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SCHOOL OF COMPUTING AND
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eLearning Portal for Persons with Visual
Disabilities: Case of Low Vision

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Document submitted in partial fulfillment of the requirements of Master of Science
in Computer science

DECLARATION

This project as presented in this report is my original work and has not been presented for any other University award.

Signed.....

Date.....

Wambua, Ruth Nthenya

This project has been submitted as partial fulfillment of the requirements for the Master of Science in Computer Science of the University of Nairobi with my approval as the University supervisor.

Signed.....

Date.....

Dr. Robert Oboko

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ABSTRACT

As the adage goes “Disability is not inability”. We live in a world whose population comprises of persons with disability. Despite this fact, such persons are well useful in a countries economy provided their needs are well taken care of. For instance, education should be made available to all irrespective of their physical form.

With the increased advances in technology today, there is dire need to consider persons with disabilities, so as to ensure that their interests are also factored in. Narrowing the cases of disabilities to that of visual disability, and the scope of education/learning to that of eLearning, one realizes that unless special considerations are factored in to the design of eLearning platforms, persons with visual impairments may never benefit! Reason for this project!

This project implements an eLearning platform that is usable by persons with low vision. This has been achieved by incorporating technological advances such as: use of text with the highest possible contrast; use of varying font size; among other customized HCI effects. Moreover, use of complicated, decorative or cursive fonts has been avoided, as well as italic text and capital letters, which can be difficult for users with reading impairments. To add on these, the implementation includes a sound output which is a key aid for persons with low vision.

Conclusively, this project supports the fact that eLearning is possible for persons with low vision, provided that all the necessary technological advances have been considered.

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ABBREVIATIONS

HCI: Human Computer Interface.

FOSS: Free and open source software.

PWLV: Persons With Low Vision.

DEFINITION OF TERMS

ELearning: refers to leaning electronically. In this case, being able to acquire knowledge through reading and studying from materials that have been made accessible through a machine/computer.

PWLV: Persons with Low Vision refer to people who have sight problems, in that they have partial sight.

MySQL: (pronounced My SEE Q EL) is one of the standard query languages for interacting with databases. MySQL is an open source database server that is free and extremely fast. MySQL is also cross platform and it has a high customer base for its flexible licensing terms, ease of use and high performance.

PHP: is the web development language written by and for web developers. PHP stands for Hypertext Preprocessor. It is a robust, server-side, open source scripting language that is extremely flexible and very easy to learn.

Apache: is the most popular of all the web servers available because it supplies basic web server functionalities.

CHAPTER 1: INTRODUCTION

Persons of low vision refer to people who have sight problems, in that they have partial sight. Consequently such individuals experience difficulties in reading/studying either from a book print or computer screen. For some individuals, the standard size of letters on a computer screen or printed in documents are too small to read, whereas others may not distinguish one color from another.

The reason for low vision according to (Bjork, Ottosson and Thorsteinsdottir, 2008) could be because of clouding of the lens of the eye, which causes light that passes through the lens to the retina to be scattered. The scattered light causes images to be blurred and visual acuity to be reduced. Moreover, as one continues to age, the lens of the eye also yellows and becomes fixed and is thus unable to focus. In this case, the pupil does not dilate very well to changes in illumination, and the retina and cortex become less able to process visual information. Consequently, contrast sensitivity decreases, visual acuity drops somewhat, and vision in low light levels suffers. On the contrary, low vision is also suffered by the young in schools and colleges.

Following the remarkable advances in technology, there is dire need for support technology which goes a long way to ensure that individuals with partial sight impairment also benefit from technological advances such as eLearning. Considering that people with low vision are still capable of using the normal standard computer keyboards and screen, then improved technological advancements would ensure that they are also able to type using those keyboards and read from those screens. For example, according to (Burgstahler, 2012), computer-generated symbols, both text and graphics, can be enlarged on the monitor or printer, thereby allowing individuals with low vision to use standard word processing, spreadsheet, electronic mail, and other software applications. Moreover, the ability to adjust the color of the monitor or change the foreground and background colors is also of value. Consequently, people with low vision also stand to benefit from the current Kenyan government promises whereby laptops will be offered to primary school going pupils (Jubilee Manifesto, 2013).

This project provides a technological eLearning platform for people with low vision. The level of visual impairment and blindness in this case is based on the World Health Organization document: International Statistical Classification of Diseases and Related Health Problems (2010). The details are as tabulated in the table (Table 1) below:

Level of Visual Impairment and Blindness according to the World Health Organization			
Level of Blindness		Definition	Implications
0	Mild or no Visual Impairment	Vision better than: 6/18, 3/10, 20/70	Maybe glasses
1	Moderate Visual Impairment	Vision better than: 6/60, 1/10, 20/200 Vision worse than: 6/18, 3/10, 20/70	Glasses and possible need for magnifiers on computer interface
2	Severe Visual Impairment	Vision better than: 3/60, 1/20, 20/400 Vision worse than: 6/60, 1/10, 20/200	Magnifiers and color contrasters for computer interfaces
3	Blindness	Vision better than: Can count fingers @ 1 meter distance Vision worse than: 3/60, 1/20, 20/400	Strong magnifiers for some but mainly screen readers for computer interfaces
4	Blindness	Vision better than: Light perception Vision worse than: 1/60, 1/50, 5/300	Screen readers for computer interfaces
5	Blindness	No light perception	Screen readers for computer interfaces

Table 1: Level of visual impairment and blindness according to the World Health Organization

1.1 Background to the problem

ELearning basically refers to leaning electronically. In this case, being able to acquire knowledge through reading and studying from materials that have been made accessible through a machine/computer. An education research paper by (Klopfer, Osterweil, Groff and Haas, 2009) discussed the need to conceptualize and experiment with new methods in education so as to be able to appreciate the dynamics of our changing world.

Naturally, persons who are medically and physically fit, in this case, they have normal eyesight, are able to access such online material with less or no struggle at all. Moreover, such individuals are in a position to add to their pool of knowledge through surfing the net for further relevant materials, in addition to accessing volumes of books and literature from the library.

On the other hand, persons with low vision have a significant vision loss that cannot be corrected medically or surgically (World Health Organization, 2012). These vision problems impact work, school, recreation and other activities of daily living. Moreover, majority of institutions of higher learning have not yet incorporated adaptive technologies to aid learning for people with low vision. For example, the University of Nairobi has an eLearning portal which is only usable by people of normal vision (University of Nairobi Multimedia Portal, 2009).

Hence the push to implement an eLearning platform which caters for persons with low vision.

1.2 Problem Statement

An eLearning portal enables teacher – student interaction through the student’s period of study. However, majority eLearning portals have not incorporated adaptive technologies to aid persons with low vision. Considering the ideal situation where the majority of any population has normal eyesight, dedicated research continues to dominate technological innovations to the advantage of the majority. For example, the University of Nairobi eLearning portal hardly considers cases of persons with low vision (University of Nairobi Multimedia Portal, 2009).

According to (World Health Organization, 2012), 285 million people are visually impaired worldwide: 39 million are blind and 246 million have low vision. Moreover, About 90% of the

worlds visually impaired live in developing countries! Hence the dire need to incorporate such individuals in the ever growing world of technology!

1.3 Purpose of the project

A visually impaired adult or child can be trained, with the help of vision enhancement, vision rehabilitation and assistive technology and low vision aids to learn.

This project provides an eLearning portal for persons with low vision. Thus providing a platform through which such persons can train and learn.

The implementation allows for varied accessibility options of background color, text color, font size and style. In addition to use of large monitors and anti-glare screens, the implemented portal allows for speech output.

1.4 Research outcomes and their significance to key audiences

The implemented eLearning portal incorporates adaptive technologies for the benefit of people with low vision. For instance, having large prints enhances visibility. Moreover, color adjustments ensure better and motivated learning. In addition, having speech output perfects the whole implementation since the individual reading through the portal gets a clear understanding of what he/she is reading.

1.5 Research objectives

This project seeks to achieve the following objectives:

1.5.1 General objectives

1. To implement an eLearning platform for persons with low vision.

1.5.2 Specific objectives

1. To implement an eLearning portal with added technological advances such as sound output.
2. To test that the implemented eLearning portal is usable by people with low vision.

1.6 Assumptions and limitations of the research

The implementation of this project assumes that the person using the portal, despite the fact that they have low vision, they are able to hear and understand.

This project is limited in the fact that it may not be usable by 100% of the population of people with low vision, since it only assumes a case whereby low vision is the only and only disability, and that the disability is to a particular level (level 2 and above only) as shown in table 1 of this document.

CHAPTER 2: LITERATURE REVIEW AND THEORY

2.1 Introduction

The world today has all kinds of people. Each and every person has a desire to grow both physically and emotionally. Moreover, with increased technological advances, majority of people desire to grow and enhance both their educational and technological knowledge by day. Despite such desires, there happens to be forces beyond human control, such as visual disability among others. According to the Kenyan census statistics of 2009, 3.5 percent of the total population, people with disabilities in Kenya is about 1.3 million. Of those with disabilities, 51 percent are female, while 49 percent are male. The largest proportion is physical and self care disabilities, which is 31 percent, followed by visual disabilities at 25 percent and hearing disabilities at 14 percent. This project focuses on a case scenario of a person with a visual disability, in this case, a person with low vision.

Education for people with low vision becomes a real challenge in cases where their learning is not well facilitated. For instance, such people may suffer challenges when studying together with people of normal vision. For example, unlike normal people who would be comfortable in any well set computer laboratory, the case of a person with low vision would be different. For instance, a computer laboratory will only be comfortable and usable by a person of low vision if it's appropriately lit as desired, probably computers with magnifiers among other requirements which may not be necessary for normal sighted people. Consequently, there is need to consider all genres of people in all technological advancements.

The University of Nairobi for instance has an eLearning portal which is at the moment only suitable for people of normal vision since technological advancements to accommodate people with visual disabilities has not been put in place (University of Nairobi Multimedia Portal, 2009). This is the case across majority of the Kenyan universities that have eLearning platforms already in place. Consequently, there is a dire need to incorporate the visually impaired people in the ever advancing area of eLearning.

2.2 Current situation in Kenya

In Kenya, majority learning institutions are not in a position to adopt inclusive education whereby people with special needs can be accommodated in mainstream classrooms with other students/pupils. The reason for this is because they either lack the supporting environment for such students or lack trained personnel who would be able to handle such cases. As a result, special cases call for people to be confined in special schools with specialized curriculums and mode of study. When it comes to institutions of higher learning and specialized careers, people with disabilities are most of the time left out since the facilities to accommodate their training is either inadequate or lacking completely. According to (Flores, 2003), Inclusive education isn't easy, but it benefits kids with and without disabilities. Moreover, teachers in special needs inclusive classrooms encounter several challenges such as having to deal with individualized lesson plans, lack of teaching aides, among other challenges, as discussed by (Ramos, 2003).

