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Assistive Computer Software: Motivations, Challenges and Expectations of Visually Impaired Undergraduates at the University of Lagos, Akoka, Lagos State, Nigeria

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ABSTRACT

The emergence of information and communication technologies (ICTs) has significantly improved the way visually impaired persons access information. With the use of assistive computer software, they can access information easily just like their sighted counterparts. Previous studies were based on awareness, and factors affecting the use of assistive computer software by visually impaired persons. This study was carried out to investigate the motivations, challenges and expectations of visually impaired undergraduates of the University of Lagos for using assistive computer software. The study adopts a descriptive survey design. The study used a purposive sampling technique and a semi-structured interview guide for data collection. Thirty-six visually impaired students from fourteen departments at the University of Lagos participated in the study. Data collected was categorised into themes (nodes) and analysed using NVIVO version 12 application software. The findings revealed that visually impaired persons believe that assistive computer software help them access information as they find them as alternatives to their sight. They also find the assistive computer software useful and easy to use. The study recommends that developers of assistive computer software should make the software affordable and accessible. Educational institutions should also provide a conducive learning environment for students with visual impairment by making facilities and materials in accessible formats. They should also make assistive computer software available.

Keywords: Assistive technology, Computer software, ICTs, Information access, Visual impairment

1. INTRODUCTION

Background to the Study

Information is needed in all human activities as it enhances growth and development (Soman & Sudhier, 2015; Bloom, Canning & Chan, 2014). Users therefore must get access to relevant information on time. According to Pardeshi, Pawar, Kharat, & Chavan (2021), the process of acquiring information about

objects or obstacles ahead and quickly making decisions about how to navigate these obstacles is one of the major problems faced by persons with virtual impairment in their daily lives. Information is an important and irreplaceable resource for the growth and development of many users including persons with special needs.

According to Article 19 of the Universal Declaration of Human Rights (2006), everyone has the right to freedom of expression, the right to seek, receive and share their opinions and ideas. Article 19 states further that appropriate measures should be taken to enable persons with disabilities to live independently and participate fully in all aspects of life. This is an indication of the need to ensure that visually impaired students have access to community services and facilities (including ICTs) provided for the general population on an equal basis with others.

According to Soman & Sudhier (2015), the emergence of ICTs has brought about ample opportunities for persons with special needs to easily access information. This has been made possible through the use of assistive software for users with visual impairments (Senjam, 2020). Years back, before the emergence of information technology, the braille machine was the most common device used by persons with visual impairment.

Recently, more technological devices have been made available through the help of special information technology referred to as assistive technologies. Assistive technologies generally refer to software and hardware devices designed to assist individuals with disabilities (Kumar & Sanaman, 2015). It refers to any product that helps a person with a disability perform a task that would otherwise be difficult or impossible. It includes items, pieces of equipment or products, whether acquired commercially off the shelf, modified, or customized that are used to increase, maintain, or improve the functional capabilities of people with disabilities (IDEA, 2012).

The assistive technologies range from low to high-tech assistive technology. Examples include mobile assistive technology such as handheld devices and smartphones, braille machines, and assistive computer software used on the monitor screen through speech synthesizers such as JAWS screen reader, and Duxbury Braille Translating software. Assistive computer software are products of electronic information developed with the intent of meeting users' information needs (Tramullas, Sánchez-Casabóna, & Garrido-Picazob, 2013). It provides access to a wide range of materials and services online which leads to rapid growth in rich digital content. Diverse assistive technologies for VPIs have been designed and used to overcome various physical, social, infrastructure, and accessibility challenges in the past (Hwang, Kim, Hwang, Sungchan and Lee, 2020).

This study is in two parts: Part A examines the motivations, challenges and expectations of the visually impaired undergraduates at the University of Lagos based on assistive computer software used while Part B investigates factors affecting the use of assistive mobile applications by persons with visual impairments. Persons with visual impairments (PVIs) are people with low vision or total blindness without residual vision (Fulton, 2017). The use of assistive technologies helps PVIs to live independently and participate fully in all aspects of life (Senjam, 2020).

The use of computer software has greatly helped PVIs in different ways such as accessing materials, images and graphics easily which ordinarily they could not have had access to (Adetoro, 2016). Despite the numerous opportunities derived from the use of assistive computer software by PVIs, it is pathetic that this set of users has underutilized this software for information access (Soman & Sudhier, 2015). Despite the technological innovations in the digital age, persons with visual impairments are still faced with challenges in the use of computer software (Ajuwon & Chitiyo, 2016).

