienced researchers and adjusted them to make sure that they will be measuring what they are supposed to measure. The supervisors from the University of Agder (UiA) and from UR have checked the validity of the questionnaires and interview guides. An expert in Special Education Needs checked the accessibility of the questionnaires to blind students using a screen reader and confirmed that they will be accessible for blind students.

3.7.2 Reliability

An instrument is said to be reliable when the results obtained after the test and re-test using that instrument with similar subjects are the same or similar (Orodho, 2004). Reliability is the extent to which the results can be reproduced when the test is repeated under the same conditions. In this research, questionnaires and interviews were used to make sure that the responses given were correct.

3.8 Ethical considerations

In conducting this study, ethical considerations were observed. The purpose of the study was explained to the participants, and they voluntarily participated. All participants signed the informed consent form, and the researcher ensured the participants that their privacy will be protected. So, attention was paid to anonymity, confidentiality, and appropriate storage of data (Allen, 2017).

The researcher submitted the research ethical clearance form to the Research and Innovation Unity of the College of Education at University of Rwanda and the later provided clearance.

3.9 Limitations of used methods

In collecting the data using the chosen methods and instruments, the researcher encountered some challenges especially collecting the data from blind students. The collection of data was entirely done online yet some of the students have no access to the internet when they are not on campus. In the plan to carry out this research, the period for data collection was planned to take place in April and it was expected that all students at UR would be on campus where students can easily have access to computers and internet and get a facilitator when needed. But due to Covid-19, the

previous academic year took to finish, and this had impact on the beginning of the following academic year. Instead of starting in March as planned before, the academic year is to start towards the end of May 2022.

Another limitation was on communication with other participants, namely, Campus administrators and Directors of human resources. They all refused to take part in the interview despite all the means the researcher used. They were contacted through email, and they did not react, and then short messages were sent to their personal mobile number, again no reaction. Finally, the data collector called some of them and said that they do not see where their positions relate to the teaching of blind students. One of them said that he prefers to have written questions so that he can give written response but again he did not answer the interview guide questions sent to him.

3.10 Summary of the chapter

This chapter discussed methodology, research instruments, research design and sampling techniques. The chapter also discussed the validity and reliability of the research instruments, data collection procedures as well as ethical issues considered.

CHAPTER FOUR: FINDINGS, INTERPRETATION AND DISCUSSION

4.1 Introduction

The aim of this chapter is to report the collected data from the respondents through questionnaire and interviews, analyze the data and relate them to the objectives and research questions to provide a picture of the access and use of VLEs by blind students at the University of Rwanda. The research objectives of the study addressed the following key areas: To identify the learning content accessibility requirements to allow blind students to use the Learning Management System, to investigate to what extent course content offered to blind students via LMS meet the accessibility requirements, to identify skills gap for teaching staff in creating accessible course content, and to develop guidelines for increasing learning content accessibility for blind students.

4.2 Demographic information

This section presents the demographic data from the lecturers, blind students, and e-learning officers. The variables that were taken into consideration to analyze demographic data are age, gender, experience, level, and area of study for blind students.

4.2.1 Demographic data for blind students

This part answers the first part of the questionnaire which delt with demographics of the participants. Demographic characteristics were discussed in terms of age, gender, how long they have been blind, area and level of study. The questionnaire was distributed to 15 blind students and 14 attempted to answer the questionnaire but 4 of them partially completed the questionnaire. So, only 10 fully completed the questionnaire and this represents the return rate of 71.4%.

Table 4. 1 Gender and age of blind students who participated in the research

Gender	**Female**		**Male**		**Total**	**Percentage**
Age	**Frequency**	**Percentage**	**Frequency**	**Percentage**		
15-20	0	0%	0	0%	0	0%
21-30	5	100%	5	56%	10	71%
31-40	0	0%	4	44%	4	29%
Total	5	100%	9	100%	14	100%

Source: Primary data

In the table above, 5 (36%) of the total respondents are female, while 9 (64%) are male. The findings also show that 10 (71%) are between 21 and 30 years of age whereas 4 (29%) are between 31 and 40 years. No respondents under 20. The number of female blind students is low compared to their male peers, and this is a general fact even for other students without disabilities. According to Elizabeth C. Reilly (Reilly, 2021), the women's acceptance rate into higher education as undergraduates is small and suggest that further investigation can shed light on the reasons for low acceptance of women into the university.

Table 4. 2 How long respondents have been blind

Gender	**Female**		**Male**		**Total**	**Percentage**
How long have you been blind?	**Frequency**	**percentage**	**Frequency**	**percentage**		
0-5 years	1	20%	3	33%	4	29%
6-10 years	0	0%	0	0%	0	0
11-15 years	0	0%	0	0%	0	0
Above 15 years	4	80%	6	67%	10	71%
Total	5	100%	9	100%	14	100%

Source: Primary date (2022)

The table above shows that 71% of the respondents have been blind since birth and 29% became blind later in life.

Students were asked to say their level/year of study, and the following table shows the year of study of blind students.

Table 4. 3 Year of study

Year of study	**Frequency n=10**	**Percentage**
Year 1	2	20%
Year 2	5	50%
Year 3	2	20%
Year 4	1	10%

50% of the respondents are in year two of study, 20% in year one, 20 % in year three and 10 % in year four.

4.2.2 Demographic data for lecturers

In this research, the questionnaires were used to collect data from lecturers. The first section of the questionnaire asks about demographic characteristics of the lecturers and were discussed in terms of age, gender, area of specialization and teaching experience.

Table 4. 4 Age of the respondents

Age	Percent	Number of respondents
25-35	5%	1
36-45	27%	6
46-55	41%	9
55 and above	27%	6
Total	100.0%	22

Source: Primary data 2022

In the above table, the findings show that 1 (4.8%) of the respondents are between 25 and 35 years of age, 6 (28.6%) of the respondents are between 36 and 45 years, 9 (42%) are between 46 and 55 years, finally 5 (23%) are above 55 years of age. The observation is that the considerable number of the respondents are between 40 and 55 years, and the reason behind is that UR no longer recruit tutorial assistants who possess a bachelor's degree and of course younger generation. According to UR 7 years' thematic report 2013-2020, the distribution of academic staff for the academic year 2019/2020, assistant lecturers were dominating with 45% of the entire academic population, while tutorial assistants are 17%.

Table 4. 5 Gender of the respondents

Gender	Percent	Number of respondents
Female	27%	6
Male	73%	16
Other	0.0%	0
Total	100.0%	22

S*ource:* Primary data 2022

Table 6 shows that 6 respondents representing 28.6% of the total number respondents are female while 15 (71.4%) of the respondents are male. The small number of the female respondents reflects those female academic staff are few at the University of Rwanda. This is confirmed by the UR 7 years' thematic report 2013-2020, which says that female academic staff are 25% against 75% male academic staff.

4.3 Experience of lecturers

This is the question that was asked to the respondents to have information on their teaching experience. Teaching experience of the respondents sought to be important in identifying the skills gap in creating course content that meet the accessibility requirements on Virtual Learning Environment. The table below shows the experience of the respondents.

Table 4. 6 Experience of the respondents

Years of experience	Percent	Number of respondents
1 to 5 years	5%	1
6 to 10 years	9%	2
11 to 15 years	41%	9
15 to 20 years	18%	4
More than 20 years	27%	6
Total	100.0%	22

Source: Primary data 2022

Table 7 shows the findings on the lecturers' teaching experience, where 1 (4.8%) has less than 5 years of experience, 2 (9.5) of them have teaching experience between 6 and 10 years, 9 (42%) have 11 to 15 years of experience while 4 (19%) have experience between 15 and 20 years, 5 (23.8%) have experience of more than 20 years.

Table 4. 7 Area of specialization of the respondents

Area of Specialization	Percent	Number of respondents
Mathematics Education	22.7%	5
Languages	18.1%	4
Computer Sciences	9%	2
Foundations of Education	18.1%	4
Curriculum and Instruction	13.6%	3
Economics	4.5%	1
Biology	4.5%	1
Sciences with Education	9%	2
Total	100.0%	22

As observed in the table above, each respondent has indicated his area of specialization. The findings show that 23.8% of the respondents are specialized in Mathematics Education, 19% have specialization in languages (Linguistics and Literature), 9.5% are specialized in computer sciences. 14.2% specialized in foundations of Education as well as those in curriculum and instruction. The findings also show that 1 (4.7%) of the respondents have specialization in Economics, 1 (4.7%) in Biology and 9.5% specialized in Sciences with Education (Integrated Sciences with Education).

4.4 Level of Experience in using digital technology

The experience in using computers, smartphones and other devices that are used in technology have a considerable influence on access and use of VLEs. To find out the experience of blind students in using digital technology devices, the respondents were asked to tell the level to which they think they are in using such devices. The table below presents the findings on the level of experience in using digital devices.

Table 4. 8 **Level of Experience in using digital technology**

Level of experience	**Percent**	**Number of replies**
Novice	10.0%	1
Medium	70.0%	7
Experienced	20.0%	2
Total	100.0%	10

4.5 Learning content accessibility requirements

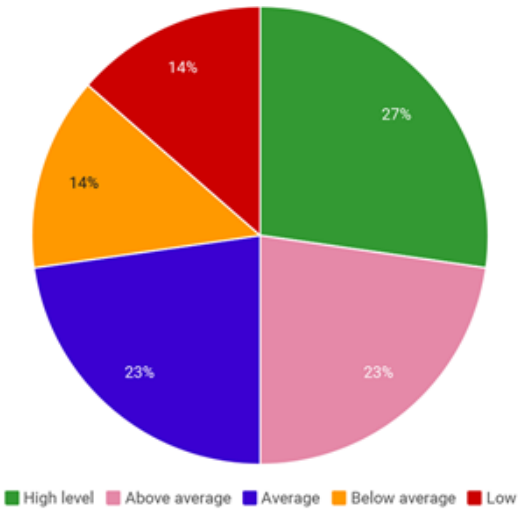
The first objective of this research was to identify learning content accessibility requirements for blind students using learning Management Systems at UR. The University of Rwanda has in place different documents, polices and regulations that aim at ensuring the learning accessibility requirements in general. The documents do not say blind students, but if the accessibility requirements are observed, blind students also have less challenges in accessing learning content on Moodle. The UR Open and Distance Learning policy[2] says that in line with supporting ODeL teaching and learning, the Center for Open and Distance Learning must ensure the production of high-quality distance learning materials that are available to learners in a variety of instructional media. This entails producing materials that are accessible to all learners including blind students. The policy gives responsibility to CODL to work collaboratively with teaching departments to convert teaching materials and programs into accessible online materials for distance and online mode. The policy continues to provide that CODL is responsible for training staff on development of accessible learning materials, on ODeL-related assessment practices; on facilitation of learning; administration and management of ODeL process and systems.