According to the International Labour Organization (ILO) fact sheet of 2009, many disabled people in Kenya, as in most developing countries in the world, live in poverty, have limited opportunities for accessing education, health, and suitable housing and employment opportunities. Hence the dire need to look in to ways of having Special needs, "mainstream" kind of classrooms by taking advantage of the enhanced technological advancements as is the case with eLearning. As a result, there will be a positive move in ensuring a disability perspective in all aspects of policy and labour legislation, effective implementation and enforcement of existing disability laws and policies and providing for equal employment opportunities and training, among other factors that contribute to the reduction of poverty and to the social and economic inclusion of people with disabilities in Kenya.

According to the Kenya National Survey for Persons with Disabilities main report, which was compiled in November, 2008, it showed that, 67% of Persons With Disabilities attained a primary level of education, with only a small proportion of 19% attaining secondary level education. Moreover, it was reported that approximately 2% reached university level. To add on this, only 2% of those with primary level education and 0.4% with secondary level education, attended special schools. Such an analysis goes a long way in explaining the need for more focus to such persons in the society we live in.

The current Kenyan constitution is also not silent on this matter. According to Chapter four, part 3, section 54, sub section (1), part **a** and **e**, the constitution states that a person with disability is entitled to be treated with dignity and respect and to be addressed and referred to in a manner that is not demeaning; and that he/she is entitled to access materials and devices to overcome constraints arising from the persons disability (Kenyan Constitution, 2013).

According to the Daily Nation newspaper dated Friday, March 1, 2013, a total of 879 candidates with special needs sat the end of secondary education examinations countrywide. Kiambu County had 28 students, whereas Nairobi County had 18 students with low vision! Moreover, examination experts from South Africa, Ghana, Tanzania, Zambia, Botswana, Rwanda, Swaziland and Zimbabwe on a recent visit to Kenya observed that Kenya is miles ahead in the education and assessment of candidates with special needs.

2.3 Other works that accommodate people with low vision

According to the Royal National Institute for the Blind, “the internet is one of the most significant communication developments since the invention of Braille (Peterborough, 2004). For the first time ever, many blind and partially sighted people have access to the same wealth of information as sighted people and on the same terms”.

The digitalization of many public services such as education and government, may allow people with disabilities to live in much the same way as those who are not disabled.

On the other hand, if the information and services provided by governments, institutions and public enterprises are not fully accessible, there is a serious risk that they erect new barriers, increasing the information gap and creating a “digital divide” between those who can benefit from opportunities provided by ICT and those who cannot. Another disadvantage of the Internet for students with disabilities is that they have to purchase special adaptive technology to make the computer accessible.

The most frequently used network technologies in eLearning are email and the Web. Moreover, the Computer Mediated Communication (CMC), such as asynchronous communication (e-mail) and synchronous communication (chat) would give the learner the chance to participate actively in cooperative learning activities and to communicate easily with other learners, without having the other participant's preconceived notions of disability. All that is required is to ensure that vocal ability is incorporated in to the implementation.

The following framework (Figure 1) incorporates functions necessary to ensuring eLearning is usable by visually challenged individuals, (Arrigo, 2002). This framework was used in supporting blind people to have access to the web, in Proceedings of the ICTE2002 International Conference on ICT's in Education, which was held in 2002.

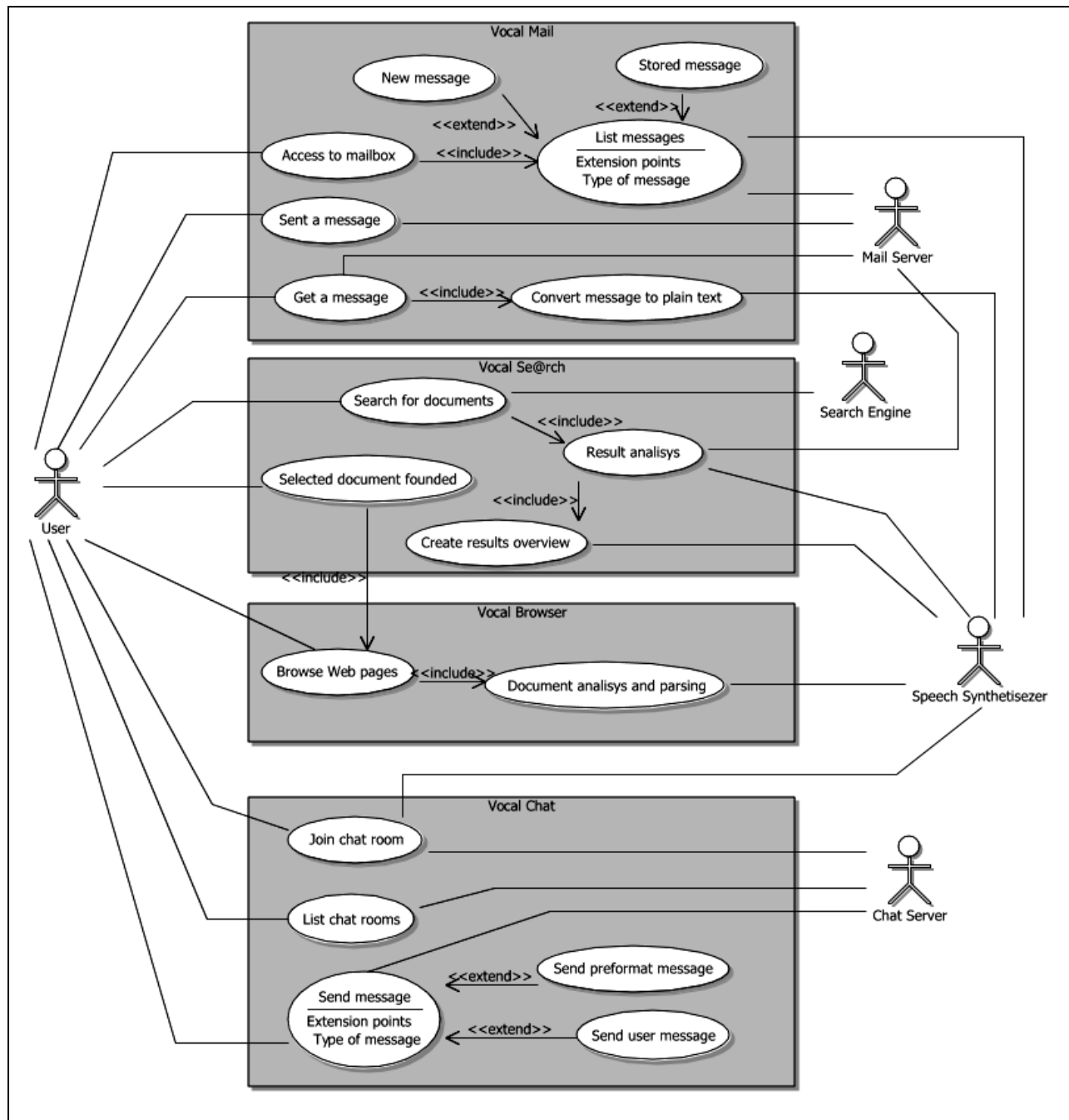


Figure 1: *Vocal tools use case view.* Framework functions and the system module.

The architecture of the system is based on the client-server model. The server provides search, chat, and mail functions for client modules. In order to support visually impaired students in their learning activities, a voice and a search option have been provided.

This model has greatly influenced the implementation of this project in that the designed portal also includes a voice functionality which works to ensure that content available on the portal can be listened to through a voice output. Hence ensuring enhanced functionality.

To add on to the available case studies of implementations to cater for persons who are visually impaired is VISUAL. This is an international project with financial support of the Information Society Technologies Programme of the European Commission to develop voice based technology in order to improve the access of visually impaired, as discussed by (Torres, Trapero, Martos, Vazquez and Soluziona, 2002). One of the main results of the VISUAL Project was suggested to be the creation of an eLearning portal accessible by visually impaired people.

This proposed implementation informed this study in that there is still dire need for more system implementations that are usable by persons with visual disability. Consequently, the implemented system in this project includes technological advances that ensure that the eventual system is adequately usable by persons of visual disability: case of low vision.

The last and not the least is the American Foundation for the Blind (AFB), whose main objective is to expand the possibilities for people with vision loss. The foundation has implemented an eLearning platform for use by persons of Low Vision. In this platform, technological enhancements have been implemented to ensure that all content availed in that site is readable by people of low vision. For instance, they have options to amend background and text colors, as well as amend text sizes.

This implementation has equally informed this project design and implementation in that the technological advancements applied, are still applicable in this implementation. In this case, the implemented portals allows for change of background color, text color, text size, in addition to sound output.

2.4 Summary on adopted implementation

To ensure effective implementation of the eLearning portal that is usable by people of low vision, the following basic guidelines for making effective legibility choices that work for nearly everyone, as discussed by (Arditi, 2013) have been followed:

1. **Contrast:** Text has been printed with the highest possible contrast. For example, white letters on a black background.
2. **Type Color:** Appropriate color combinations have been used. Printed material, generally, is most readable in black and white. It's been ensured that different colors if at all necessary are used for larger or highlighted text, such as headlines and titles.

Therefore, to ensure a usable eLearning portal, the following color combinations have been considered:

- i. Black on a light grey or white background
 - ii. Dark blue on a light grey or white background
 - iii. Dark blue on a light yellow background
 - iv. Black text on beige-light brown background
3. **Point Size:** Large type has been ensured in this implementation, bearing in mind that the relationship between readability and point size differs somewhat among typefaces. In this case, varied letter size has been ensured.
4. **Leading:** Leading, or spacing between lines of text, should be at least 25 to 30 percent of the point size. This has been ensured since many people with partial sight have difficulty finding the beginning of the next line while reading.
5. **Font Family:** Complicated, decorative and cursive fonts have been avoided, and it's been ensured that if used, they are reserved for emphasis only. Standard serif or sans-serif fonts, with familiar, easily recognizable characters are best and have therefore been considered in this implementation. Also, there is some evidence that sans-serif fonts are more legible when character size is small relative to the reader's visual acuity. This

majorly applies to Arial and Verdana fonts. Reason they have also been considered in this implementation.

The following table (Table 2) shows the preferred fonts for this implementation as informed by research and literature review (W3Schools, 1999-2013).

Generic family	Font family	Description
Serif	Times New Roman	Serif fonts have small lines at the ends on some characters
	Georgia	
Sans-serif	Arial	"Sans" means without - these fonts do not have the lines at the ends of characters
	Verdana	
Monospace	Courier New	All monospace characters have the same width
	Lucida Console	

Table 2: Sample font families.

6. **Font Style:** While there is little reliable information on the comparative legibility of typefaces, there is some evidence that a roman typeface, using upper and lower cases, is more readable than italics, oblique or condensed. Hence the consideration of roman type faces in the solution implementation.

On the other hand, the following have been avoided during the implementation of the solution model:

1. Italic text and capital letters, which can be difficult for users with reading impairments.
2. Bold text and underlined text.
3. Pop-ups and other automatic appearing windows that make orientation difficult.
4. Unusual words and long sentences, which are normally problematic.
5. Blinking graphics that may cause serious problems for some people, such as people with epilepsy, whereby a frequency from 4 to 59 Hz can start an epileptic attack!
6. Red light which is more provocative than blue light for example.