This study is therefore designed to identify the motivations, challenges and expectations of PVIs towards the use of assistive computer software. Motivation is defined and captured in this study as hedonic motivation. Hedonic motivation refers to the fun or pleasure derived from using technology and has been shown to play an important role in determining technology acceptance and use (Thong & Hong & Tam, 2006). Challenges refer to the difficulties facing the PVIs in the use of computer software for accessing information, while their expectations pertain to the improvements they hope to see with the use of assistive computer software. This study is limited to users with visual impairment who are undergraduates at the University of Lagos, Akoka, Lagos State, Nigeria. Lagos State is the second most populous state in Nigeria. It is located in the Southwestern part of Nigeria. At the time of this study, the University of Lagos admitted many undergraduates with visual impairments. The University also has a Counselling Centre which attends to some of the needs of the PVIs within the University.

Statement of the Problem

The study by Olaopa (2017) investigates how factors such as information literacy skills and availability of alternative formats affect information resource utilization by visually impaired students in South-Western, Nigeria. Another study by Soman & Sudhier (2015) examines the awareness and usage of internet resources among PVIs in Thiruvananthapuram district, Kerala, India. Zaid (2017) examines the extent to which information provision affects the outcomes of the Braille Project funded by a non-governmental organisation to meet the information needs of the PVIs at the University of Lagos. None of these studies examined the motivations, challenges and expectations of PVIs from the use of assistive computer software, which this study examines.

Okiki and Okonji (2019) focus on the challenges of access to educational resources and the social exclusion of PVIs at higher education institutions in Lagos, Nigeria. Although Okiki and Okonji (2019) examined some types of challenges to accessing educational resources, not the use of assistive computer software. Kiambati (2015) investigates the challenges in accessing electronic information resources by students with visual impairments at Kenyatta University Post Modern Library, Kenya. Ajuwon & Chitiyo (2016), explore the state of the use of assistive technology (AT) in Nigeria through a survey of special educators. Ajuwon & Chitiyo (2016) focus on those with deafness or hearing impairment, and those with a learning disability while this study focuses on people with visual impairment.

Kamaghe, Luhanga & Michael (2020) determined the level of awareness and use of mobile assistive technologies and found that lack of awareness and technology barriers are important challenges faced while adopting mobile learning. The study by Kamaghe, Luhanga & Michael (2020) examines the challenges faced by VPIs when using mobile technology for learning while this study examines the challenges of VPIs in using assistive computer software. Studies by Pardeshi, Pawar, Kharat, Chavan (2021) and Manjari, Verma, & Singal (2020) assess various assistive technologies for VPIs which use advanced image processing techniques for wearable and handheld devices. All the aforementioned studies do not focus on the motivations, challenges and expectations of visually impaired persons towards the use of assistive computer software for information access at the University of Lagos, Nigeria. This study achieves this.

Research Questions

This study provides answers to three research questions:

1. How does hedonic motivation affect the use of assistive computer software for information access by the visually impaired?
2. What are the challenges encountered by visually impaired students when using assistive computer software for accessing information?
3. What are the expectations of the visually impaired students in using assistive computer software for a better experience?

2. LITERATURE REVIEW

Overview of Visually Impaired Users

Visual impairment is used to describe a wide range of conditions which affect clarity of vision and the visual field. Visually impaired persons are people who have a limited range of sight and focus that cannot be easily corrected with spectacles. It also includes people who squint and need special lighting to be able to see, or individuals with blurred, tunnel vision or blindness (Bell, 2013). According to the World Health Organization (2017) report, at least 2.2 billion people across the world have a visual impairment or blindness. Fulton (2017) also emphasized that visual impairment can be quite common, ranging from mild to extreme disabilities. According to Fulton (2017), common visual impairments are classified and estimated as follows:

Colour blindness

Colour blindness involves difficulty in perceiving or distinguishing between colours as well as sensitivity to colour brightness. It affects approximately 4.5% of the entire global population.

Low vision

Low vision can include partial sight in one or both eyes, poor acuity (blurry vision), tunnel vision, central field loss, and clouded vision. It affects 246 million people or about 4% of the world's population.