In addition to the open and distance learning policy, UR adheres to the *Quality assurance guidelines on disability and other special needs for higher education in East Africa.* According to IUCEA (2015) the course content must entail adoption and adaptation of a variety of inclusive teaching methods, resources, and techniques to facilitate effective and meaningful learning for all ranges of categories of students with disabilities and other special needs and ensure that all academic staff are equipped with education resources in accessible formats or supported by assistive provisions.

The figures below show their responses on how the learning contents they create meet the accessibility requirements.

The respondents were asked to tell at what extent they consider accessibility requirements in their course content.

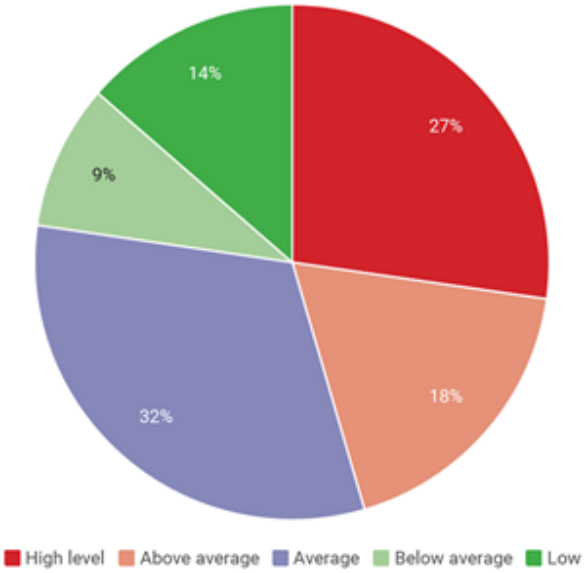
Figure 4. 1 Maximize compatibility with current and future user tools



This graph shows that 27% of the respondents said that they consider maximizing compatibility with current and future tools for the course content they create, 23% consider it on above average, the same 23% consider it on average, while 14% consider maximizing compatibility of the course content on low average. The content must be compatible with different browsers, assistive technologies, and other user agents.

(40%) of the respondents from blind students strongly agree that the content on Moodle can be accessed using tools they have such as screen readers, and 6 (60%) of the respondents also agree that they can access the text of the learning content on Moodle. To understand this well, the researcher conducted a semi-structured interview with 7 students, and they confirmed this. One of them said; “We can access the text in all languages on Moodle using JAWS (Job access with Speech) even if some of us struggle to capture the pronunciations of the software depending on the experience, they have in using it. The problem comes when we come across non-text content

Figure 4. 2 Provide text alternatives for non-text content



In the figure above, 27% of the respondents said that when creating content to be accessible on Moodle, they consider at important level the provision of text that describes images, photos, and any other non-text content. 32% of the respondents consider this accessibility requirement on average while 18% consider it above average. The findings also show that 9% of respondents consider providing text for non-text content below average and 14% give low importance to providing text to non-text content. These findings were supported by the responses given by the blind students both through questionnaire and interviews conducted with some of them on whether the course contents on Moodle are accessible to them as blind students. They pointed out that it is difficult for them to access some of the content on Moodle, especially images, photos graphics and tables due to lack of alternative text explaining those non-text elements in the course content. One of the respondents said,

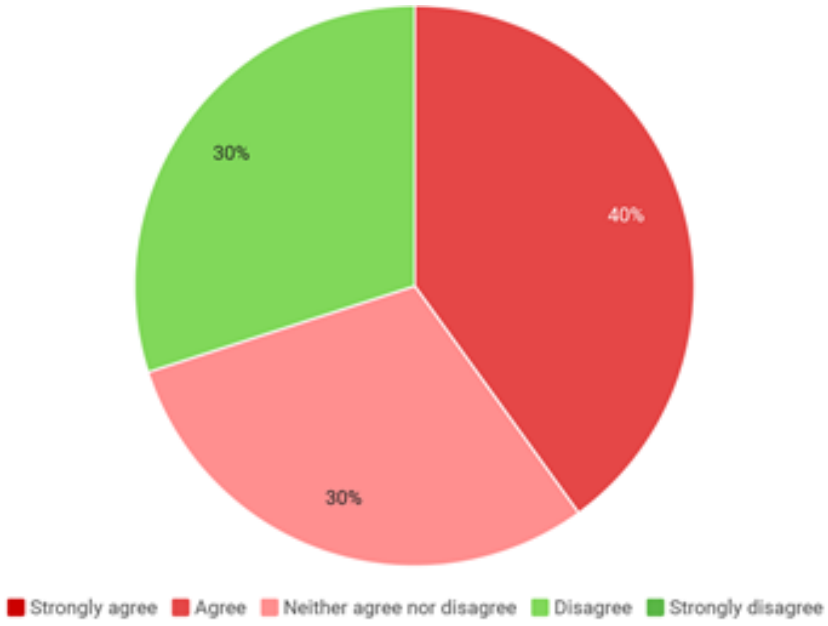
"*When I find that there is an image or a photo, I find a colleague who is not blind to assist me to know what the image or a photo is about because lecturers do not put text that illustrate the image or photo."*

Another blind student said: "*Most of the time when learning on Moodle and we come across an image or a graph, it is difficult for us to know what it is about using the screen readers that we have. But we heard that there is a software called* ***'look-out'*** *that may be able to give an overview of the image or a graph, but we cannot understand it well. We always need support from others. There is another application I heard people talking about which is called* ***super sense****, it may be helpful for us."*

Blind students were asked to indicate whether they strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree with the statement on how accessibility requirements are met in the course content on Moodle. The figure below summarizes the findings from blind students on Text Alternatives.

Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree - All images, graphs, tables, and videos in Moodle provide text alternatives that can be changed into braille or speech

Figure 4. 3 Alternative text for non-text content



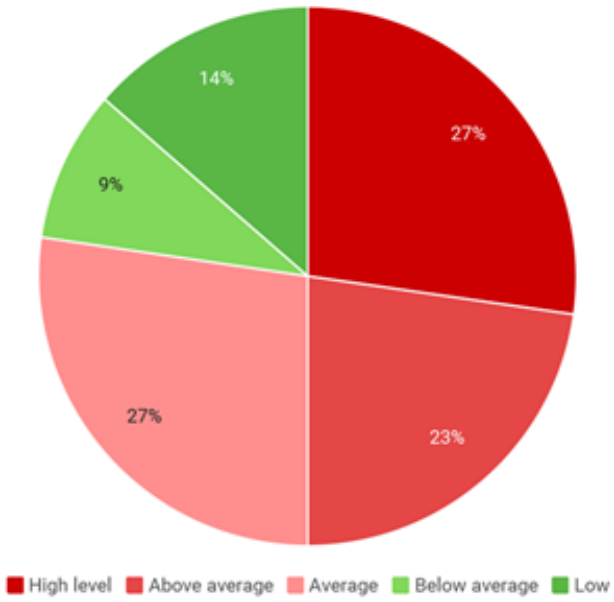
From this figure, 40% of the respondents strongly agree that non-text content have text that describes the image, graph, or tables. 30% of respondents were neutral then in the interview they said that they do not use online very often due to lack of skills and materials such as computers and other devices. The remaining 30% strongly disagreed.

Findings show that the accessibility requirement of providing the text to non-text content is met but not always. The participants said that it is not easy for them to really understand the non-text content using screen readers and devices that convert the content into braille are not able to transcribe the non-text content. One of them said "*The screen readers that we use, just say that there is an image and for us to know what that image is representing, we ask somebody to tell us"*

According to W3C[3]Alternative text is important for three reasons: Accessibility, user experience and image traffic. For accessibility requirement, the equivalent alternatives to auditory and visual content must be provided. That is to say that any content with images should include equivalent information to its visual or auditory content.

The respondents were asked to rate the extent to which they meet the accessibility requirement of creating the course content that can be presented in different ways. The figure below shows the findings from the respondents.

Figure 4. 4 Create content that can be presented in different ways, including by assistive technologies, without losing meaning



As it is shown in the figure above, 27.3% of respondents confirmed that they make sure the course content can be presented in different ways and the meaning is maintained on a high level, again 27% of the respondents said that they consider on average to meet this accessibility requirement, 23% of them consider this requirement on above average, while 14% give low importance meeting the accessibility requirement of creating content that can be presented in different ways and 9% consider it at below average. On this accessibility requirement, students who participated in this

research were asked if they can access the content in different ways or formats and some said that some of the content cannot be converted in the format they can access.

"*Yes, it is possible for us to download the content on Moodle and put it in a format that is easy for us to use, but some of the elements of the content are not accessible either with screen readers or with braille outputs. We are not skilled enough to do it, but we still meet challenges."* - A blind student at University of Rwanda

4.6 Make all functionality available from a keyboard

To investigate how learning content accessibility requirements are met at UR, we aimed also at knowing at what extent the learning content on Moodle at UR meet the accessibility requirement of making all functionality available from a keyboard. Keyboard accessibility is of paramount importance for people with disabilities who cannot use a computer mouse. Blind students interact with the keyboard to use their screen readers[4]. It is not possible for learners with no vision to use a mouse because using it requires the coordination of the hand and eyes. The respondents expressed the levels to which they consider making all functionality available from a keyboard to be important. The figure below shows the findings from lecturers.