The above discussed variables and technological features were decided on after the review of other related works as discussed in this chapter.

CHAPTER 3: METHODOLOGY

This section gives a detailed explanation of how this project has been implemented. In this case the guiding considerations, processes and eventual implementation and evaluation.

3.1 Research Methodology

3.1.1 Research Process

Figure 2 below shows a typical research process since the inception of a project to the point of presenting the project results. This project implementation involved coming up with defined objectives, which led to intense literature review so as to inform the implementation.

After all the underlying concepts were clarified, variables were operationalized, after which an informed strategy was laid to test the proposed objectives, collect, analyze, and interpret data. Eventually, conclusions were done and results presented.

The variables identified for this implementation included:

1. Background color: whereby the appropriate background color options suitable for persons with low vision are provided.
2. Text color: whereby text color options are provided to ensure maximum contrast to the selected background color.
3. Font style: whereby font styles that work for people with low vision are provided.
4. Font size: such that varied size options are allowed as opposed to fixed font sizes.
5. Sound output: whereby sound output provided is clear and appropriate.

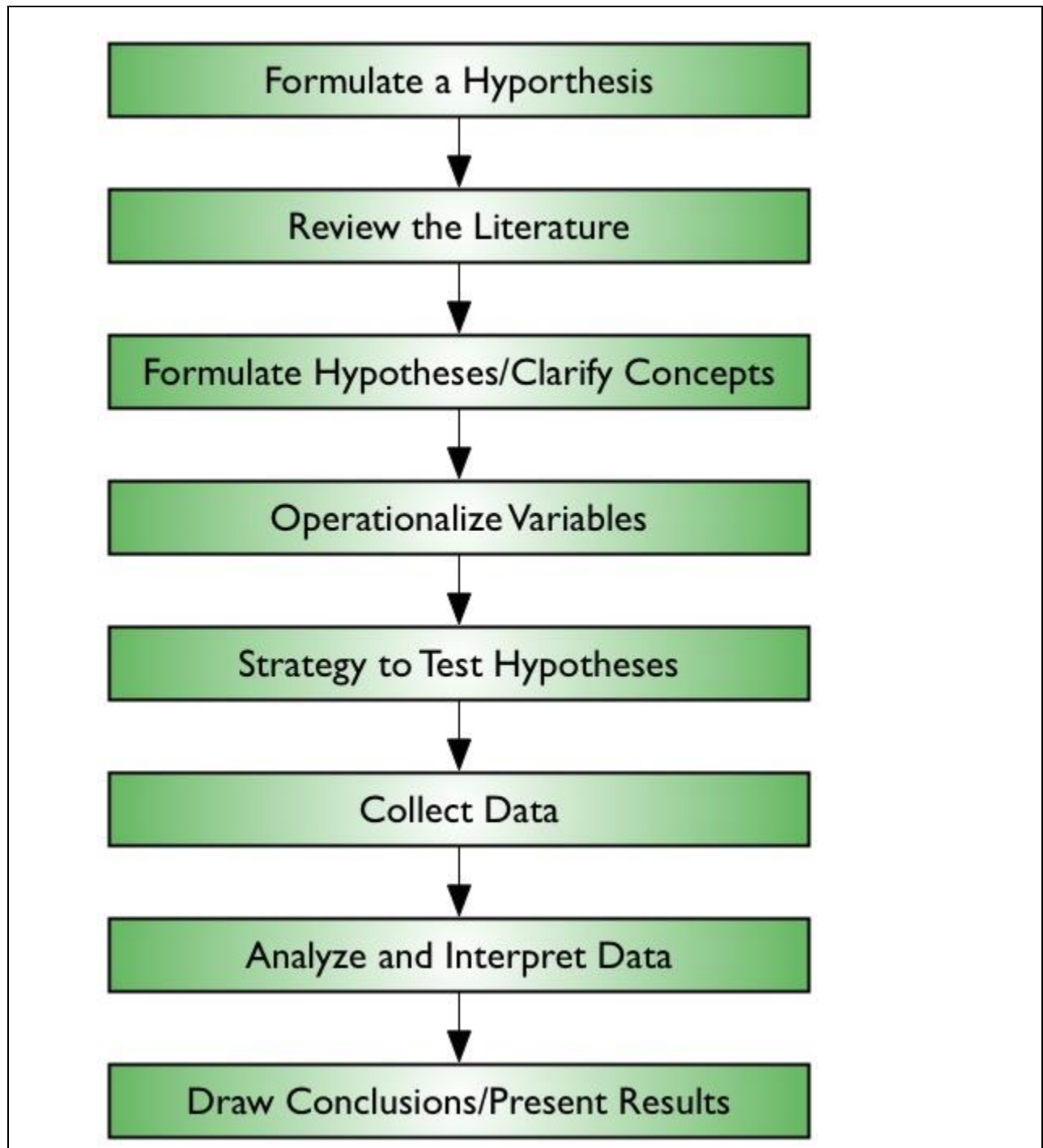


Figure 2: Research Process Diagram.

3.2 Design Methodology

The methodology adopted is the Structured Systems Analysis and Development Method (SSADM) as illustrated in Figure 3 below:

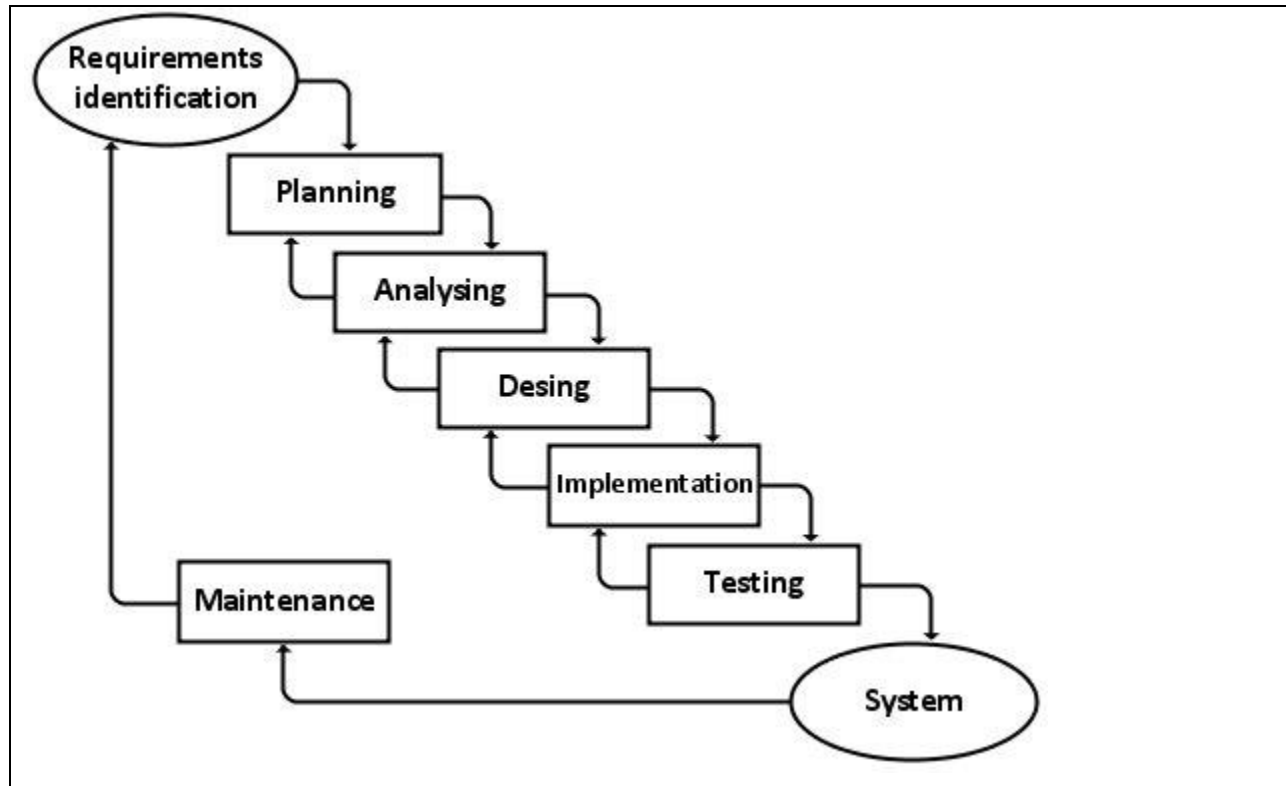


Figure 3: Structured Systems Analysis and Development Method (SSADM) structure.

This methodology adopts a sequential design process, which is often used in software development processes. Progress in this model flows steadily downwards (like a waterfall) through the phases of Requirements Identification, Planning, Analysis, Design, Implementation, and Testing, as illustrated in Figure 3 above.

3.3 The Process flow

3.3.1 Requirement identification process

Requirement identification process basically involved identifying all that was required to design and implement an eLearning portal that was usable by persons of low vision. This led to

appreciating the fact that impaired vision affects reading. This is because impaired vision often makes reading difficult by: reducing the amount of light that enters the eye; blurring the retinal image; and damaging the central portion of the retina best suited to reading.

Consequently, light reduction and blurring reduces the effective contrast of the text, while central retinal damage impairs the ability to see small print and to make eye movements that are crucial to reading.

3.3.2 Planning process

The planning process involved putting in place all that which would be required during the system design. In this case, it involved identifying the required platform, variables and technological features of the system to be implemented.

This project uses Moodle to design an eLearning portal for use by people with low vision.

Moodle (abbreviation for *Modular Object-Oriented Dynamic Learning Environment*) is a free source eLearning software platform, also known as a Course Management System, Learning Management System, or Virtual Learning Environment (VLE), (Wikipedia, 2012).