Blindness

Blindness is the substantial loss of vision in both eyes. It affects 39 million (0.6%) people globally. Regardless of the type of visual impairment a user might be experiencing, using appropriate computer software and hardware, can give the visually impaired user access to a wide range of standard resources. For example, speech synthesizers can read a word-processed file to a blind person without translating it into braille.

Information Access for Persons with Visual Impairment

Access to information is important to everyone in society because it is a good resource for social, economic and political development, as well as for good decision-making (Bloom, Canning & Chan, 2014). It has been established that access to information is one of the important human rights as it enables users to be highly informed and relevant in society (Universal Declaration of Human Rights, 2006). McCreadie & Rice (1999) define information access as having access to knowledge that can affect quality of life and decision-making abilities.

In a study of the relationship between reading interest, information materials availability and alternative format utilisation by persons with visual impairment in selected libraries in South-western Nigeria, Adetoro (2009) revealed that braille and audiobooks are not readily available in the libraries; only braille materials are highly utilised. Consequently, persons with visual impairment may be dependent for life and therefore limited in making decisions that will benefit them from all that society has to offer.

Lack of access to information could lead to social exclusion of PVIs. Moore (2000) stated that humans acquire information using all the senses but sight is the most important. People acquire 80 per cent of information around them through sight (Willetts, 1997). Unlike sighted persons, individuals with visual impairment depend on other senses since they are limited in sight or have no sight. Without sight, it is more difficult for PVIs to access information. However, advancement in technology has brought about ample opportunities for persons with visual impairment, making it easier for them to access information on the internet. They can download electronic books, browse the internet, post on social media and access relevant information in a format that is accessible (Rayini, 2017). Likewise, visually impaired students can access course study notes and handouts on the e-learning platforms without the need for assistance, as long as these ICTs are designed in an accessible format (Zaid, 2017). The use of assistive computer software can facilitate access to timely, accurate, current and reliable information.

Application Software for Persons with Visual Impairment

The electronic information world empowers PVIs to complete tasks independently, which they would normally not be able to accomplish without the help of others (Soman and Sudhier, 2015). Assistive technologies could be in the form of wearable and handheld devices that use advanced image processing techniques to aid the mobility of PVIs. It could also come in the form of computer application software such as screen magnifiers, screen readers, objects and colour identifiers, text-to-speech software, and other software for text messaging, social networking, and accessing and sharing information.

Screen Magnifier

Special screen magnification such as SuperNova Magnifier software can be used to give more control over the screen display and adapt it to meet the individual's needs. The software can also keep track of events on the screen and alert the user. Not all users with visual impairment will use speech to access their website as the majority of users have some sight and will either use a screen magnification program or rely on features built into the browser to enhance the visibility of the website. It is possible to alter the screen display, for example, larger text sizes can be selected or different colours used. For some PVIs, the choice of colour and layout can make an enormous difference in their experience of the page. The screen magnification program makes text and graphics on the webpage bigger. Users can only see part of the screen at a time and move the viewing area around to see everything. The disadvantage in this is that the heading or the label may be on the right while the graphics is on the left and the user may not understand that the two are related.

Braille Technology

Braille machine is the reading and writing system for visually impaired users. It uses raised dots to represent numbers and letters of the alphabet (Britannica, 2022). Braille was introduced in the early 19th century by Louis Braille (Britannica, 2022). Many people see it as the primary medium for information for blind and visually impaired readers. Before the advent of computers, braille machines were used to transcribe print materials using hand frames, styluses, or braille typewriters. Computers and electronic embossing machines came and made it easier to produce braille materials.

With the emergence of technology, it is possible to have virtual braille keyboards and refreshable display braille keyboards for users to be able to operate their devices with ease and without depending on any other. The refreshable display brailed keyboard is a portable keyboard attached to a computer or iPhone. It helps facilitate access to information by visually impaired users and it serves as an alternative to the hardcopy braille machine (Rayini, 2017).

Speech Synthesizer (text-to-speech)

Computers can use a speech synthesizer to read texts, and screen contents thereby giving visually impaired users access. Adding speech support to standard software can give additional help to someone with visual impairment. Software such as *Job Access with Speech (JAWS)*, *@VoiceAloud Reader Nonvisual Desktop Access (NVDA), Digital Accessible Information System (DAISY),* and other text-to-speech software programs make use of speech synthesizers.