Figure 4. 5 Make all functionality available from a keyboard

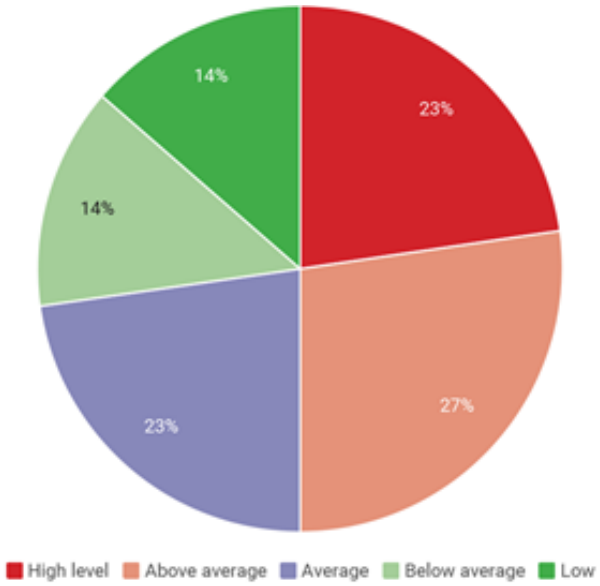


Figure 5 shows the feedback from lecturers who participated in the research to what extent they consider making the leaning content that can be accessed with a computer keyboard. 23% of the

respondents expressed that this requirement is considered at an important level of importance, 23% give it an average level of importance. 27% of the respondents revealed that making learning content accessible from a keyboard on above average level of importance, while 14% consider it below average and low level of importance. Blind students were asked whether they agree/disagree that they can access all the content on Moodle. Most of the respondents agreed that they can access the content using only the keyboard, but others said that some of the learning content is not accessible from a keyboard.

The figure below shows the findings from respondents

Figure 4. 6 All functionality of the content is operable through a keyboard interface

(Strongly agree, agree, neither agree or disagree, disagree, or strongly disagree)

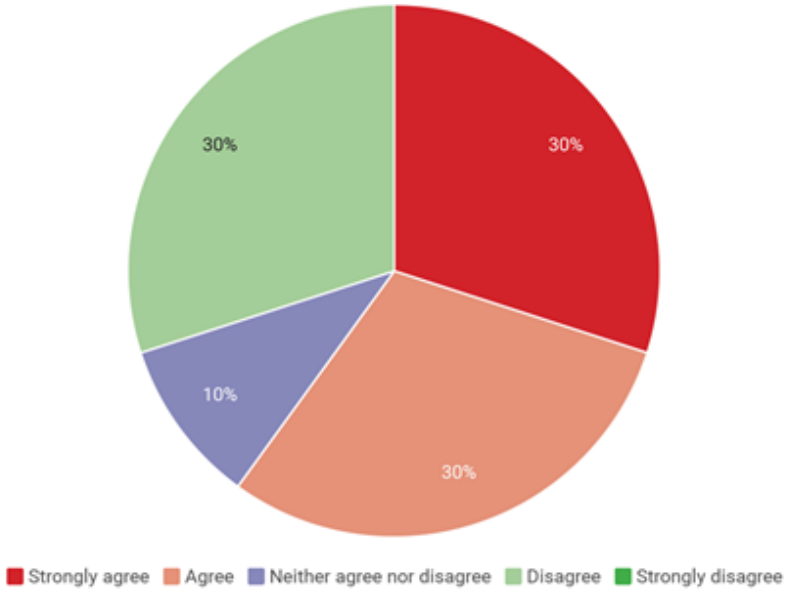


Figure 6 presents the results from students where 60% of them agreed that with the keyboard interface they can navigate the course content with ease but again 30% disagreed that it is not possible for them to access the content from the keyboard, then 10% neither agree nor disagree. The researcher wanted to better understand this phenomenon, and conducted interviews with some of the blind students and here are some of their responses:

"When learning online, I can access the content that is on Moodle with the use of a keyboard. The problem comes when we are doing an assignment which is timed. The time can elapse when we are still struggling to type and input the text because it takes time to use the keyboard to read, to write and at the same time listening to screen reader" said one of the blind students.

"Even though it consumes a lot of time, it is possible to navigate by using the keyboard only." Said another student

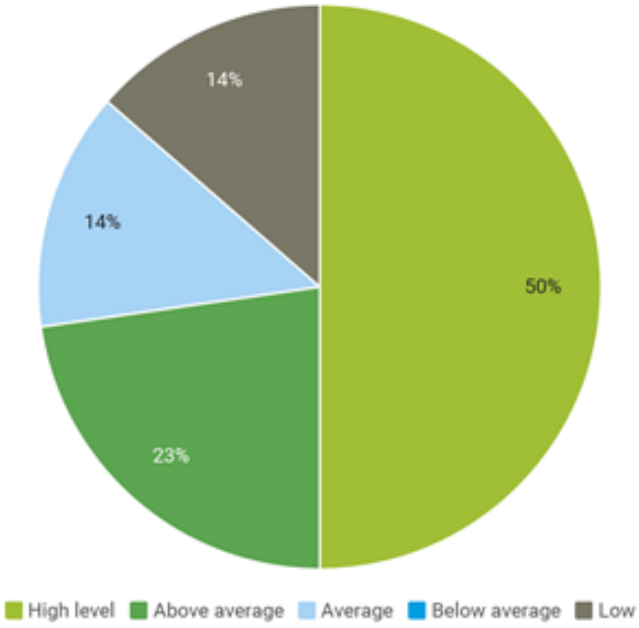
On the other hand, one of the respondents said "*If I am to tell the truth, on my side I cannot tell you that I access the content using the keyboard. First, I am not good at using the computer even offline. The big challenge is that we do not have our own computers that we can use everywhere. I get access to the computer when I am on campus, and I always need assistance from my colleagues. So, I cannot agree or disagree"*

"All functionality of the content is not accessible with the use of a keyboard. There is a time when you want to skip using the table button and you fail. So, not all functionality of the content is accessible using the keyboard only." Said another student in an interview with the researcher.

Make text readable and understandable

In line with finding answers to the research question about the accessibility challenges that blind students face in using the learning contentment on Moodle at UR and contributing to the research objective of investigating the extent to which learning content offered to blind students in an undergraduate program at UR meets the accessibility requirement, the researcher asked the respondents from lecturers to what extent they consider making the text readable and understandable for blind students. The answers indicated that most of the lecturers make sure that the text is readable and understandable.

Figure 4. 7 Make text readable and understandable



Of 22 lecturers who answered the questionnaire, 50% revealed that they consider creating text that is readable and understandable to the important level, 23% above average, 14% consider this accessibility requirement on average. But also, 14% of the respondents said that they do not give much attention to this accessibility requirement. On the other hand, students were asked if the text is readable by digital tools, they use such as screen readers and if it is easy for them to understand as they go through the course content. All the respondents from students agreed that the text of the content on Moodle is readable, but some of them said that it is difficult to understand the content due to the way the screen readers read the content. They pointed out that sometimes the content on Moodle presents issues of space between lines of the text and some of the texts are underlined. This makes it difficult for the screen readers to read and give the intended meaning.

One of the students said, "*When the text is not aligned on the left margin, reading and understanding the content becomes difficult for us.*"

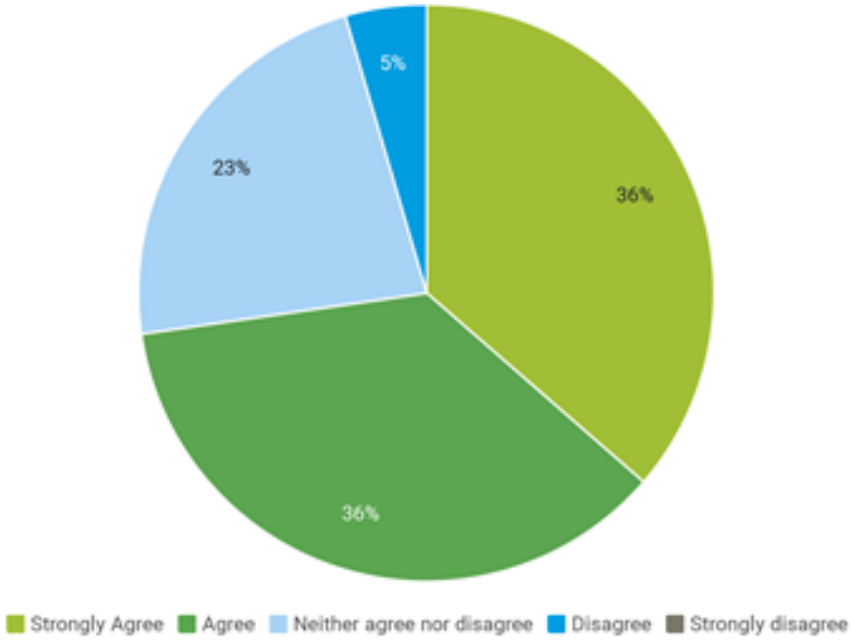
4.7 Titles that describe the topic of study

Blind students, like any other people with disabilities, should be facilitated to know what is relevant to them when learning. Not everything that is put online in the course content is important, students must be given ways to select the most relevant information they need to learn. Provision of titles that describe the topic of study helps in making the decision of what to read. The provision

of the titles helps blind students from being able to differentiate the content when multiple pages are open.