The adopted plan in developing the eLearning system was two-fold: First, was to download the free eLearning open source software from the Internet, and secondly, to expand and adapt the FOSS to satisfy local environment. The system uses tools such as: PHP as Front-end, Apache as Middle-ware and MySQL Database as Back-end as illustrated in Figure 3 below:

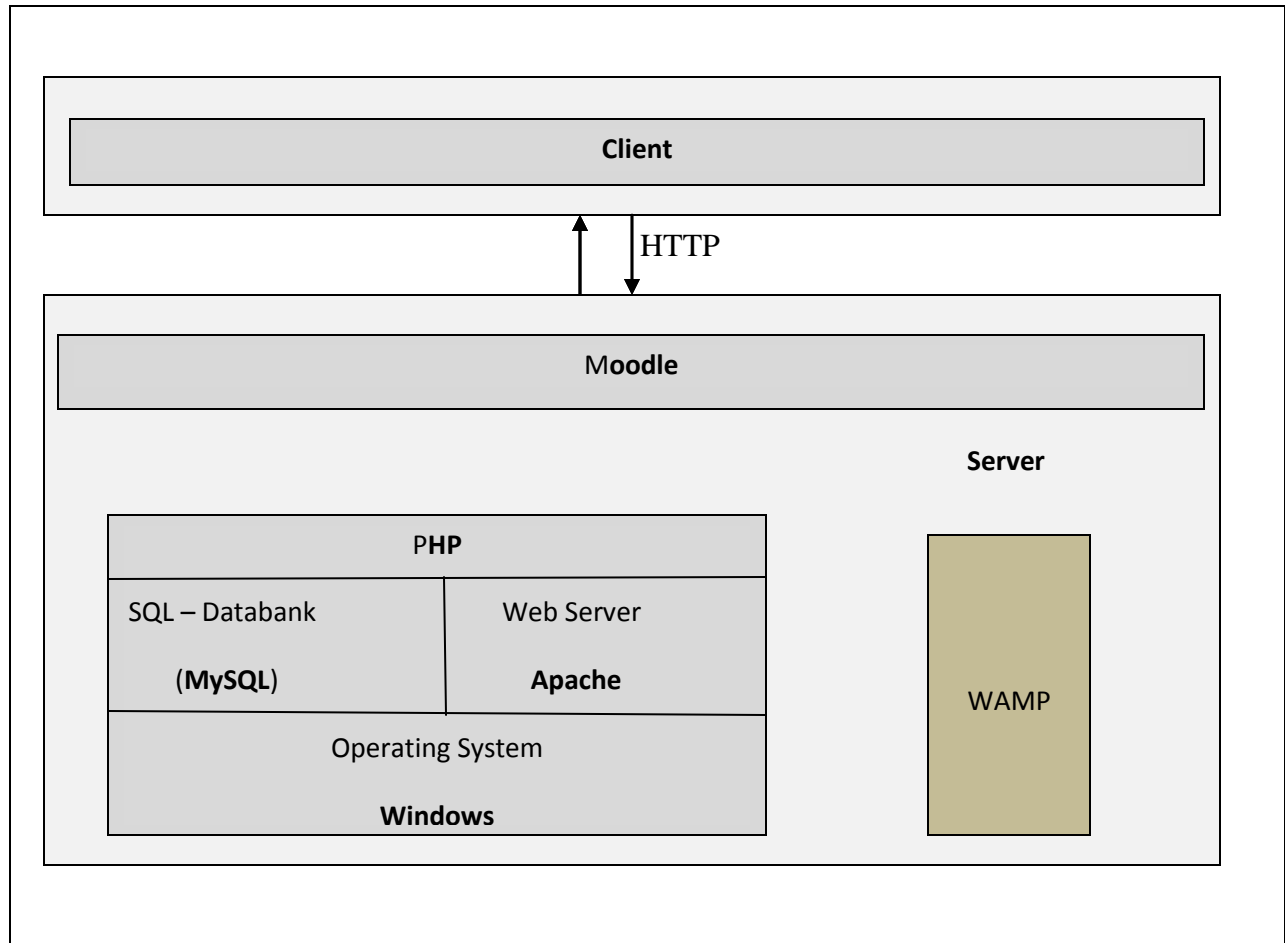


Figure 4: Moodle Architecture.

Specifically, this **Moodle Windows Installer** includes the applications to create an environment in which **Moodle** will operate, namely:

1. Apache 2.2.17
2. PHP 5.3.5 (VC6 X86 32bit) + PEAR
3. MySQL 5.5.8 (Community Server)

Why Moodle?

The following are the reasons as to why Moodle was preferred to other Learning Management Systems:

With Moodle, teachers can set up courses, create discussions, assign homework, and assign grades. They can also integrate with external content such as photos or videos, or with

applications such as Google Docs. Moodle's features also include assignment submission, discussion forums, file downloading, instant messaging, an online calendar, news and announcements (college and course level), online quizzes, and a Wiki.

Moodle can scale to handle hundreds of thousands of students given enough server capacity and bandwidth and a variation called Poodle installs software to a local machine so the app can be used offline. Poodle can even boot off a thumb drive (Booker, 2013).

3.3.3 Design process

After planning, design process followed. The eLearning platform (Moodle) adopted is open source. However, all the suggested technological advancements have been incorporated in to the implementation to achieve the main objective of this project: an eLearning portal for people with low vision.

Moodle allows for student-based cooperative learning where feedback can be given regularly and immediately on a 'need to know' basis, as well as offer great opportunities for enquiry-based learning (Ferreira-Meyers and Nkosi, 2010).

Therefore, after successful installation of Moodle, keen observation of Section 508 Standards, as discussed by the United States Patent and Trademark Office, Office of the Chief Information Officer, was considered to ensure appropriateness of implementation.

To make on-screen information easier to see, the following was adopted:

1. The contrast between text and the background was increased.
2. Placing text over a solid-color background was observed. A patterned background can make text harder to discern.
3. Consistent layouts for all screens and dialogs within the portal was ensured.
4. Accessing tools via a menu bar was provided.
5. Line width guidelines when drawing lines on the screen was followed. Using the line width information provided by operating system settings was used, since that ensures that the learning application increases all lines proportionally should a user choose to enlarge the view (e.g., for horizontal separation in HTML, use HR tags instead of graphics).
6. Allowing the user to zoom into or magnify images and text.

7. A volume controls option was ensured.

To make software more compatible with other applications that offer low-vision access features, the following was considered:

2. Using system pointers whenever possible.
3. Including a highlight or focus indicator when dragging the mouse cursor, even at those times when the cursor is invisible. This adjustment helps screen enlargement software using "pan and zoom" features to track the user's movements more accurately.
4. Adding support for a high-contrast setting.
5. Protecting users from the need to monitor two or more events simultaneously, especially those that occur far apart from each other on the screen.

Moreover, the implementation allows for text enlargement, color and contrast adjustments and speech output.

3.3.4 Implementation process

The implementation phase involved putting in to place all the proposed design processes, so as to achieve the desired system. In this case, an eLearning portal that is usable by persons of low vision.

The following (Figure 4) is an illustration of the implemented solution:

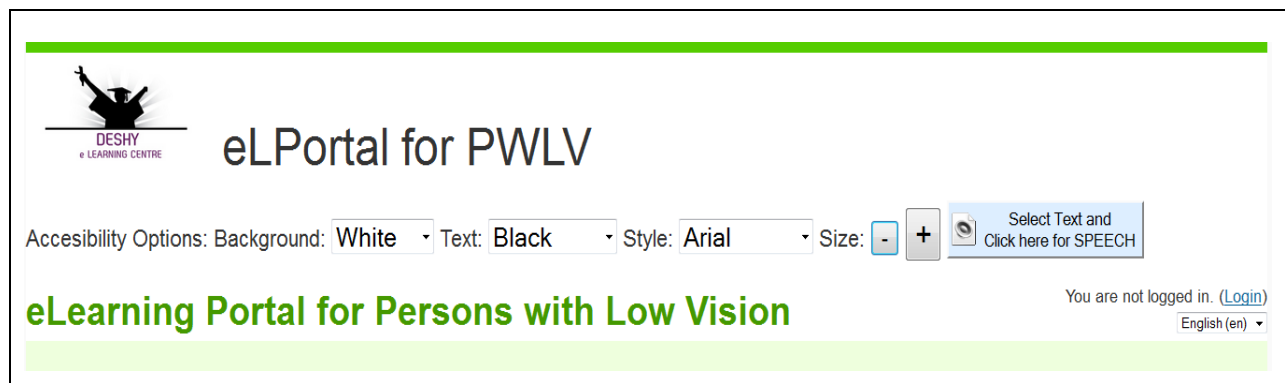


Figure 5: Implemented Solution.

To ensure good and efficient accessibility by people with low vision, a speech output has been implemented. Moreover, the portal allows for color and font size adjustments among other HCI effects as illustrated in Figure 4 above.

According to a research conducted by Georgia Tech Research on Accessible Distance Education (2006), Individuals with partial or low vision may use magnification software to enlarge screen images, which causes only a small portion of a page to be visible at a time. Poor contrast with text color, inconsistent layout, and cluttered pages can create confusion. Even with enlarged text, individuals with low vision may experience eyestrain, headache, nausea and/or other undesirable effects if required to read a large quantity of material within a constricted period of time. Small to medium-size text, decorative fonts, italics, and single-spaced lines of text are problematic as are formats that have less than 1 inch margins, distracting background, or text overlaying graphic content.

3.3.5 Testing phase

The testing phase ensured that the implemented system is usable as proposed and intended. This process involved engaging the targeted users, in this case, people with low vision, to work on the system as the end users. As a result, identifying any gaps that needed to be worked on.

This process was carried out at the Kenya Institute for the Blind, off Langata Road, Nairobi. The mandate of this institute is to offer quality services for self reliance. Five participants with low vision were engaged in the pre-testing phase, with fifteen other participants taking part in the actual testing of the implemented eLearning portal.

The participants interacted with the system with a goal of determining the following:

1. The most preferred accessibility options as provided on the portal.
2. The effects of the sound output.
3. Whether the system is generally suitable for persons with low vision.

The following were the leading questions during the testing exercise:

1. What is your preferred background and text color combination?
2. What is your preferred text size and font style?

Once the participants were done with their selection as per the leading questions above, a sample eLearning Course was attempted to test the desired goal of implementing an eLearning portal that was usable by persons with low vision.

3.3.6 Maintenance

Once the system has been fully tested, it is then ready for the intended users. During the period that the system is in use, the system will require constant maintenance to ensure that it remains relevant. Hence the need of the maintenance phase.

3.4 System Evaluation

System evaluation entails periodic evaluation of the system to assess its status in terms of original or current expectations and to chart its future direction. In this case of an eLearning portal, it will be of paramount importance to always ensure that learning is actually taking place. To do this, the implemented project adopted the enquiry-based learning process model.

Inquiry-based learning is a learning process through which questions are generated from the interests, curiosities, and perspectives/experiences of the learner (Paula, 2003). It covers a range of approaches to learning and training, including case studies, investigations and research work. Moreover, it is perhaps more open to divergent ways of thinking about problems, more open to exploring and understanding different ways of perceiving the world and less concerned with providing firm solutions to problems that do not have simple or unique solutions. The following diagram (Figure 6) illustrates the process.