Job Access with Speech (JAWS)

JAWS is a computer software program for Microsoft Windows that allows visually impaired users to read the screen either with text-to-speech output or with a refreshable braille display. JAWS is a screen reader that allows all major functions of the Microsoft Windows operating system to be controlled with keyboard shortcuts and spoken feedback. Every aspect of JAWS can be customized by the user, including keystrokes and factors such as reading speed, granularity used when reading punctuation and hints. It also includes a scripting language to automate tasks and make more complex modifications to the program's behaviour.

The software includes a distinct mode specifically designed for web users or browsers activated when Internet Explorer or another browser is in the foreground. Figure 1 shows the screenshot of the user interface of JAWS.

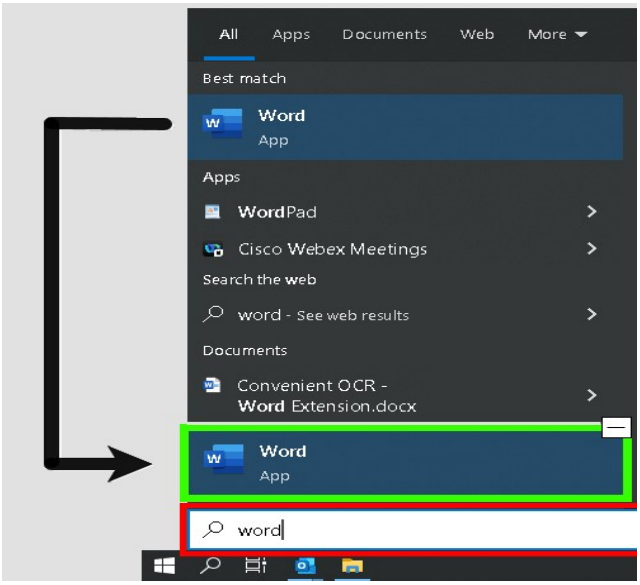

Figure 1:Screenshot of the user interface of JAWS (Job Access with Speech)

@VoiceAloud Reader

It is an application for personal computers for Windows and Mac. It reads aloud the text displayed in an Android application' such as web pages, news, articles, emails, messages, and PDF files. Figure 2 shows the screenshot of the user interface of the @VoiceAloud reader.

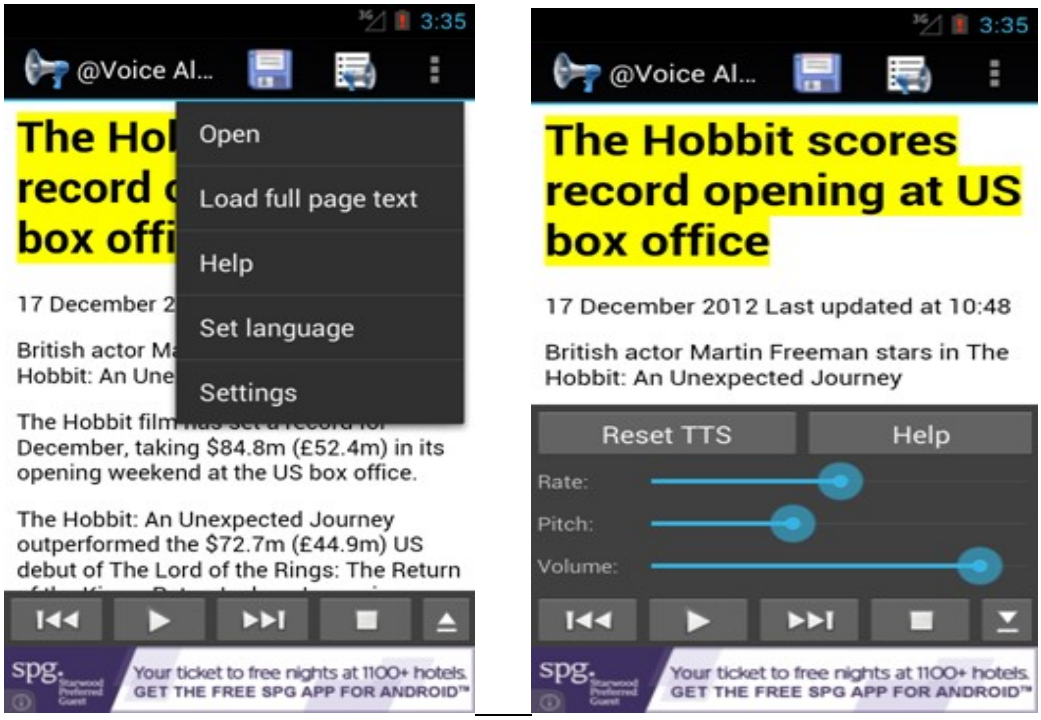

Figure 2: Screenshot of the user interface of the @VoiceAloud reader

Nonvisual Desktop Access (NVDA)