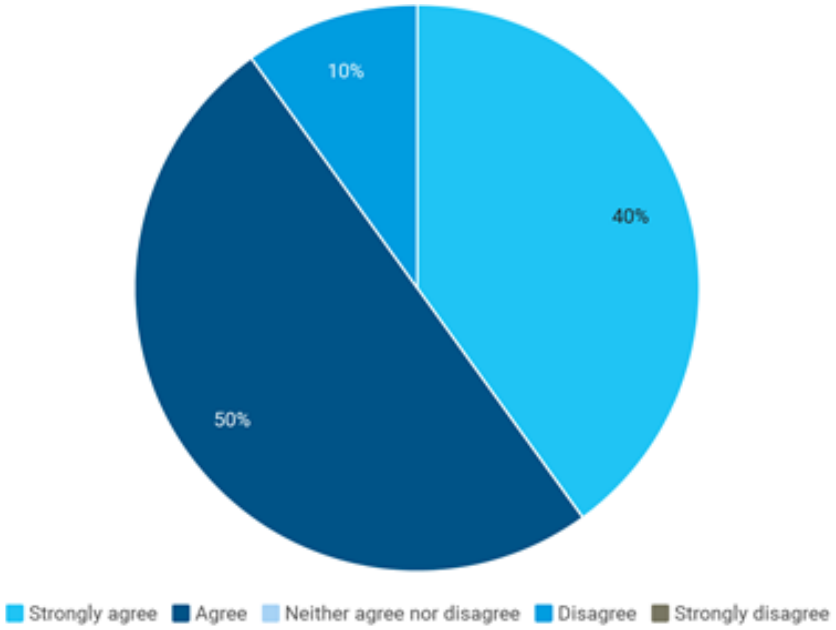
To find out the opinions of the lecturers on this accessibility requirement. The respondents' responses on the scale of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree are represented in figure below

Figure 4. 8 Content pages have titles that describe the topic of study



Based on the responses of lecturers shown on this figure, a cumulative total percentage of 72% agreed that at a considerable extent the learning contents on Moodle provide page titles to facilitate blind students select most relevant information they need when studying online. However, 23% of those who did not provide their stand on this accessibility requirement. There is also a small percentage of 5% who disagreed. Furthermore, blind students were asked to confirm if the page titles are provided on Moodle, and a cumulative of 90% of the respondents agreed that they can find page titles to facilitate them to recognize what they would study first.

Figure 4. 9 Responses of blind students on provision of page titles



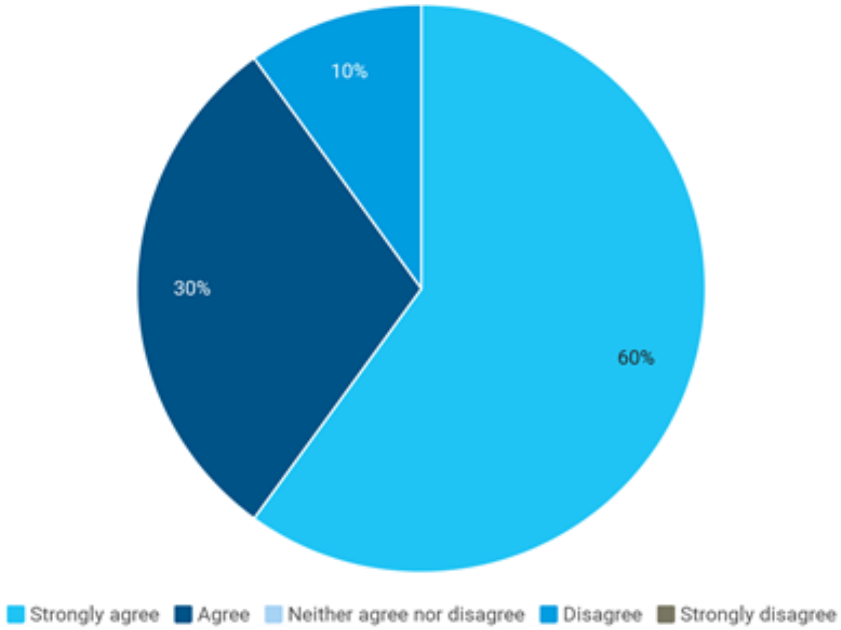
Based on the figure 9 above, 90% of the respondents believed that the content page titles are provided to describe the study topic.

4.8 Possibility to detect and correct mistakes

VLEs enable the management of online learning, facilitate accessing learning materials and resources, they provide easy delivery of teaching and learning. With VLEs it is easy to track students but also help students do assignments and exams. By doing so, students may make errors or mistakes in writing. The research wanted to find out whether blind students can be aware that they made a mistake either when writing or submitting assignments and can correct it. Of 10 students who responded to the questionnaire 9 (90%) agreed that they can detect the error and correct it. This was confirmed by those who participated in the interview.

One said, "*Due to my own reason I can't say that I often use e-learning platform to do and submit assignments but really, I do it and when I make a mistake I can get it, I can understand it because my screen reader reads to me, and I discover where I made an error and I correct it by either removing or deleting the error"*

Figure 4. 10: Opinions of students on the possibility to detect and correct errors



From the figure above, a cumulative of 90% of the respondents agreed that they can detect an error when writing on Moodle or submitting the assignment and the system gives them the possibility to correct the error. 10%, which is 1 student of 10 respondents disagreed and in an interview with them, they revealed that they do not have enough skills to use all the functionalities of the computer and the VLEs. "*When submitting an assignment, it is not easy for us as blind students write an assignment and upload it on Moodle. We prefer to use emails where we send the work, we did to teacher's email instead of using e-learning platform."* Replied one of the respondents in an interview with the researcher

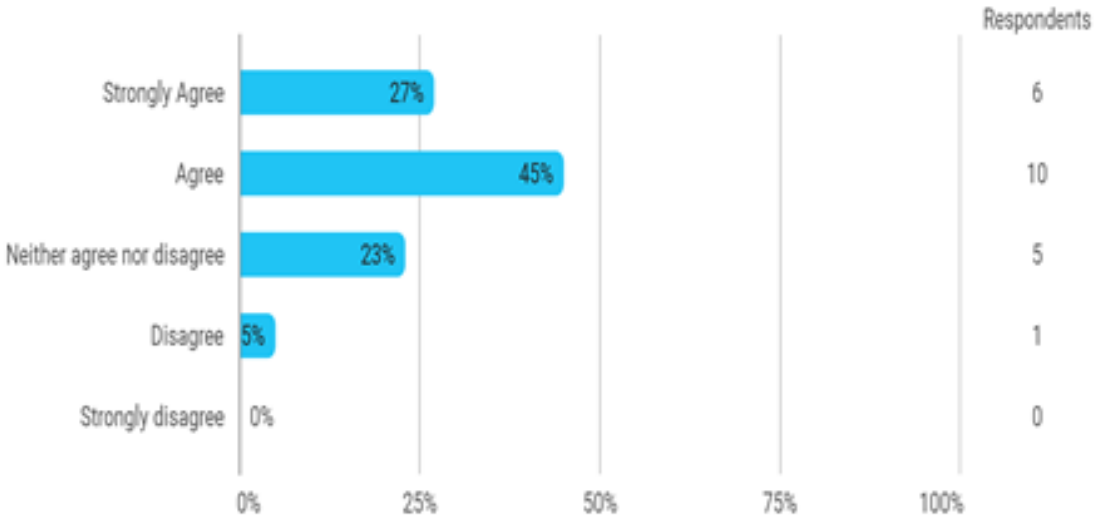
4.9 Descriptive headings and section labels

For the users to easily find the information they are looking for on Virtual Learning Environments, the headings should be clear and descriptive. This also helps them to understand the relationship between the content elements presented more easily. The same goes for the labels, when they are descriptive the users can easily identify specific components within the content. For blind students who use screen readers to read the content, the provision of headings and labels that are descriptive helps them to ensure that the heading and labels are meaningful in the context. To investigate the extent to which learning content offered to blind students in an undergraduate program at UR meets this accessibility requirement, the researcher asked lecturers and students to agree or

disagree if the headings and section labels are descriptive. The following charts show how respondents provided their answers.

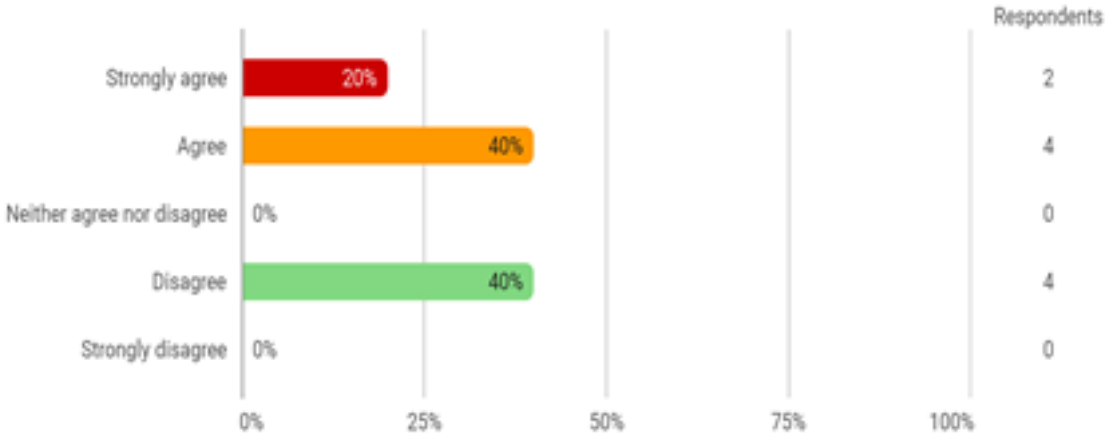
Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree - Headings and section labels are descriptive

Figure 4. 11 Lecturers' respondents on headings and section labels



This figure shows the responses from lecturers who participated in the research about the learning content meeting the accessibility requirement of providing headings and section labels that are descriptive. The cumulative average of 72% of the respondents agree that the learning content offered for blind students at UR meets this accessibility requirement. 23% did not agree or disagree while 5% disagreed. This was supported by the responses provided by blind students as shown in the figure below. The same question was asked.

Figure 4. 12 Students respondents on headings and section labels



In the figure above, 60% of the respondents confirmed that the headings and section labels are descriptive, while 40% of the respondents disagreed. Though most of the respondents revealed that the headings and section labels are descriptive, there is a need to improve the way headings are presented. In some cases, the headings are just put in bold or are underlined and for a student who relies on assistive technology like screen readers, it will be difficult for him or her to differentiate the heading from the rest of the content. The spaces between headings and other parts of the content should be similar throughout.