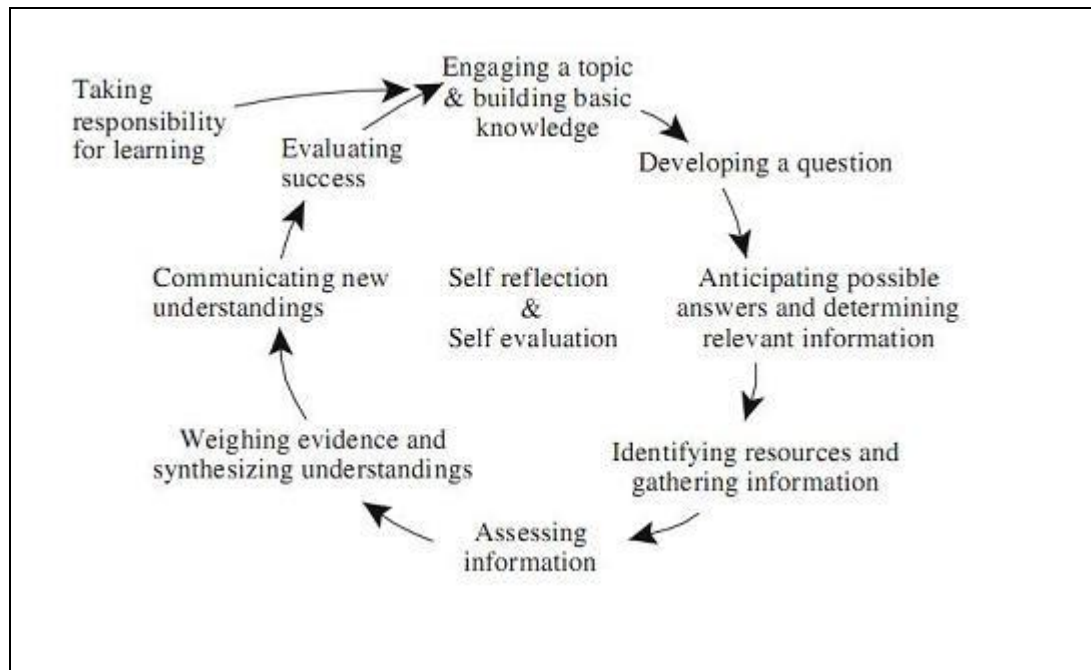


Figure 6: Inquiry-based process of learning.

Expected:

A Challenge: After becoming aware of the issue that ought to be addressed, participants reach a state of puzzlement, curiosity and/or concern and feel challenged to enquire further. The next step is to clarify, define and redefine the particular question, issue or problem to investigate.

Active participant investigation: Participants gather resources and work out what they need to know and do. They consider the problem, cast around, imagine, try to predict, work out what they already know, and/or assess their ability to succeed. This is the stage when participants analyze and interpret the data before them. In this case, they check on all the provisions available on the computer screen that may be adjusted for clarity, at the same time monitoring the effects of any adjustments made.

Making generalizations: Eventually participants synthesize what they have found into generalizations or principles which are used to decide on possible solutions.

Reflection: Participants consider how they achieved what they set out to do. They reflect, confirm, see where to improve, plan new things, evaluate, and consider possible action.

Eventually, if the participants are positively engaged and are able to follow the learning process through and through and with less strain, and at the same time achieving the intended purposes of the engagement, then it may be concluded that the participants are actually leaning. As a result, it's evident that learning is actually taking place.

3.4.1 Aspects of Evaluation

To ensure proper evaluation of the implemented system, the following aspects of evaluation were considered:

Population: the population used was exactly of the intended users. In this case, a population of users with low vision was preferred. In this case, the system was relevantly evaluated by persons whose issues had been taken in to consideration during the entire process of the system development.

Sampling: this involved identifying the participants who would be involved in evaluating the system to ascertain its authenticity and relevance to goal and objectives. A sample size of five (5) participants was used for instrument pretesting, whereas a sample size of fifteen (15) participants was used for eventual data collection and testing. This was advised by the availability of the participants and their level of fitness to the study. In this case, persons with visual disability: case of low vision.

Variables: the sampling variables were advised by the design process and the eventual implementation of the system. This included all the technological enhancements that were incorporated to the system in the effort to make the eLearning portal usable by persons of low vision. The variables included: background color, text color, text size, font style and sound output.

3.5 Sources of data/information

The following were the sources of data in implementing the project:

1. The internet: this was used in obtaining and searching for any relevant information that had been published in relation to visual disabilities, low vision and any other related data/information.

2. Previous research and publications: this was used to explore and understand the scope of study that had been done in relation to the implemented project.
3. Journals: these were reviewed for any relevant information on visual disabilities and low vision cases.
4. Any other relevant educational materials: these were explored for any relevant data/information in relation to the implemented project.

3.6 Instrument Development and Pre-testing

This stage involved developing a data collection and testing instrument, in this case, a researcher administered questionnaire. The proposed data collection and testing questions were then to be presented to a sample target group. This group of participants was then supposed to inform whether or not the proposed method of data collection and testing was acceptable.

The following (Table 3) was the instrument developed for data collection and testing:

Participant:				
Part 1				
Preferred Accessibility Options:		Variables	Response	Comments
	1	Preferred Background color		
	2	preferred Text color		
	3	Preferred Size		
	4	Comment on Sound Output		
	5	General Comment		
Part 2				
Your comments on the following:				
			Preferred	Not Preferred
	6	Complicated, decorative or cursive fonts		
	7	Large font size		
	8	Italic text		
	9	Capital letters		

Table 3: Data Collection and Testing Template.

The sample population in this case comprised of people with low vision, from which a sample size of five was selected. These participants were supposed to assist in determining whether the proposed eLearning portal was acceptable and appropriate for Persons with Low Vision.

Interview method which is well interactive and allows for clarity of issues was used. Questions were posed to the selected target group and responses were collected. The interview questions used were as shown in the following table (Table 4).

	Interview Questions
1	What are some of the challenges experienced by PWLV?
2	What are some of the things that may be incorporated to an eLearning portal to make it usable by PWLV?
3	Is sound output already available in your computers?
4	Are there any challenges/difficulties experienced with using the available sound output?
5	Would you consider the implemented eLearning portal that incorporates accessibility options and sound output as its key features helpful?

Table 4: Interview Questions.

The following table (Table 5) shows a summary of the responses recorded from the interview questions.

	Interview Questions	Recorded Responses
1	What are some of the challenges experienced by PWLV?	Difficulties reading content.
2	What are some of the things that may be incorporated to an eLearning portal to make it usable by PWLV?	Adjustable color options for background and text, adjustable text sizes, and sound output.
3	Is sound output already available in your computers?	Yes.
4	Are there any challenges/difficulties experienced with using the available sound output?	Yes, the speech generator just keeps talking for as the window remains open. One has to keep putting it on and off.
5	Would you consider the implemented eLearning portal that incorporates accessibility options and sound output as its key features helpful?	YES

Table 5: Interview Questions and Responses.

3.7 Tools, procedures and methods for data collection

The methods used for data collection included a researcher administered questionnaire as shown in Table 3 above, and general observation. Reading of publications, journals, research papers and any other relevant material was helpful in collecting all the required information, that informed

the developed questionnaire and the general issues observed during data collection. Moreover, surfing the internet worked to expose other relevant materials which would otherwise be neglected, such as the fact that not all color combinations work for Persons with low Vision.

Participants: Fifteen (15) participants (8 females and 7 males) volunteered for this study. The mean age of the participants was 27 years with an age range from 19 to 63 years. All participants were familiar with reading from a computer screen, and suffered low vision.

Task design: each participant was allowed to interact with the portal for at least 5 minutes. A word document had been uploaded on the system. This document was to be used to test the effects of varying the provided accessibility options and also to test the sound output.

Procedure: the participants were supposed to choose the accessibility options that worked for them among the ones provided on the portal. These options included background color, text color, font style, and font size. Lastly, the participants were expected to comment on the sound output provided on the portal, in addition to giving a general comment about the eLearning portal. All these details were to be recorded by the researcher.

3.8 Data analysis methods

All the data/information gathered needed to be analysed so as to be of relevant value. Editing, classification, and analysis using graphs and charts was used. The collected data was saved as an excel document. It was then edited and classified accordingly so as to ensure significance and validity of the project conclusion.

3.9 System Requirements

The basic requirements for Moodle are as follows:

3.9.1 Hardware

Disk space: 160MB plus as much as needed to store necessary materials. 5GB is probably a realistic minimum.

Backups: at least 160MB (preferably at a remote location) so as to keep backups.

Memory: at least 256MB. 1GB or more is strongly recommended. The general rule of thumb is that Moodle can support 10 to 20 concurrent users for every 1GB of RAM, but this will vary depending on specific hardware and software combination and the type of use. In this case, concurrency is web server processes in memory at the same time.

3.9.2 Software

An operating system: Anything that runs the following software; although the choice will most likely depend on the performance needed and the skills available. Linux and Windows are the most common choices. Linux is generally regarded to be the optimal platform. Moodle is also regularly tested with Windows XP/2000/2003, Solaris 10 (Sparc and x64), Mac OS X and Netware 6 operating systems.

Web server: Primarily Apache or IIS. The following though not fully tested (or supported) should work: lighttpd, nginx, cherokee, zeus and LiteSpeed. Moodle will refuse to install on any other web server. The web server needs to be correctly configured to serve PHP files.

PHP: The minimum version is currently 5.3.2 with a number of extensions required.

A database: MySQL and PostgreSQL are the primary development databases. Oracle and MSSQL are also fully supported.

1. MySQL - minimum version 5.1.33
2. PostgreSQL - minimum version 8.3
3. MSSQL - minimum version 9.0
4. Oracle - minimum version 10.2
5. SQLite - minimum version 2.0

Minimum browser for accessing Moodle: Firefox 4, Internet Explorer 8, Safari 5, Google Chrome 11, Opera 9.

CHAPTER 4: IMPLEMENTATION OVERVIEW AND TESTING

4.1 Implementation Overview

The implemented system incorporates the following technological advancements that are aimed at providing accessibility options to the users.

The following are the accessibility options as availed in the system:

Background Color

The background basically refers to the area on the screen upon which everything else on the computer screen appears. In this case, its color should be set such that any details on display are visible. In this case, various options have been provided to allow for varying of the background color as shown below in Figure 7.



Figure 7: Background Color options.

Font Color

Font color in this case is the preferred color to the style of type within the type family being used. This color ought to be favorable to the user. Figure 8 below shows various options that are available for selection in this implementation.



Figure 8: Font Color options.

Font Style

The font-style property is mostly used to specify italic text. However in this implementation only normal typeface has been adopted so as to fit the study. The following (Figure 9) are the font styles as provided in the implementation.



Figure 9: Font Style options.

Font Size

This refers to the specific size of the font selected. The following illustration (Figure 9) shows options available to either increase or decrease font size.

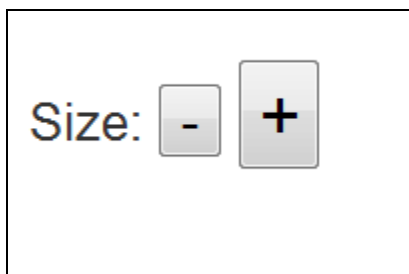


Figure 10: Font Size options.

Sound Output

This allows for the user to be able to listen to any portion of text on display that has been selected. The following (Figure 10) shows the implementation as provided in the portal.

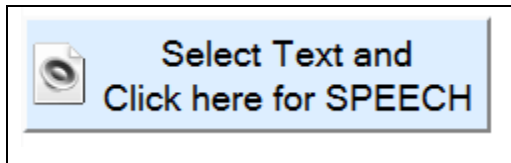


Figure 11: Sound Output option.