This is an application that enables PVIs to access and interact with the Windows operating system and some other third-party software. NVDA promotes multi-lingual usage and may be used with some other speech synthesizers to give better output. Although NVDA itself has been translated into other languages which are more from the Western world except for Afrikaans spoken by some Africans.

Digital Accessible Information System (DAISY)

This is an audio substitute for print materials used by VPIs and it is based on MP3 and XML formats. It has more features than the traditional audiobook. Many libraries across the world use the standard for talking books. The above software are very useful via computers, although there are applications developed for mobile phones and smartphones; these are discussed in Part B of this study. According to Rubin (2016), the advent of smartphones has led to more complex and dynamic changes in messaging and communication styles.

Empirical Review of Literature

A study on the use of library and information services by PVIs (Rayini, 2017), found that developing an efficient library service for PVIs is crucial because of the limitations in the availability of books in accessible formats. The study investigates the barriers faced by PVIs, their information needs, devices and services that the libraries are expected to provide for them. It was observed that PVIs encounter various challenges in their course to access opportunities on an equal basis with their sighted counterparts. Also, according to Rayini (2017), they suffer negative attitudes from people in society. Olaopa (2017) examined factors affecting information sources utilisation by visually impaired secondary school students in South-western, Nigeria, using a descriptive survey design. The result shows that the information literacy skill of persons with visual impairment has a significant relationship with information resource utilization in the selected libraries. According to Zaid (2017), library websites are inaccessible to PVIs because web developers do not consider their information needs before designing the websites. In line with this study, Adetoro (2016) investigates information access for the visually impaired in the digital age.

The study highlights the positive impacts of the digital revolution on information provision for PVIs. It examined the information access problem, web content accessibility issues, and the provision of online digital collection. Adetoro (2016) found that braille materials, talking books/audio recordings, as well as large prints, were not readily available in the libraries.

A study by Kiambati (2015), examined the challenges in accessing electronic information resources by students with visual impairments in the Kenyatta University postmodern library. The study investigated the technological, institutional and personal factors and their related challenges in accessing e-resources by students with visual impairment. The researcher employed Rogers (1986) experiential learning theory.

The population comprised all 80 students and 5 staff members of Kenyatta University Post Modern Library. The study established that most students with visual impairment depended on other students to read for them, more than half of the students found it difficult to use e-resources and had not received any user education on how to access e-resources, and the staff attending to users with visual impairment had average skills in assistive technology.

A study by Soman & Sudhier (2015) investigated the awareness and usage of internet resources among students with visual impairment in Thiruvananthapuram district, Kerala. A survey was conducted. The results showed that many students are computer literate and are aware of online resources but internet usage is minimal among the computer literates due to the lack of proper training. The study implied that visually impaired students might be computer literate and be aware of the resources, but they had less access to assistive information technology.

3. RESEARCH METHODOLOGY

The study adopts a descriptive survey design. The total enumeration technique was adopted in the selection of the forty-six (46) participants, however, only thirty-six (36) PVIs of the University of Lagos participated in the study. Data was collected using a semi-structured interview schedule.
The interview schedule consists of open-ended questions that allow the respondents to express themselves and share their experiences on the use of assistive computer software for information access.

The interview schedule is segmented into two parts; Section A collects demographic information such as sex, level of study, and department while Section B features semi-structured questions on the motivation, challenges and expectations of visually impaired undergraduates on the use of assistive computer software. A pilot study was conducted using three (3) undergraduate students with visual impairment from the Department of Special Education and Social Sciences, University of Ibadan, Ibadan. The result of the pilot study shows that the interview questions are clear and easy to understand by the respondents. All interviews with the participants were recorded, transcribed into text and analysed with the NVIVO Version 12; a computer application software used to analyse the qualitative data.