4.9 Accessible content creation skills and competence needs

Accessibility in e-learning involves using technology and standards to create training content that can be used by all learners, regardless of their ability[5].

This study sought to identify the skills gap for the teaching staff responsible for creating accessible learning content. To meet this objective, the research was guided by the following research question: What are the skills gaps for teaching staff to create accessible learning content for blind students? To get a response to this question, the researcher distributed a questionnaire to teaching staff and blind students.

4.10 Training in special needs education

This was determined by inquiring from teaching staff at UR to say if they have gone through training in Special Needs Education. The respondents responded with Yes or No and the findings revealed that a considerable number of respondents did not receive any training in Special Needs Education.

Have you gone through any form of training in Special Needs Education?

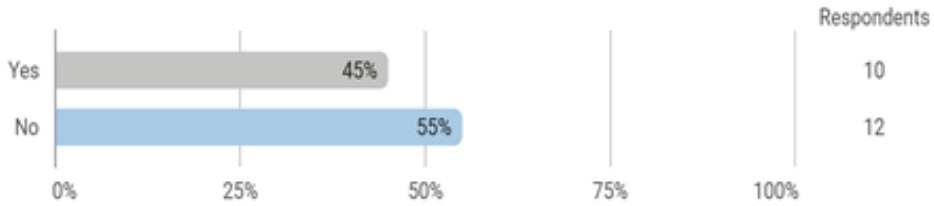


Figure 4. 13 Training in special needs education

Figure 4.13 above shows the response of lecturers on whether they got training in SNE. 55% of the respondents have never been trained in SNE while 45% got training in SNE. The findings also revealed that most of the lecturers have no idea on how Assistive Technologies used by blind students to access learning content work and this implies that it is difficulty to create accessible content when they do not understand means used to have access.

4.11 Knowledge on digital technology tools that are used by blind students to read content on Moodle

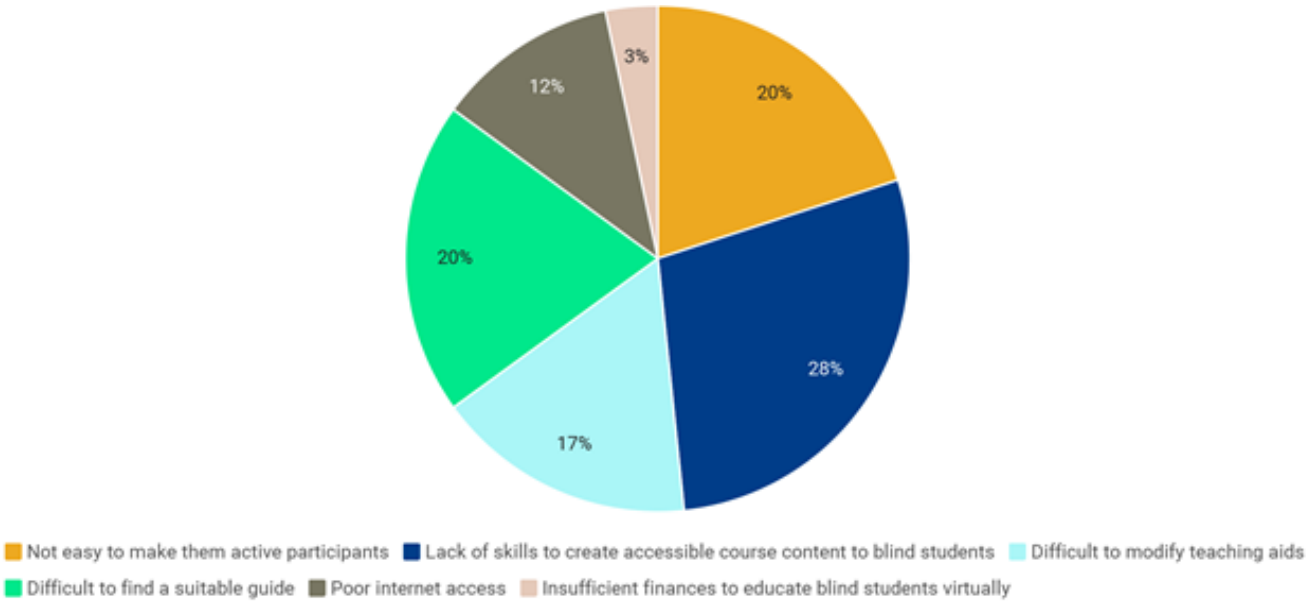
73% of the respondents reported that they have no idea on how AT blind students use work, 23% of them said that they have some knowledge on the use of AT, and only 5% reported to have enough knowledge on AT used by blind students.

The respondents pointed out that they lack skills in testing/checking if the course content they create will be accessible to blind students. 65% of the respondents said that they do not know how they can check if the content they create meets the accessibility requirements, 17% consult the quality assurance department, 9% attested that they rely on outside consultants to check the accessibility requirements while 4% use the real end user with blindness to test the course content accessibility.

4.12 Challenges faced in teaching blind students virtually

The lecturers reported challenges related to competence needs they face in teaching blind students online. Among others they pointed out lack of skills to create course content to blind students, difficulty modifying teaching aids to meet the accessibility requirements and the ability to motivate and making blind students active participants.

Figure 4. 14. Challenges in teaching blind students virtually



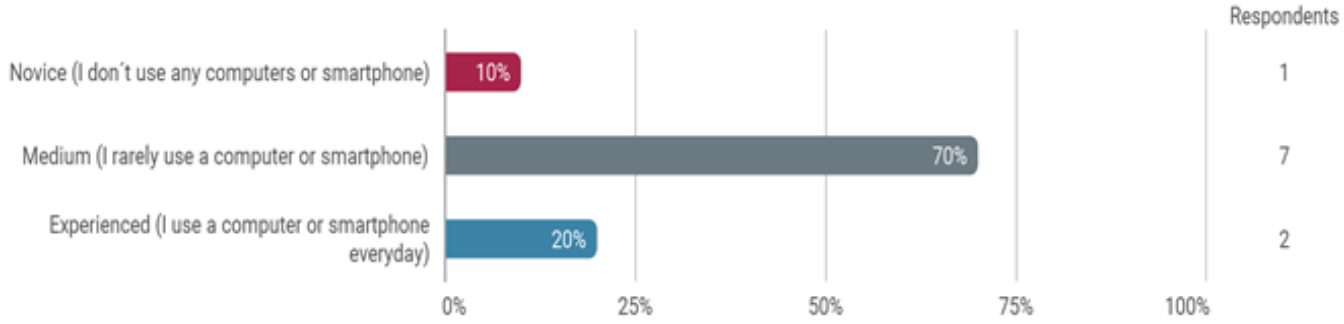
The figure above presents that 28% of the respondents claimed that they lack skills to create accessible course content to blind students. 20% of them say that they find it not easy to make blind students active participants when learning online and 17% have difficulties in modifying teaching aids to meet the needs of blind students learning virtually. 20% of the respondents claimed that it is difficult to find suitable guide to help learners who are blind to learn online.

Again, the respondents were asked to suggest what University should do to provide a better learning experience for blind students learning virtually. 14 which is 64% revealed that they have skills gap in transforming traditional content presentation into blind friendly formats, adapting Moodle to existing assistive technologies available in the resource room and skills gap in handling students with special educational needs.

4.13 Accessibility challenges blind students face in using the learning content on Moodle at UR

The findings on challenges faced by blind students in accessing and using learning content on Moodle at the University of Rwanda were collated and analyzed using frequency counts and percentages

Figure 4. 15 Level of Experience with using digital technology such as smartphones and computer



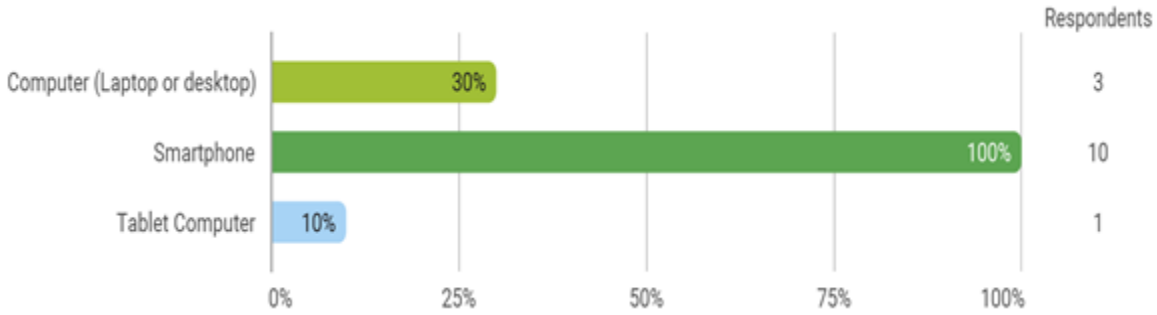
Students were asked their level of experience in using smartphones and computers as tools that are used to access learning content on Moodle. The findings show that 7 (70%) responded that they are of a medium level, 2 (20%) said that they are experienced while 1 (10%) said that he/she does not use computer or smartphone. The researcher conducted an interview with some of these blind students to understand in depth the experience they have in using ICT (Information and Communication Technology) materials.