The following is part of the system solution as implemented in the eLearning Portal:

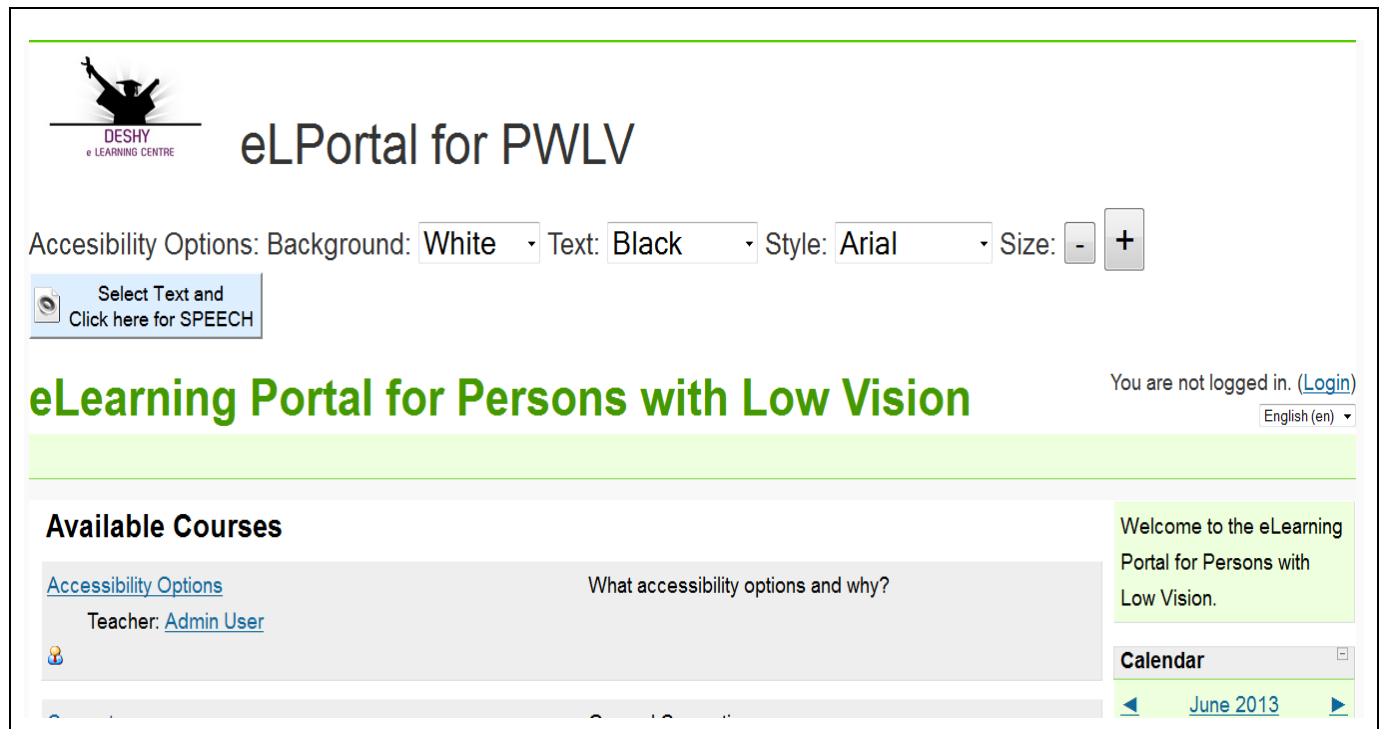


Figure 12: Part of implemented solution.

4.2 Testing

The testing process was carried out at the Kenya Institute for the Blind, off Lang'ata Road, Nairobi. The fifteen participants that undertook the study were required to indicate their preferences of the various variables that were provided in the portal. In this case, the following was expected:

1. Each participant was supposed to indicate the best three preferred options on background color, text color, and font style

2. Each participant was expected to comment on whether they preferred varied or fixed font size.
3. Each participant was supposed to comment on the clarity of the sound output provided.

The following (Figure 13) is a tabulation of the test data as was collected for the fifteen participants. Numbers 1, 2, 3 have been used to indicate preference of background color, test color and font style, with 1 indicating the most preferred, whereas 3 indicated the last preferred of the three allowed options. For the font size, affirmative ‘Yes’ indicated the option chosen whereas a dash (-) was used to show non-preference. Finally, number 1 was marked against the option chosen by each participant concerning the sound output.

Variables	Options	Participants															Preference Level	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Background Color	White	1	1,3	3	1	1,3	2	1,3	3	2		2	1		2	1	15	
	Grey	2	2	2	3	2	3		2	3	1	3	2	1,3		2	14	
	Yellow			1	2		1	2		1	3		3	2		3	9	
	Brown								1			1			3		3	
	Black														1		1	
	Orange	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Purple	3									2							2
	Red	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Text Color	Black	1,2	3	3	1,3	1,2,3	2,3	3	3	2	1	2	1,3	1	1,2,3	1	23	
	Dark blue		1,2	1,2	2		1	1,2	1,2	1,3	3	1,3	2	2,3		2,3	20	
	White	3									2						2	
Font Style	Arial	1,3	2	1,2,3	2,3	2	1,2,3	2	1	2	3	1	1,2,3		1	1	22	
	Verdana	2	1		1	3		3	2	3	1	2		1	2	2	12	
	Times New Roman							1	3					3		3	4	
	Georgia		3			1				1	2	3		2	3		7	
	Courier New	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Lucida Console	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Blackoak Std	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Blackadder ITC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Castellar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Font Size	Fixed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
	Variable	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	15	
Sound	Clear	1	1			1	1	1		1		1		1		1	9	
	Not Clear			1											1		2	
	Not Sure				1				1		1		1				4	

Figure 13: Recorded participants preferences.

CHAPTER 5: SYSTEM EVALUATION, RESULTS AND CONCLUSION

5.1 System Evaluation

The implemented eLearning Portal was evaluated to ascertain that it met the proposed objectives. It was also checked for efficiency, appropriateness and its level of usability by persons with low vision.

The general objective of this project was to implement an eLearning portal that was usable by persons with low vision. To begin with, persons with low vision are not comfortable with all background colors and text colors. They are also not comfortable with small font sizes since their vision is usually problematic and somehow limited. In this case, the implemented portal included variables of background color, text color, font style and size, which allowed for flexibility in terms of choices and preferences. Eventually, all the participants (people with low vision) who were involved during the project process were able to interact with the implemented portal as desired. Consequently, it was concluded that the implemented portal was usable by people with low vision.

On the other hand, this project sought to implement an eLearning portal with technological advances such as sound output. Moreover, the implemented portal was supposed to be testable with the target group, in this case, people with low vision. These two specific objectives were well met in that, other than the Human Computer Interface (HCI) effects that enhanced accessibility, sound output was also achieved. This was evident in the fact that the participants only needed to highlight the part of text that they needed to read, and it would be read out on clicking the provided sound button.

The following section discusses the results of the evaluation as was recorded in Table 4, during the testing exercise.

5.2 Results

On testing the participant's preferences on Background color as compared to Text color, the results were as shown in Table 6 below:

Background Color	Text Color	Preference Level	% of Preference
White	Black	13	39.4
Grey	Black	6	18.18
White	Dark Blue	2	6.06
Yellow	Dark Blue	9	27.27
Brown	Black	1	3.03
Purple	White	2	6.06
		33	100

Table 6: Background to text color preferences.

The above results were graphically represented as shown in Figure 14 below:

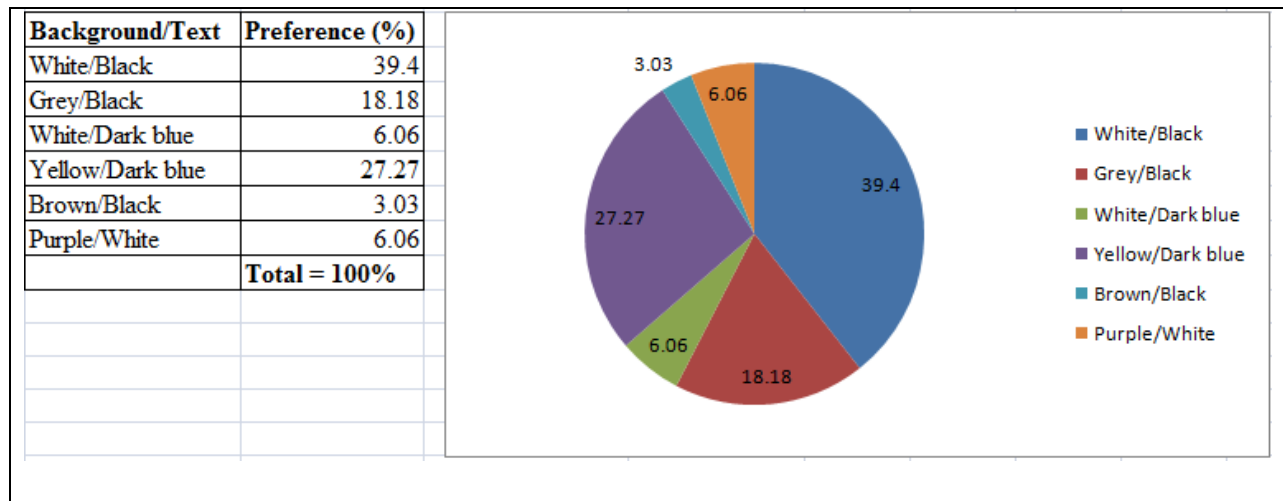


Figure 14: Background color to Text color Preference shown in percentage (%).

The level of preference of font style varied as tabulated in Table 7 below:

Font Style	Preference Level	Preference in %
Arial	22	48.88
Verdana	12	26.67
Times New Roman	4	8.89
Georgia	7	15.56
Courier New	0	0
Lucida Console	0	0
Blackoak Std	0	0
Blackadder ITC	0	0
Castellar	0	0
Total	45	100

Table 7: Font style preferences.

The following analysis (Figure 15) shows how many times a style was preferred to another, expressed as percentages.

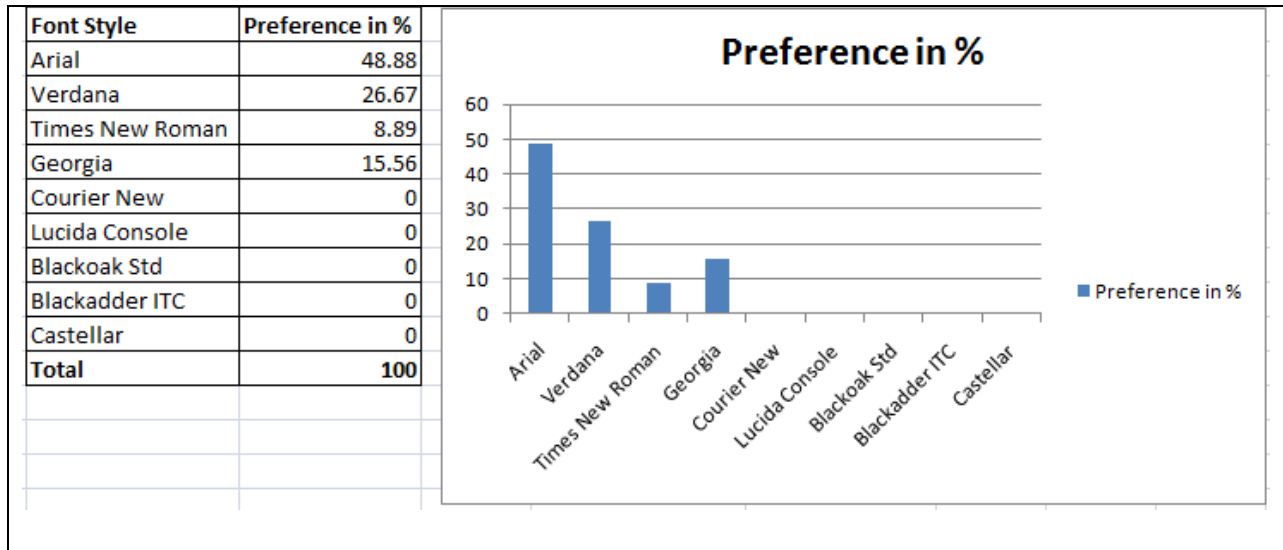


Figure 15: Font style preference in percentage (%).