4. PRESENTATION OF RESULTS

This section contains the demographic characteristics of the respondents, followed by answers to research questions and a discussion of findings from the data that are categorised into themes (nodes) and analysed using NVIVO Version 12. This session presents Table 1 detailing the demographic characteristics of the respondents. These include sex, level and course of study, department, and faculty of the respondents:

Table 1: Demographic Profile of the Respondents

Variables		Frequency	Percentage (%)
Sex	Male	17	47.2
	Female	19	52.8
	Total	36	100.0
Level of Study	100	1	2.8
	200	22	61.1
	300	7	19.4
	400	5	13.9
	500	1	2.8
	Total	36	100.0
Department	African and Ancient Land Studies	1	2.8
	Arts and Social Sciences	5	13.9
	Early Childhood Education/ Educational Foundation	3	8.4
	Employment Relations and Human Resources Management	1	2.8
	English	1	2.8
	History and Statistics Studies	4	11.1
	Law	8	22.2
	Linguistics	1	2.8
	Mass Communication	3	8.3
	Music	1	2.8
	Philosophy	1	2.8
	Political Science	2	5.6
	Social Works	2	5.6
	Sociology	3	8.3
	Total	36	100.0
Faculty	Arts	8	22.2
	Education	9	25.0
	Law	8	22.2
	Management Science	1	2.8
	Social Science	10	27.8
	Total	36	100.0

Table 1 presents the frequency distribution of the demographic profile of the respondents. Seventeen respondents (47.2%) were males while 19 (52.8%) were females. The 200 level has the highest representation of 22 respondents (61.1%), while the 100 level and 500 level have the lowest representation of one person in each case (2.8%). Eight (22.2%) respondents are from the Department of Law, while one person (2.8%) belonged to African and Ancient Studies. Employment Relations and Human Resources Management, English, Linguistics, Music, and Philosophy departments have one respondent each (2.8%). It is recorded that Faculty of the Social Science has the highest representation of ten persons (27.8%), while Management Science has the lowest representation of one person (2.8%).

Answers to the Research Questions
The research findings provide answers to the three research questions, as follows:

Research Question 1: How does hedonic motivation affect the use of assistive computer software for information access by the visually impaired?
To answer this question, respondents were asked three questions. The first question asked if respondents had fun while using the assistive computer software. The second question asked about their ratings for the levels of pleasantness and enjoyment they had while using the assistive computer software on a scale of 1 to 5. The third question is targeted at knowing the specific things that make the use of assistive computer software pleasant and enjoyable. The majority of responses to the first question are positive as shown in Figure 3, revealing that respondents have been having fun while using the assistive computer software.

Figure 3: Word cloud on having fun using the assistive computer software

To further support the interview responses, respondents were asked to rate their level of pleasantness and enjoyment while using the software on a scale of 1 to 5. For the ratings, 1 means "not pleasant and enjoyable at all" while 5 means "completely pleasant and enjoyable". A total of 23 out of 36 respondents provided answers to this question. The majority of them rated the level of pleasantness and enjoyment as 5 as shown in Table 2; five had the highest frequency count. This implies that most of the respondents who responded to the question (about 87%), found the experiences as very pleasant and enjoyable or completely pleasant and enjoyable.

Table 2: Responses on Level of Pleasantness and Enjoyment (n= 23)

Rating scale	Level of pleasantness and enjoyment	Count	Percentage (%)
Five	Completely pleasant and enjoyable	14	60.86
Four	Very pleasant and enjoyable	6	26.09
Three	Moderately pleasant and enjoyable	3	13.04
Two	Slightly pleasant and enjoyable	0	0
One	Not pleasant and enjoyable at all	0	0
	Missing	13	

For the third question asked in a bid to know the specific things that make using assistive computer software pleasant and enjoyable, respondents were asked a question on the specific things that make the use of assistive computer software pleasant and enjoyable (hedonic motivation). The findings show that the majority of respondents; 25 (69.44%) out of the 36 respondents believe that what makes the computer software pleasant and enjoyable is the ability to read text. The word cloud also corroborates this finding as shown in Figure 4.

According to Figure 4, the theme with the biggest font is the word "Able". This implies that respondents through the use of assistive computer software are 'able', that is, can perform tasks independently without asking sighted persons to assist them. Other outstanding keywords are "read", "access", "helps", "gives", "enjoyable" and "information". The word 'everything" is also outstanding but it is used with other action words like "read", "access" and "information".