"*I do not have my own computer and it is of recent that I got a smartphone right. I used Moodle once when I was doing English Pre-Test and I could not finish because I was slow, so I am learning to use a computer, but it is not easy without my own computer"* Said one of the respondents

Another respondent said this:

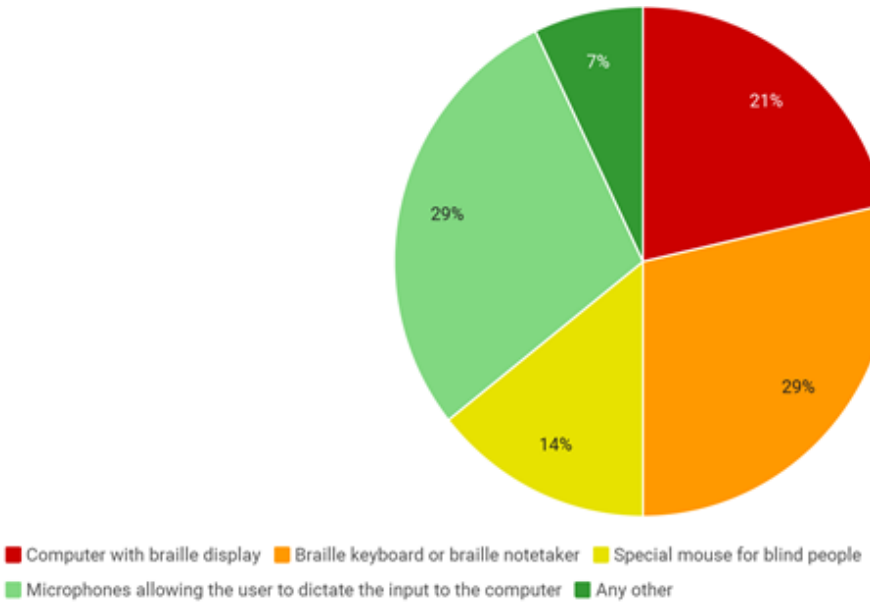
"The knowledge I have in using a computer, I can say that it is in the middle because there are some tasks that I can perform on a computer, and at the campus we do exams by typing on a desktop. But the skills to use a computer are still low because we just have access to computer when we are on campus "It is obvious that even though 7 students said that they have intermediate level of using digital technology tools, most of them were referring to smart phones.

Figure 4. 16 Ownership of digital technology devices



The figure presents the findings about respondents who own digital devices that can be used to learn online. The findings show that all the students have smartphones, but only 3 have their own laptops and 1 has a tablet computer. When we come back to the meaning of Virtual Learning which is learning through computers and the internet, inside and outside of the facilities provided by the teaching institution, you can see that blind students at UR have challenges learning online due to the lack of essential materials for the online learning to happen

Figure 4. 17: Types of devices used to interact and use a computer



Students with disabilities not only use computers to get access to online content. They need other digital assistive technologies to facilitate the interaction with a computer. Blind students particularly need screen readers, refreshable braille displays, dictation…

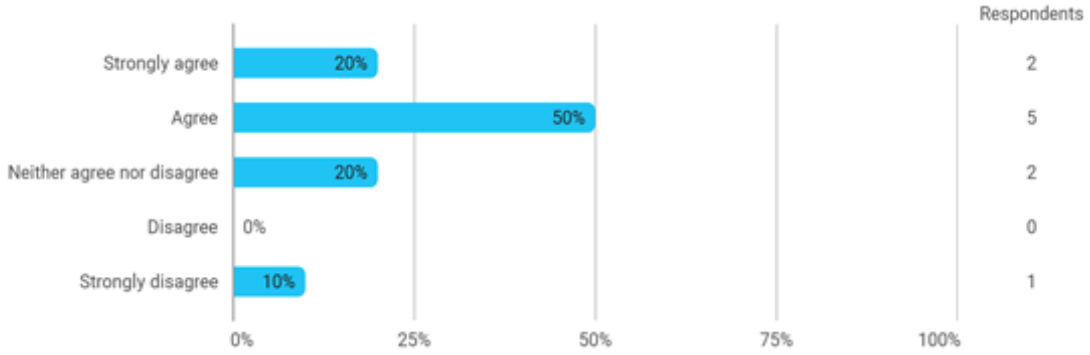
The respondents were asked the devices they use to interact with computer and the findings show that the 21% of the respondents use braille display, 29% use braille note taker, 14% use special

mouse for blind, 29% use microphone to dictate the input to the computer and there are other devices that are used by 7%. But again, these devices are kept in the resource room and students have access to them when they are on the campus.

4.14 Transmission of a file or data from one computer to another

In developing countries like Rwanda, internet access is still low and expensive. Students at Universities use the little time they get internet to download learning content so that they can continue accessing it offline. The researcher asked blind students if the content on Moodle is downloadable to be saved on other devices so that they access it without internet.

Figure 4. 18 Possibility to download files from Moodle to other devices to access the file without internet



Students were asked to agree or disagree on a Likert scale from strongly agree to strongly disagree whether it is possible to download learning content from Moodle to their Secure Digital card or computers. The results shown in figure 18, indicate that 70% of the respondents agreed that it is possible, 20% neither agree nor disagree and 10% strongly disagree. To get an in-depth understanding of their responses, the researcher interviewed 7 of these respondents.

One of them said "*I really know that it is possible, but I have never done it"*

Another said "*I have never tried to download, but when I want to save what the teacher has uploaded on Mood, I select all and paste in Word or in WPS office to access them later my phone. On a computer we get challenges because it may require using a mouse as using direction key on the keyboard does not give you the download button."*

*"Yes, there is possibility to download the content from Moodle and save it on a memory stick or on a memory card in a phone." S*aid a blind student in an interview.

In summary, the students know that there is a possibility to download the content from Moodle, but they do not practice that. 70% who agreed that they can download the content just heard that it is possible, but they did not experience it themselves.

Lastly, blind students were asked to say if they find learning on Moodle easy or difficult. 90% of the respondents said that learning on Moodle is difficult for them and they prefer learning face to face instead of online. Asked to give reasons for their choice, they said that they do not enjoy learning online due to lack of facilitation (computers, internet, and training).

"Learning online for me I see it to be beneficial compared with face to face because like now I am at home, and I can learn and do my E-tivity without moving from home to the class. I may have other things to do at home and a lesson. It is possible to learn and immediately continue with my work without movement. However, the constraints are the channels we use and the financial situation. The network (internet) is an issue to our learning online. We have tried it during lockdown, but it failed, due to network. Despite those challenges, learning online seems to be better compared to face to face." One of the blind students in an interview

Another respondent said *"My choice would be to study face to face where I am with a teacher in class. Online learning requires a lot of things. It requires us to have internet, yet our financial means does not allow us to buy internet. Another reason I prefer to be with a teacher in class, when you fail to understand, you ask the question directly to the teacher and helps you instantly especially for us who are disabled, when the content has graphs, photos, or images it is easy for a teacher to give clarifications. But online it is difficult because you may have to stop and wait until the teacher goes online."*

4.15 Guidelines for increasing learning content accessibility

According to Cambridge English dictionary, guidelines mean the information intended to guide people on how something should be done or what something should be (*Cambridge English Dictionary*, n.d.). The guidelines for increasing learning content accessibility are the information that gives directions or orientation in creating the learning content that benefits all people regardless of their disabilities. The learning content accessibility guidelines must fulfill four principles as stipulated by Web Content Accessibility Guideline (WCAG) which are Perceivable, Operable, Understandable and Robust. The learning must be perceivable to be accessed by everyone at least by one human senses. The learning content must be Operable to be accessed

using other inputs than a mouse. It has also to be Understandable which means that the content is clear and concise to facilitate learners access it on their own pace. Finally, the learning content should be robust to be accessed and interpreted by different assistive technologies.

4.16 Summary of the chapter

This chapter provided an analysis and interpretation of the data collected using questionnaires and interviews from blind students, lecturers, and e-learning officers at UR. Looking at the analysis and interpretation of collected data, it can be concluded that the respondents of the study sample revealed that the access and use of VLEs by blind students at the University of Rwanda is still under development. Findings show that there is a skills gap in creating accessible learning content on the side of teachers and blind students revealed that they do not have enough skills to access the content on Moodle. Apart from the skills among blind students pointed out that they lack required materials like computers, smartphones, and other assistive technologies. The issue of the internet also was said to be one of the factors that contribute to the challenges blind students face in accessing learning content on online platforms. All these challenges resulted in underutilization of the online platform even though the LMS that is used by UR fulfils the minimum requirements to be accessible by all learners.

CHAPTER FIVE: Discussions and conclusions

Drawing from the findings of this study presented and analyzed in the previous chapter, in this chapter the systematic discussion of the findings in light with the objectives is provided. This chapter will also discuss the recommendations for relevant stakeholders as well as suggestions for future work.

5.1. Summary of the findings

The purpose of the study was to investigating the Access and use of Virtual Learning Environments by blind students in accessing information on e-learning platform with a view to identify learning content accessibility requirements, investigate the extent to which learning content offered to blind students in an undergraduate program at UR (University of Rwanda) meets the accessibility requirements and identify the skills gap for the teaching staff responsible for creating accessible learning content. What should be the challenges and what would be the strategies to increase Virtual Learning Environment accessibility for blind students. The findings of this study are the

product of the objectives and responses to the research questions. The findings were drawn from the respondents with different demographic backgrounds. The participants were blind students, lecturers, and e-learning officers. The chapter discusses thematically the findings in accordance with the objectives and referring to the existing art of work. Since the target population on side of the students was small, the researcher opted to work with the entire population, targeting 30 lecturers and 5 e-learning officers. All 15 students agreed to participate in the study, but since collection of data was done virtually, some of the students did not manage to fully participate due to internet issues and phone network. So, 10 from 15 completed the questionnaire and 7 participated in a semi-structured interview. The questionnaire was also given to lecturers and e-learning officers.

5.1.1. Learning accessibility requirements

Through the documents review, the findings showed that University of Rwanda has in place different documents, guides and policies that aim at ensuring the creation of learning content accessible to all learners including blind students. These documents are published both on UR website and on the front page of the e-learning platform. However, from the respondents to questionnaires and interviews, it was noticed that UR must put in place the implementation strategies of those good guides and policies.