Out of the possible 15 participants, all of them preferred varied font size as opposed to a case whereby the font size is fixed. The results of the analysis are as shown in Table 9 below:

Font Size	Level of Preference	Preference in %
Fixed	0	0
Variable	15	100

Table 8: Font size preferences.

The above results expressed graphically were as follows in Figure 16:

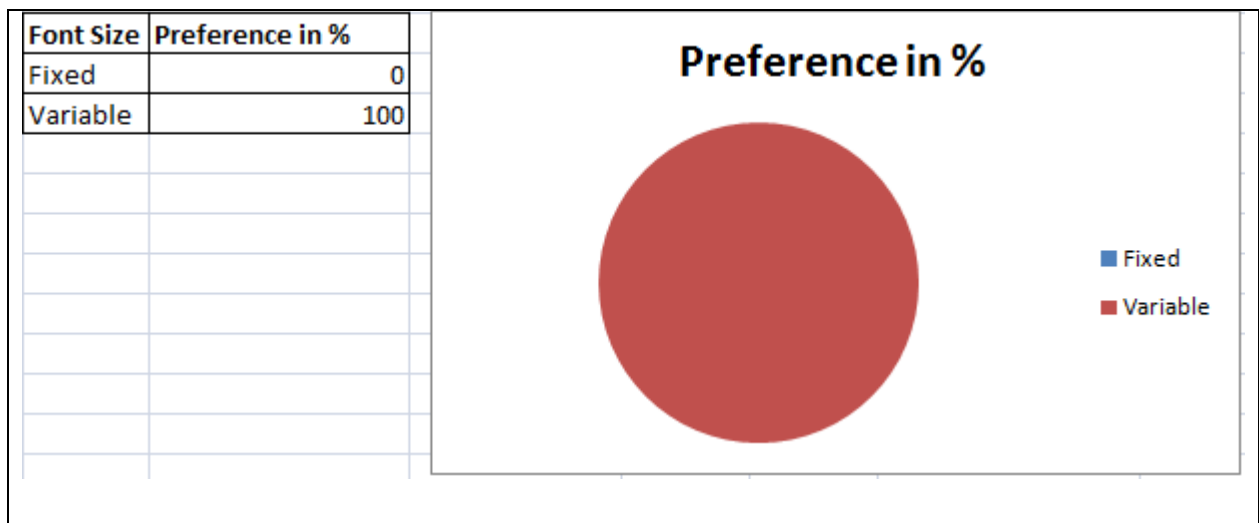


Figure 16: Font size preference expressed in percentage (%).

Sound was analysed as shown in Table 9 below:

Sound	Level of Preference	Preference in %
Clear	9	60
Not Clear	2	13.33
Not Sure	4	26.67
Total	15	100

Table 9: Sound preferences.

The sound preferences expressed graphically were as shown in Figure 17 below:

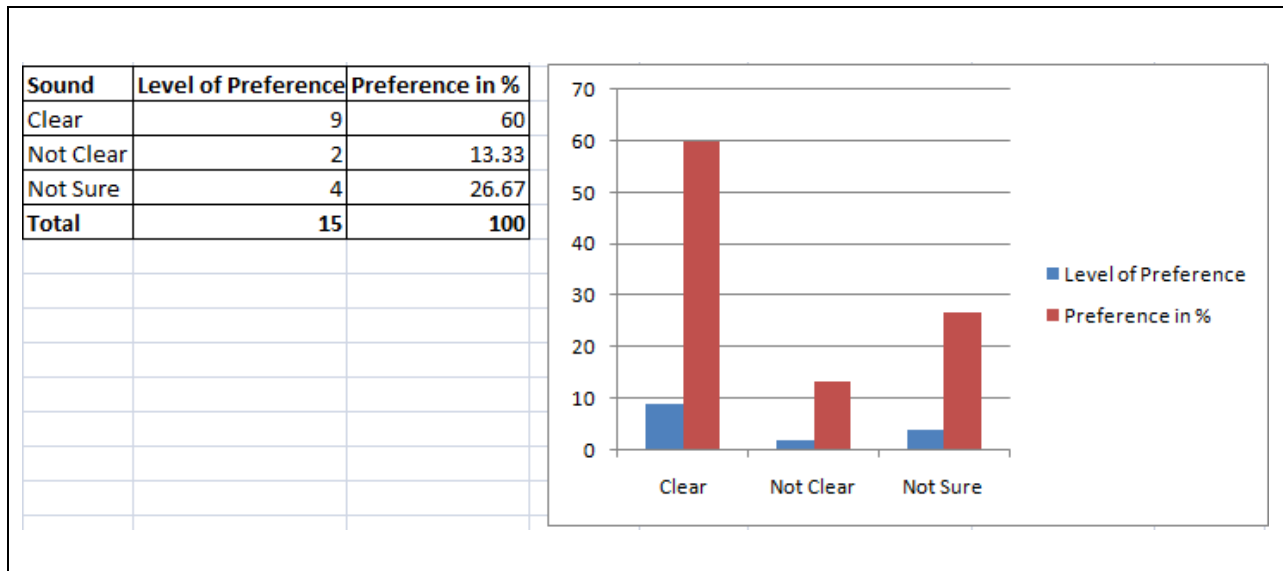


Figure 17: Sound preference expressed in percentage (%).

5.3 Results Interpretation, Discussion and Conclusion

According to the testing carried out and the analysis thereof, it was concluded that people of low vision preferred text with the highest possible contrast. For example, majority preferred white letters printed on a black background. Moreover, appropriate color combinations were preferred, such as black on a light grey or white background, dark blue on a light grey or white background, dark blue on a light yellow background, and black text on beige-light brown background.

To add on this, majority preferred to work on the large font size. The fact that font size was easily varied was preferred by all the participants. This resulted from the fact that, with the enlarged fonts, vision was enhanced, thus making reading easier. On the other hand, the enlarged fonts meant that spacing between words was more clear, making it easier to distinguish between a start and end of a sentence or paragraph.

On the other hand, it was noticeable that almost all participants avoided the use of complicated, decorative or cursive fonts. Standard serif or sans-serif fonts, with familiar, easily recognizable characters were best preferred. The reason for the preference was concluded to be the fact that sans-serif fonts were more legible when character size was small relative to the reader's visual acuity. In addition to this, normal typeface was considered to font style in italics, oblique or condensed.

On further investigation and observation, it was concluded that, italic text and capital letters, which can be difficult for users with reading impairments was avoided. Moreover, bold text, underlined text, pop-ups and other automatic appearing windows that make orientation difficult was never preferred. Unusual words and long sentences, which are normally problematic and blinking graphics that may cause serious problems for some people, were seriously not preferred.

Gauging from the results of the test, and again by general observation of the current society where we live in, it was noticeable that there was need of usable eLearning portals to cater for persons with visual disability. Majority of the users today have been forced to struggle with eLearning, since no conducive environment had been provided to ensure their comfort. Therefore, the implemented portal works as an enhancement to the existing implementations that cater for persons with visual disabilities.

CHAPTER 6: FUTURE RESEARCH AND RECOMMENDATIONS

Public Policy and assistive technology for low vision are stalled. With few exceptions, typographic flexibility of web language has been ignored in research, assistive technology and policy regarding low vision. Research is needed to determine efficacy of typographic intervention. Typometrics provides an engineering approach that uses basic findings of psychophysics and the flexibility of web technology. Formal clinical trials are needed to verify the efficacy of emerging assistive technologies. This should protect consumers with low vision and enable informed policy (Dick, 2012).

In this regard, there will be need to check on Public Policy and assistive technology for persons with low vision.

It is recommended that eLearning portal usable by all categories of people considering their visual capability be adopted by all learning institutions. Consequently, some of the population, in this case, persons with visual disabilities are not left out by the advancing technology.

REFERENCES

1. Center for Assistive Technology and Environmental Access. 2006. *Individuals who are Blind or have Low Vision*. [ONLINE] Available at: http://www.accesselearning.net/mod1/1_04.php. [Accessed 18 February 13].
2. Eric Klopfer, Scot Osterweil, Jennifer Groff, Jason Haas. (2009). Using the technology of today, in the classroom today. Available: http://education.mit.edu/papers/GamesSimsSocNets_EdArcade.pdf. Last accessed 27th November, 2012.
3. Evastina Björk, Stig Ottosson, Sigrun Thorsteinsdottir. (2008). E-LEARNING FOR ALL. In: Audrey R. Lipshitz and Steven P. Parsons *E-Learning: 21st Century Issues and Challenges*. Nova: Nova Science Publishers, Inc. 65.
4. Ferreira-Meyers, Nkosi, K. F. M, J. N, 2010. *Incorporating the Enquiry-Based Approach into Moodle?* Academic Literacy Development. Swaziland: University of Swaziland.
5. <http://teorije-ucenja.zesoi.fer.hr>. 2012. *Inquiry-Based Learning*. [ONLINE] Available at: http://teorije-ucenja.zesoi.fer.hr/doku.php?id=instructional_design:inquiry-based_learning. [Accessed 12 March 13].
6. Inclusion of People with Disabilities in Kenya International Labour Organization. October 2009.
7. InformationWeek/Ellis Booker. 2013. *Why Moodle Matters To Teachers*. [ONLINE] Available at: <http://www.informationweek.com/education/instructional-it/why-moodle-matters-to-teachers/240145508>. [Accessed 02 April 13].
8. Jubilee Manifesto (2013).
9. Kathy Flores. (2003). Special needs, "mainstream" classroom Inclusive education isn't easy, but it benefits kids with-and without-disabilities.
10. Kenyan Constitution, 2013

11. Lighthouse International. 2013. *Designing for People with Partial Sight*. [ONLINE] Available at: <http://www.lighthouse.org/accessibility/design/accessible-print-design/making-text-legible>. [Accessed 23 January 13].
12. M. Arrigo, *et al*, VocalSearch: Supporting blind people to have access to the web, in Proceedings of the ICTE2002 International Conference on ICT's in Education; 858-862 (2002).
13. Moodle. (2012). *Installation Quickstart*. Available: http://docs.moodle.org/23/en/Installation_Quickstart. Last accessed 16th June 2013.
14. Royal National Institute for the Blind, *Communicating with blind and partially sighted people*. Peterborough (2004).
15. Scribd. 2009. *Kenya Census 2009*. [ONLINE] Available at: <http://www.scribd.com/doc/36672705/Kenya-Census-2009>. [Accessed 07 March 13].
16. Sheryl Burgstahler. (2012). *Working Together: People with Disabilities and Computer Technology*. Available: <https://www.washington.edu/doit/Brochures/PDF/wtcomp.pdf>. Last accessed 28th November, 2012.
17. The United States Patent and Trademark Office, Office of the Chief Information Officer. 2012. *Section 508 Reference Guide Appendix B: Tips for Creating Accessible Products*. [ONLINE] Available at: <http://www.uspto.gov/about/offices/cio/section508/11b.jsp>. [Accessed 18 February 13].
18. The University of Nairobi. (2009). *Multimedia Portal*. Available: <http://learning.uonbi.ac.ke/>. Last accessed 4th Jun 2013.
19. Toni-Marie Ramos. *Top Challenges Teachers Face in Special Needs Inclusive Classrooms*.
20. Vision-Aid. 2008. *Serving the visually disadvantaged in Under-Served Areas*. [ONLINE] Available at: http://www.visionaid.org/?gclid=CMjIoonU_rQCFe3KtAodEUwAwA. [Accessed 14 March 13].