Figure 4: Word cloud for what makes using computer software pleasant and enjoyable

Below are the excerpts of the responses provided by some respondents when asked what made the computer software pleasant and enjoyable to them:

> *Yes, it is because of the way it helps me to access the internet and assists me in reading materials in my academics.* (Male, 31yrs, 200 Level, Linguistics Yoruba, African and Ancient Lands Studies Department, Faculty of Arts)

> *Yes, I can just bring out my computer when I'm less busy and I don't wish to read, I can play a cool jamz, and scroll through it by myself without calling anyone for assistance.* (Male, 31yrs, 200 Level, Linguistics Yoruba, African and Ancient Lands Studies Department, Faculty of Arts)

> *Yes, it enables secrecy and gives the confidence to work without any sighted assistance. I can use it at my own convenient time* (Male, 26yrs, 300 Level, English Education, Arts and Social Science Department, Faculty of Education).

To further answer research question 1 on how hedonic motivation affects the use of assistive computer software, respondents were asked which computer software is most pleasant and enjoyable. As shown in Figure 5, the result shows that the theme with the biggest font is "JAWS". This implies that the majority of the respondents found the use of "JAWS" most pleasant and enjoyable.

Figure 5: Word cloud for what computer software is most pleasant and enjoyable

Findings show that the students with visual impairment made use of various kinds of computer software for accessing information such as JAWS, NVDA, @Voice aloud reader, Daisy and Voiceover (Apple laptop). Findings show that JAWS software is used more by students with visual impairment (see Table 3).

Table 3: Responses to Assistive Computer Software that is most Pleasant and Enjoyable

S/N	Nodes	Respondents(N=36)	Frequency
1	Digital Accessible Information System (Daisy)	0	0
2	Job Access with Speech (JAWS)	26	72.22%
3	Nonvisual Desktop Access (NVDA)	1	2.78%
4	Voice over (Apple laptop)	1	2.78%
	Missing	8	

Most of the respondents 26(72.22%) find JAWS software to be the most pleasant and enjoyable, Also, 1(2.78%) of the respondents find NVDA to be the most pleasant and enjoyable and 1(2.78%) respondent find Voice over (Apple laptop) to be most pleasant and enjoyable.

Research Question 2: What are the challenges encountered by visually impaired students when using assistive computer software for accessing information?

Respondents were asked about the challenges they encountered while using the assistive computer software. Most of them shared their experience with the use of assistive computer software. Even though the respondents had good experience with the JAWS, they reported challenges while using the JAWS and other assistive computer software (see Table 4).

Table 4: Challenges Encountered when Using Assistive Computer Software

S/N	Nodes	Respondents (N=36)	Percentage
1	When using the assistive computer software, the software hangs and trips off	32	88.8%
2	Lagging and inability to pronounce native words	30	83.3%
3	Inaccessible to all images and expensive	30	83.3%

Table 4 reveals that 32 (88.8%) out of the 36 respondents indicated that when using the assistive computer software, it hangs and sometimes trips off. A total of 30 (83.3%) out of 36 respondents also experience lagging and inability to pronounce native words while 30 (83.3%) respondents find the software inaccessible to all images and costly at times. As shown in Figure 6, the word "Hangs" has the highest frequency. Findings show that students with visual impairment are faced with challenges like the system hanging as a result of the software not responding, and sometimes, it stops working until it is fixed by persons with full sight. The inability to pronounce some words correctly, especially native words and names, and the inability to access images, pictures and graphics with the software constitute another challenge. Websites with lots of images, pictures and graphics cannot be accessed sometimes.

Figure 6: Word cloud for challenges encountered by respondents while using the assistive computer software

Below are the excerpts of the responses given by some respondents when asked about the challenges they encountered while using the assistive computer software:

> *There are some words JAWS will not pronounce well such as native names. There are some names with* "e"*; it won't pronounce the* "e" *for instance Babatunde, it will just pronounce "Babatund*". *Sometimes the computer also hangs and won't respond.* (Male, 31yrs, 200 Level, Linguistics Yoruba, African and Ancient Lands Studies Department, Faculty of Arts)

> *Most of the time it hangs, it does not describe images and does not pronounce native words well.* (Female, 21yrs, 200 Level, English Education, Art and Social Sciences Department, Faculty of Education)

> *Sometimes it trips off. It does not read some important aspects for instance, when you are reading, it will just skip some parts of the materials you will have to scroll up. It is not easy.* (Female, 24yrs, 200 Level, Mass Communication Department, Faculty of Social Science)

Research question 3: What are the expectations of visually impaired students in using assistive computer software for a better experience?