5.1.2. Maximize compatibility with current and future user tools

The findings identified the extent to which lecturers know about accessibility requirements and the extent to which their learning content meets the accessibility requirements. Based on the findings in 4.1, lectures do not know much about the accessibility requirements but the content they create meets the requirement more than 50%. Furthermore, the findings show that the content can be accessed using assistive technology devices used by blind students though due to other factors the use of VLEs by blind students is still low and they prefer to learn face to face and not online. The screen readers and braille output devices they use can help them to access the content on Moodle because the system itself is compatible with different digital devices.

5.1.3. Provision of text alternatives for non-text content

From the findings, the lecturers who participated in the research agreed that although they understand the requirement of providing the alternative text to images, graphs and other non-text

elements in the learning content, blind students still have challenges to understand the interpretation of the non-text content. Blind students indicated that they are unable to access the content when presented as images, tables, or graphs due to lack of descriptive text to those images, tables, and graphs. (See figure 4.3)

5.1.4. Creating content that can be presented in different ways without losing the meaning

The findings revealed that most of the lecturers consider creating learning content that can be presented in different ways. The content they create can be downloaded and converted into formats and the meaning is maintained when accessed by assistive technologies (see figure 4.4). Blind students concur with the opinions of the lecturers concerning the possibilities to access the learning content in different ways and they access it using assistive technologies. Again, the challenge remains the availability of devices that students can use to access the content off campus. As indicated by blind students who participated in the study, very few have their own computers and access to the internet when they are off the campus is not easy.

5.1.5. Making all functionalities available from the keyboard only

From the findings, it has been noted that the learning content on Moodle at UR can be accessed using the computer keyboard without the use of mouse. ¾ of the respondents from lecturers agreed that the learning content must be created by making all functionalities available from the keyboard. However, students pointed out that it takes them a long time to complete the tasks using the keyboard due to lack of experience in using computers. Good guidelines and policies to make LMS content accessible to learners with disabilities are clear, but availability of materials to increase the expertise of learners to interact with technology devices is still an issue.

Looking at the findings from students (Figure. 4.6), both from the questionnaire and interviews, there are even students who chose not to say whether it is possible to navigate through the learning content using the keyboard because they have never or rarely use Virtual Learning Environments.

5.1.6. Making the text readable and understandable

Trying to find out how this accessibility requirement is met, the respondents to the questionnaire and interviews agreed that the text is readable and understandable to the levels of learners and the assistive technologies read well the text. However, some of the respondents pointed out that there are texts that are not understandable when read by screen readers due to the way the text is written.

When the spaces between the lines between the sentences are not well maintained, the screen readers get confused and do the combinations of the words wrongly and the meaning changes.

5.1.7. Making sure that the content pages have titles that describe the topic of the study

This accessibility requirement, when met, makes it easy for the user to select what he/she wants to read. The findings revealed that most of the respondents from lecturers know this requirement and consider it to be at the highest level. Students also confirmed that they find content pages with titles that describe the topic of study and using the arrows and the tab button of the keyboard they can make the choice of what to read first depending on their interest and priority. However, the skills to use computers remain a challenge.

5.1.8. Possibility of detecting and correcting errors

This accessibility requirement is applicable to the Learning Management Systems rather than being applicable to learning content. The findings revealed that students can detect and correct errors when they are using Learning Management Systems. What was evident is the need to increase the access to online learning content, otherwise learning content accessibility requirements are in place and the content created for blind students meet minimum accessibility requirements.

5.1.9. Description of headings and labels

This is another accessibility requirement the study wanted to know how it is implemented in creating learning content that is accessible to blind students. The findings show that most of the respondents confirm that the headings and labels are described to ease accessibility of the learning content for blind students. However, the findings from the interviews revealed that sometimes the headings, though they are descriptive, the way they are presented confuse screen readers. The alignment of the headings matters in facilitating a blind student using a screen reader to easily distinguish the heading from the rest of the content.

5.1.10. Training and competencies to create learning content that is accessible to blind students

The findings show that only a few lecturers have training in Special Needs Education. Lecturers have specialization in other different fields, but they said they lack skills in teaching learners with

Special Educational Needs. In addition, the findings noted that there is no formal or informal training on accessibility requirement. Most of the lecturers revealed that they are unable to transform the learning content into accessible online content. The knowledge on the use of assistive technologies that blind students use to access the learning content was reported as a hindrance to the creation of learning content because it would be easy to test accessibility of the content before it is uploaded in Moodle for the learners to access it.

5.2. Conclusions

Our study focused on the access and use of Virtual Learning Environments by blind students at the University of Rwanda. This maybe the first research on VLEs with emphasis on accessibility requirements for blind students in Rwanda. Other studies were done on students with disabilities in general or all visually impaired students.

1. The findings revealed issues on accessibility to people who are blind but also these issues are still valid to other users of VLEs. The findings determined that the accessibility requirements are available in documents and policies that are available at UR, but people who are to implement them do not know much about them. They use common sense to try to meet the needs of blind students.
2. The learning content for blind students at UR meets the accessibility requirements on average level since lecturers are not trained in creating accessible learning content and there are no measurement tools to assess the extent to which the accessibility requirements are met.
3. The study confirmed that there is lack of digital materials that blind students can use to access learning content without depending on the materials that are on their campus. The aim of VLE is to enable learners access to learning anytime and anywhere on their own availability and needs. But the findings show that only a few students have their own computers and other devices.
4. The findings also revealed that the skills to use digital devices for blind students are still low yet having access and use of VLEs requires skills in using technological materials.
5. This study noticed that UR administration staff do not feel concerned by the improvement of learning accessibility is an issue that should be dealt with by faculty members only

CHAPTER SIX: Recommendations and future work

6.1 Recommendations

Referring to the above discussions, conclusions and implications highlighted above, here are recommendations to improve the accessibility and use of VLEs by blind students.

1. University of Rwanda should Training lecturers on how to transform traditional content presentation into blind friendly formats,
2. The university of Rwanda should enhance the support for blind students in terms of teaching/learning materials
3. University of Rwanda should advocate for blind students to get laptops and other assistive technology they can own for themselves
4. The University of Rwanda should Establish a suitable technology supported and enabled learning environment by providing all the required technology infrastructure and equipment.
5. Organization of workshops to inform all university community about the existing guides and policies that are in place to enhance Open Distance Learning/online learning
6. Designing a course in online environment requires skills and expertise in utilization of VLEs, therefore, the study recommends that UR put in place regular training for academic staff on technology enhanced content design and development; teaching methods and assessment methods
7. Other stakeholders in education should work closely with UR to provide facilities to blind students
8. Rwanda Education Board, Higher Education Council and Ministry of Education to make regular follow up on implementation of policies enhancing access to quality education
9. Training blind students in the use of computers and other assistive technology.

6.2 Suggestion for Further Research

This study focused on blind students, and we recommend that this study be extended to all visually impaired students to evaluate the extent to which they access and use online platforms. Another

study should be conducted on the collaboration of academic and administrative staff on provision of quality education to students with disabilities. It was noticed that other staff than academic staff and staff who work in the faculty do not know much about how learners study yet they occupy important positions that take decisions regarding availability of materials and staff.

This study was conducted at University of Rwanda, it can be conducted to other higher learning institutions, or to other students who have other disabilities.

APPENDICES

Appendix A: Informed consent letter

Consent to take part in the research

I…… voluntarily agree to participate in this research study.
I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
I understand that I can withdraw permission to use data from my interview/survey within two weeks after the interview, in which case the material will be deleted.
I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
I understand that I will not benefit directly from participating in this research.
I agree to my interview being audio-recorded.
I understand that all information I provide for this study will be treated confidentially.
I understand that in any report on the results of this research my identity will remain anonymous.
This will be done by changing my name and disguising any details of my interview which may
reveal my identity or the identity of people I speak about.
I understand that disguised extracts from my interview may be quoted in Thesis
I understand that if I inform the researcher that myself or someone else is at risk of harm they
may have to report this to the relevant authorities - they will discuss this with me first but may be
required to report with or without my permission.
I understand that signed consent forms and original audio recordings will be retained in private
and only be used in Thesis until June 2022.
I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.
I understand that I am free to contact any of the people involved in the research to seek further
clarification and information.

Signature of research participant .....

Signature of researcher .....

I believe the participant is giving informed consent to participate in this study

Appendix B: Questionnaire for blind students

Dear Participants,
I am a post graduate student at University of Rwanda and an exchange student at the University of Agder. It is a requirement of the course to carry out a research project. I am soliciting for information on the topic "ACCESS AND USE OF VIRTUAL LEARNING ENVIRONMENT BY BLIND STUDENTS AT UNIVERSITY OF RWANDA". This research is purely academic and any information provided shall be treated with confidentiality. Kindly participate and respond appropriately to the questions given below. Your contributions are highly appreciated

Your participation is voluntary and you are free to leave the study at any time.

NB: This questionnaire is meant for totally blind students at the University of Rwanda

Part 1. Demographics

What is your Gender?

(1) □ Male
(2) □ Female
(3) □ Other

What is your age range?

(1) □ 15-20
(2) □ 20-30
(3) □ 30-40

Which College are registered to?

(1) □ College of Education
(2) □ College of Arts and Social Sciences

What is your Campus?

(1) □ Huye
(2) □ Nyagatare
(3) □ Rukara

Level of study program
(1) □ Dipoma

(2) □ Bachelor

What is your field of study?

(1) □ Education and Sciences
(2) □ Education and Arts
(3) □ Arts
(4) □ Humanities
(5) □ Sciences

Year of study

(1) □ 1
(2) □ 2
(3) □ 3
(4) □ 4

How long have you been blind?