21. VISUAL (Voice for Information Society Universal Access and Learning). J.L. Torres, J. Trapero, F. Martos, G. Vazquez and A. Fernández Soluziona, Spain <http://www.afb.org>. Last accessed on 22nd February, 2013.
22. W3/Wayne E. Dick Ph.D. 2012. *Discovering Typographic Environments for Reading with Low Vision*. [ONLINE] Available at: <http://www.w3.org/WAI/RD/2012/text-customization/r2>. [Accessed 03 April 13].
23. W3Schools. (1999-2013). *CSS Font*. Available: http://www.w3schools.com/css/css_font.asp. Last accessed 25th June 2013.
24. WAFULA, C. W, 2013. Central had highest number of special needs students sit exam. *Daily Nation*, 01 March. 5.
25. WHO Media Centre. 2012. *Visual impairment and blindness*. [ONLINE] Available at: <http://www.who.int/mediacentre/factsheets/fs282/en/>. [Accessed 27 February 13].
26. Wikipedia. (2012). *Moodle*. Available: <http://en.wikipedia.org/wiki/Moodle>. Last accessed: 3rd Dec 2012.

APPENDICES

1 Moodle installation guidelines

Basic Requirements

To start with, a working web server (such as Apache), a database (such as MySQL or PostgreSQL) is required, in addition to having PHP configured.

To enable Moodle to send email, a working Sendmail (Unix/Linux) server or access to an SMTP mail server will be required.

Getting Moodle

The required version should then be downloaded from: <http://moodle.org/downloads>.

Create a Database

Using the chosen database server, a new empty database is then created. The default encoding must be UTF8. For example, using MySQL, do:

```
CREATE DATABASE moodle DEFAULT CHARACTER SET UTF8 COLLATE
utf8_unicode_ci;
```

Create a user/password combination with appropriate permissions for the database. For example:

```
Mysql>GRANT SELECT,INSERT,UPDATE,DELETE,CREATE,CREATE TEMPORARY
TABLES,DROP,INDEX,ALTER ON moodle.* TO moodleuser@localhost IDENTIFIED
BY 'yourpassword';
```

Create data directory

Create an empty directory to hold Moodle files. It **must not** be in the area served by the web server and must have permissions so that the web server user can write to it. Typically, either make it owned by the web server user or give it write permissions for 'everyone'.

Install Moodle code

Unzip / move / copy the Moodle code (obtained above) so that it will be served by the web server (e.g. on Debian based Linux, move to /var/www/moodle).

Check the permissions and make sure that the web server does **not** have permissions to write to any of the files in the Moodle code directories (a very common root cause of sites being hacked).

If you need to, configure your web server to serve the Moodle site with your chosen URL.

Configure Moodle

In the Moodle code directory, find the file *config-dist.php* and copy it to a new file called *config.php* (but read next step, 'Install Moodle', first).

Edit config.php with any preferred editor and change the appropriate settings to point to ones site, directories and database. Note: the Moodle install script will create config.php if it does not exist but make sure to (re-)set permissions appropriately afterwards.

Install Moodle

Go to the URL for your moodle site in a browser (installation will complete automatically) or run the command line version at (requires cli version of PHP):

```
/usr/bin/php /path/to/moodle/admin/cli/install.php
```

The CLI creates the config.php for you and will not run if you created one in the previous step.

After completing the install make sure your file permissions are okay for the Moodle program files which are not writeable by web server and the Moodle data files which are writeable by web server (Moodle, 2012).

2 Data Collection Authority Form



UNIVERSITY OF NAIROBI
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Our Ref: UON/SCI/MS(CS)/2013

23 May 2013

To Whom It May Concern

Dear Sir/Madam

RUTH NTHENYA WAMBUA – REG. NO. P58/P/63760/2013

The above named is a bona fide student pursuing a Master of Science in Computer Science degree at the School of Computing and Informatics, University of Nairobi. She is currently carrying out her research on the project entitled: "**e-Learning Portal for Persons with Visual Disabilities : Case of Low Vision**".

We would be grateful if you could assist the student as she gathers data for her research. If you have any queries about the exercise please do not hesitate to contact us.

Yours faithfully


PROF. W. OKELO-ODONGO
DIRECTOR
SCHOOL OF COMPUTING AND INFORMATICS

School of Computing and Informatics
University of NAIROBI
P. O. Box 30197
NAIROBI

3 Sample Testing Template

Date: 11th June, 2013

Name of Participant: Joan Wangui (Kenya Institute of the Blind (KIB))			
Part 1			
Preferred Accessibility Options:	Variables	Response	Comments
	1 Preferred Background color	Black	good
	2 preferred Text color	White	contrast
	3 Preferred Size	Varied (large)	flexible
	4 Comment on Sound Output	Good	vary output
	5 General Comment	Good tool	Good.
Part 2			
Your comments on the following:			
		Preferred	Not Preferred
	6 Complicated, decorative or cursive fonts		✓
	7 Large font size	✓	
	8 Italic text		✓
	9 Capital letters	✓	✓

Data collected by: Ruth Wambua

 PS8/63760/2011.

4 Sample Code

Header

```
<html<?php echo $direction ?>>

<head>

    <?php echo $meta ?>

    <meta name="keywords" content="moodle, <?php echo $title ?> " />

    <title><?php echo $title ?></title>

    <link rel="shortcut icon" href="<?php echo $CFG->themewww .'/'. current_theme()
?>/favicon.ico" />

    <?php include('ui/chameleon.php'); ?>

    <?php include("$CFG->javascript"); ?>
```

Sound script

```
<script src="//ajax.googleapis.com/ajax/libs/jquery/1.9.1/jquery.min.js">
</script>

<script type="text/javascript" src="http://vozme.com/get_text.js"></script>
<script type="text/javascript" src="js/jquery.jLensMagnify.js" ></script>
<script src="speakClient.js"></script>

    <script type="text/javascript">

        $.ready(function() {

            });

    </script>

<script>
```

Accessibility options

```
$(document).ready(function(){  
    $("#vmedium").click(function(){  
        $("#div1").css({"font-size":"100%"});  
    });  
    $("#vlargest").click(function(){  
        $("#div1").css({"font-size":"200%"});  
    });  
    $("#vlarge").click(function(){  
        $("#div1").css({"font-size":"150%"});  
    });  
    $("#vblue").click(function(){  
        $("#content").css({"background-color":"blue"});  
        $("#posting").css({"background-color":"blue"});  
    });  
    $("#vyellow").click(function(){  
        $("#content").css({"background-color":"yellow"});  
        $("#posting").css({"background-color":"yellow"});  
    });  
    $('#colorlist').change(function(e){  
        $("#content").css({"background-color":this.value});  
        $("#posting").css({"background-color":this.value});  
    });  
});
```



```

    }).change();
    $('#forelist').change(function(e){
        $("#content").css({"color":this.value});
        $("#posting").css({"color":this.value});
    }).change();
    //$('#content').jLensMagnify({
        //startEffect: {'color': 'blue', 'font-size': '36px'},
        //resetEffect: {'color': 'black', 'font-size': '24px'},
        //splitChar: ' '
    //});
});
</script>
</head>
<body<?php
    echo " $bodytags";
    if ($focus) {
        echo " onload=\"setfocus()\"";
    };
?>>
<div id="div1">
<div id="page">
 <font size="24" name ="Serif">eLPortal for PWLV</font>
<p>

```

Background Color:

```
<select id="colorlist" style="font-size:110%;">
<option value="white">White</option>
<option value="grey" style="background-color: light grey;">Grey</option>
<option value="brown">Brown</option>
<option value="yellow">Yellow</option>
<option value="red">Red</option>
<option value="black">Black</option>
<!--<option value="orange" style="background-color: orange;">Orange</option> -->
<option value="orange">Orange</option>
</select>
```

Font Color

```
<select id="forelist" style="font-size:110%;">
<option value="black" > Black</option>
<option value="dark blue" > Blue</option>
<option value="yellow">Yellow</option>
<option value="red">Red</option>

<option value="white">White</option>
<option value="orange">Orange</option>
</select>
```

Font Size:

```
<button id="vmedium" style="font-size:100%;">A</button>
<button id="vlarge" style="font-size:140%; padding:4px 4px 4px 5px;" >A</button>
<button id="vlargest" style="font-size:170%; padding:4px 4px 4px 5px;" >A</button>
<button style="background:#ddeeff
url(http://vozme.com/img/paper_sound32x32.gif)
no-repeat left center;
min-height: 35px;
font-size:70%; padding:4px 4px 4px 35px;"
onclick="get_selection('en','ml');">
Select a text and<br/>click here for speech</button>
```

```
<?php if ($home) { // This is what gets printed on the home page only
?>
<div id="header-home" class="clearfix">
  <h1 class="headermain"><?php echo $heading ?></h1>
  <div class="headermenu"><?php echo $menu ?></div>
</div>
<div class="navbar clearfix">
  &nbsp;
</div>
<?php } else if ($heading) { // This is what gets printed on any other page with a heading
?>
<div id="header" class="clearfix">
  <h1 class="headermain"><?php echo $heading ?></h1>
```

```
<div class="headermenu"><?php echo $menu ?></div>
</div>
<div class="navbar clearfix">
<?php if ($navigation) { // This is the navigation table with breadcrumbs
?>
    <div class="breadcrumb"><?php print_navigation($navigation); ?></div>
    <div class="navbutton"><?php echo $button; ?></div>
<?php } ?>
</div>
<? php} ?>
<!-- END OF HEADER -->
<div id="content">
```