Respondents were asked about the various improvements they expect from assistive computer software for better experiences. Table 5 shows that most of the respondents desire that the software could read and describe images, support native languages such that it could pronounce native words, and should be able to access all websites. The respondents also expect the assistive computer software to be affordable and accessible to everyone.

Table 5: Expectations of visually impaired students from Assistive Computer software

S/N	Nodes	Respondents(N=36)	Frequency
1	To read images (describe pictures)	12	33.33%
2	To pronounce words accurately (especially native words)	5	13.87%
3	To be able to read text on images	4	11.11%
4	To be accessible by other Apps	3	8.33%
5	To be affordable and accessible to all	5	13.87%
6	To be made free	2	5.56%

The result as shown in Figure 7, there are themes in the word cloud that the VPIs would want to be incorporated into the assistive computer software for a better experience. The word "Images" has the biggest font in Figure 7; this shows that it has the highest frequency in the word count. The majority of the respondents desired that assistive computer software should be improved such that images, pictures and graphics can be easily accessed.

Figure 7: Word cloud for the expectations of visually impaired students on assistive computer software for better experience

Below are the excerpts of the responses provided by some respondents when asked 'what improvements they would want to be incorporated into the computer software':

> *I want it to be able to describe pictures without the use of another app* (Male, 26years, 200 Level, Social Works Department, Faculty of Social Science)

> *The improvement I want is that the price of the JAWS should be affordable for people to purchase both the poor and the rich.* (Female, 21yrs, 200 Level, English Education, Art and Social Sciences Department, Faculty of Education)

> *Sometimes it hangs when you have pressed the keys for too long. There should be an improvement in the pronunciation of words too, the way it pronounces some native names, is confusing, and you may get the wrong spelling.* (Male, 25yrs, 300 Level, Guidance and Counselling, Educational Foundation Department, Faculty of Education)

5. DISCUSSION OF FINDINGS

Findings show that hedonic motivation affects the decision of visually impaired students on the use of assistive computer software. In line with this, Soman & Sudhier (2015) suggested that virtually impaired students should be motivated through awareness programmes on how assistive technologies can help them access the internet and other electronic resources. Findings showed that the visually impaired students were faced with challenges like system hanging as a result of the software not responding. Sometimes it stops working and requires only the sighted to fix it. Some websites could not be accessed by the assistive computer software due to a large number of images. Once the assistive application gets to those sites, it stops working. This finding is in line with studies of Zaid (2017); and Kiambati (2015) which reveal that persons with visual impairment have challenges with online information services.

Zaid (2017) stated that some websites are inaccessible because most web developers do not consider the information needs of persons with visual impairment in their designs. This is also supported by Adetoro (2016) who stated that PVIs usually have difficulties with pages having images and other non-textual elements (such as scripts, applets, and plug-ins) especially if the images appear without alternative texts, and are used as links.

This study shows that PVIs have some expectations such as the assistive computer software being able to support native languages, having the capacity to read and describe images, with accessibility to all websites. This is in line with the observation of Okiki and Okonji (2019) which states that persons with visual impairment would want to see improvements in the existing software and that new software should be developed based on the needs of persons with visual impairment.

6. CONCLUSION

Technological advancement and innovations have significantly improved the way the visually impaired access information; as they can now access information easily just like their sighted counterparts with the use of assistive computer software. This has helped them to communicate freely and to live an independent life; without inconveniencing anyone around them. Consequently, this study concludes that the use of computer software by students with visual impairment is based on the fact that it has bridged the gap of sightedness to an extent for the visually impaired. It has not fully replaced their sight in the sense that there are some features which they would want to be incorporated into the existing assistive computer software. This study suggests that assistive computer software should be designed to support native languages, they should be able to read and describe images and access all websites.

7. RECOMMENDATIONS

This study recommends that:

1. Developers of special software should consider the needs of VPIs in their design.
2. Web developers and online information service providers should always consider the needs of PVIs as it is not only the sighted persons that should have access to resources via the Internet. They should make provisions for features that will help the VPIs use online resources more effectively.
3. The government should provide support for Centres that take care of the needs of visually impaired persons within educational institutions, by providing computers and relevant assistive technologies.

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