(1) □ 0-5 years
(2) □ 6 to 10 years
(3) □ 10 to 15 years
(4) □ 15 and above years

Level of Experience with using digital technology such as smartphone and computer

(1) □ Novice (I don´t use any computers or smartphone)
(2) □ Medium (I rarely use a computer or smartphone)
(3) □ Experienced (I use a computer or smartphone everyday)

Part 2. Availability and experience with hardware & software tools

I own the following personal devices (multiple selection)

(1) □ Computer (Laptop or desktop)
(2) □ Smartphone
(3) □ Tablet Computer

I can get access to the following devices to use in my education (multiple selection)

(1) □ Computer (Laptop or desktop
(2) □ Smartphone
(3) □ Tablet computer

I can get access to the following types of devices for interacting and using a computer

(1) ☐ Computer with braille display
(2) ☐ Braille keyboard or braille notetaker
(3) ☐ Special mouse for blind people
(4) ☐ Microphones allowing the user to dictate the input to the computer
(5) ☐ Any other

I know the following types of software / computer applications that I can use in my education:

(1) ☐ Screen readers or Text to speech solutions such as JAWS (Job access with Speech), NVDA (Nonvisual Desktop Access), Speechify etc
(2) ☐ Speech to text (speech recognition software)

Level of experience with using digital technology to support your education

	Beginner	Proficient	Expert
I can use digital technology tools to read content from Moodle as a	(1) ☐	(2) ☐	(3) ☐
I can use digital technology tools to write or enter content to Moodle as a	(1) ☐	(2) ☐	(3) ☐

Part 3. Opinions and feelings about the accessibility of learning content

Please indicate whether you strongly agree, agree, are undecided, disagree, or strongly disagree

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
All images, graphs, tables, and videos in Moodle provide text alternatives that can be changed into braille or speech	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐

I find ways to help me navigate, find content, and recognize where I am while using Moodle (For example I get help to find the location of a module content, assignment, or any other information in Moodle)	(1)	(2)	(3)	(4)	(5)
All functionality of the content is operable through a keyboard interface	(1)	(2)	(3)	(4)	(5)
Content pages have titles that describe the topic of study	(1)	(2)	(3)	(4)	(5)
Headings and section labels are descriptive	(1)	(2)	(3)	(4)	(5)

Please indicate whether you strongly agree, agree, are undecided, disagree, or strongly disagree

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
The text of the learning content is readable by digital technology tools such as screen readers	(1)	(2)	(3)	(4)	(5)
I can understand the meaning of the	(1)	(2)	(3)	(4)	(5)

learning content when it is read by digital technology tools such as screen readers					
When I make a mistake in writing, the error is described to me so that I can understand what to correct	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐
I can study online the content provided in Moodle using digital technology tools that I have	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐
I can download the learning content on my computer or smartphone to use it anytime without Internet.	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐

Describe the use of Moodle to learn for you

(1) ☐ Very difficulty	(2) ☐ Difficult	(3) ☐ No opinion	(4) ☐ Easy	(5) ☐ Very easy

Thank for participating in this survey

Appendix C: Questionnaire for lecturers

Dear participant,
Thank you for taking the time to participate in this study and supporting me in my research on **Access and Use of virtual learning environment by blind students at University of RWANDA** as part of my master thesis.Please complete the questionnaire by responding to all questions. Information that you give will be kept confidential and only be used for the purpose of this study to improve education of students with visual impairments in the institutions of higher learning. Taking this survey will only take about 10 mins of your time, but I will be forever grateful!

Thank You,

Jean Damascene Bikorimana (jeandb@uia.no)

Demographic information

What is your age?

(1) □ 25-35
(2) □ 36-45
(3) □ 46-55
(4) □ 55 and above

What is your gender?

(1) □ Female
(2) □ Male
(3) □ Other

At what Colleges do you teach?

(1) □ College of Arts and Social Sciences
(2) □ College of Agriculture, Animal Sciences and Veterinary Medicine
(3) □ College of Business and Economics
(4) □ College of Education
(5) □ College of Medicine and Health Sciences
(6) □ College of Science and Technology

What is your teaching experience?

(1) □ 1 to 5 years
(2) □ 6 to 10 years
(3) □ 11 to 15 years

(4) ☐ 15 to 20 years
(5) ☐ More than 20 years

What is your area of specialization?

_____
_____
_____
_____
_____
_____

Have you gone through any form of training on Special Needs Education?

(1) ☐ Yes
(2) ☐ No

What is your level of experience in using digital technology used by blind students?

	I have no idea	Basic	Intermediate	Advanced
I can use digital technology tools that are used by blind students to read content on Moodle	(1) ☐	(2) ☐	(3) ☐	(4) ☐
I can use digital technology that are used by blind students to write and enter content on Moodle	(1) ☐	(2) ☐	(3) ☐	(4) ☐

Please indicate whether you strongly agree, agree, neither agree nor disagree, disagree, or strongly disagree

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
All images, graphs, tables, and videos I upload on Moodle provide text alternatives that can be changed into braille or speech	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐

Blind students find ways to help them navigate, find content, and recognize where they are while using Moodle (For example they get help to find the location of a module content, assignment, or any other information in Moodle	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐
All functionality of the content is operable through a keyboard interface	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐
Content pages have titles that describe the topic of study	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐
Headings and section labels are descriptive	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐

In designing online courses, to what extent do you consider accessibility requirements

	High level	Above average	Average	Below average	Low
Provide text alternatives for non-text content	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐
Create content that can be presented in different ways, including by assistive technologies, without losing meaning	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐

Make all functionality available from a keyboard	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐
Make text readable and understandable.	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐
Help users avoid and correct mistakes	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐
Maximize compatibility with current and future user tools	(1) ☐	(2) ☐	(4) ☐	(3) ☐	(5) ☐

How do you make sure that the course content you create is accessible to blind students?

(1) ☐ We have accessibility testers in the quality assurance department who check the accessibility requirements
(2) ☐ The campus hire outside accessibility consultant to check accessibility
(3) ☐ We use real end-users with blindness to test the course content accessibility
(4) ☐ We have the document with accessibility criteria we refer to
(5) ☐ Don't know

What challenges do you face teaching blind students virtually?

(1) ☐ Not easy to make them active participants
(2) ☐ Lack of skills to create accessible course content to blind students
(3) ☐ Difficult to modify teaching aids
(4) ☐ Difficult to find a suitable guide
(5) ☐ Poor internet access
(6) ☐ Insufficient finances to educate blind students virtually

In your opinion, do you agree that use of Virtual Learning Environments (Online teaching) have had a positive impact on the education of blind learners?

(1) ☐ Yes
(2) ☐ No
(3) ☐ Can't say

In your own words, please suggest if you have any comments/suggestions for the university to provide a better learning experience for the blind.

_____
_____
_____
_____
_____
_____

Thank for your participation!!!

APPENDIX D: INTERVIEW SCHEDULE FOR BLIND STUDENTS

1. Have you been blind since birth?
2. If no, when and how have you experienced vision loss?
3. Do you own:
   a. computer
   b. a smartphone
   c. tablet?

A small audio recorder

4. Apart from blindness, do you have any other disability?
5. At what level do you think you can use the computer:
   a. Basic
   b. Intermediate
   c. Proficient
6. In your studies/learning what are the devices that you have access to help you to interact with the computer, phone or tablet?
7. There are different software and computer applications that can help the blind student to read or write using the computer. Can you tell us those software or computer applications that you know?

8. What software do you use comfortably in accessing e-learning course content on Moodle in your education?
9. When learning on Moodle, do you find alternative text that can be accessed in braille or speech to explain images, tables or graphics in the course content?
10. Do you find easy ways to help you navigate, finding content and recognize where you are (where the curser is) during the use of Moodle?

11. Does the content on Moodle allow you to navigate it using a keyboard without the need of the mouse?
12. How can you describe using the screen readers and other technological tools used by blind students to read the text of the learning content?
13. How easy it for you to understand the meaning of the learning content when it is read by technology tools like screen readers? Is the language and pronunciation easy to understand?
14. When typing, writing or submitting the assignment to Moodle and you make an error, how do you get notifications that you made the mistake and correct it?
15. Does Moodle give you the option to download and save the learning content to your devices to be accessed without internet? How easy it is to download?
16. In your opinion, is the learning online easy for blind students?
17. Thanks. Is there any other information would you like to share with us on your experience using online learning, what are the challenges and the advantages?

Appendix E: Research recommendation letter from University of Rwanda

UNIVERSITY of RWANDA

COLLEGE OF EDUCATION

RESEARCH AND INNOVATION UNIT

Rukara, 12th April 2022
Ref: 03/DRI-CE/051/EN/gi/2022

Research recommendation letter for Mr. Jean Damascene Bikorimana

To whom it may concern,

On behalf of the University of Rwanda-College of Education (UR-CE), I introduce Mr. Jean Damascene Bikorimana, a post-graduate student of the School of Inclusive and Special Needs Education at UR-CE. Mr. Bikorimana is writing his thesis on: **"Access and use of Learning Management System by Blind students at the University of Rwanda"** to complete his Master of Education in Special Needs Education.

He wishes to investigate the use of computer assistive technologies by blind students in accessing the information on e-learning platforms to identify the challenges they face and what might be viable solutions. This research will involve Blind students, Lecturers, e-learning officers, Human resource officers, and Campus administrators from the University of Rwanda: **Rukara, Nyagatare, and Huye campuses**. Thus, he requests permission to collect data from the identified UR campuses.

Mr. Bikorimana's research project passed successfully through an internal collegial ethical process. Thus, the University of Rwanda-College of Education: Directorate of Research and Innovation confirms that this research adheres to ethical standards and principles. Therefore, we kindly request you to accord him your cooperation in this research.

We very much hope to get your usual cooperation.

Yours sincerely,

COLLEGE OF EDUCATION
UNIVERSITY of RWANDA
RESEARCH AND INNOVATION UNIT

Digitally signed by
UR (Rukara, Directorate of Research & Innovation)
Date: 2022.04.12
Time: 10:08:13 +2'00

Assoc. Prof. Eugene Ndabaga
Director of Research and Innovation
University of Rwanda-College of Education
E-mail: ndabagav@yahoo.ie
Mobile: +250788308862

Cc:

- Principal, UR-CE
- Postgraduate Program Coordinator, SISNE
- Dr. Patrick Suubi (Supervisor)

EMAIL: dri.ce@ur.ac.rw P.O. Box: 55 Rwamagana WEBSITE: www.ur.ac.rw

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