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ICT accessibility and usability to support learning of visually-impaired students in Tanzania

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ABSTRACT

The main objective of this study was to assess the accessibility and usability of Information and Communication Technology facilities to facilitate learning among visually-impaired students at the University of Dar es Salaam (UDSM). The study employed a mixed methods design in gathering, processing and analysing quantitative and qualitative data. A survey was conducted at the UDSM main campus and the Dar es Salaam University College of Education (DUCE). A total of 36 respondents took part in the survey. The study found that ICTs support innovative learning, encourage independent learning, and promote participatory and collaborative learning. On the other hand, the units surveyed at the UDSM faced challenges such as insufficient special ICTs to cater for the needs of visually-impaired students, inadequate training on the use of special ICTs, and a shortage of ICT experts. There is also a necessity for the visually-impaired students' education needs and wants to be met to engender effective learning.

Keywords: *ICT access; ICT utilisation; learning; visually-impaired students, Tanzania*

1. INTRODUCTION

The rapid development coupled with widespread adoption of technology has fundamentally changed almost every aspect of life. For example, in education, Information and Communication Technologies (ICTs) have changed the way of accessing and utilising learning, teaching and research resources. Despite the availability of a growing number of technology-enhanced and sophisticated assistive devices that provide alternative formats to support the learning of visually-impaired students, there are numerous challenges in when it comes to accessing and using ICTs tools at the University of Dar es Salaam. For example, limited availability of specialised disabled-friendly hardware and software resources, limited flexibility in training options for students with disability, attitude barriers towards people with disability, lack of appropriate disabled-friendly policies and their implementation strategies (see Wyclife & Nyambura; Ndijuye, 2009; Ndumbaro, 2009). In other words, the accessibility and usability of ICTs for the visually-impaired students in supporting learning continue to present a daunting challenge in Tanzania. Gronlund et al. (2010) confirms that access to special materials for education of disabled students also appears to be insufficient. This in turn may affect the accessing and using of information also education performance of visually-impaired students. To date, little is known on the extent to which ICT is accessed and utilized to support learning among visual-impaired students in Tanzania. It is against this backdrop that this study examined the extent of accessibility to and usability of ICTs to support the learning of the visually-impaired at the University Dar es Salaam in Tanzania and how they could be improved. Specifically was to examine the types of the required ICTs available for the visually-impaired students; establish the extent to which ICT supports learning among the visually-impaired students; and explore the limiting factors for the accessibility and usability of ICT among visually- impaired students.

2. RELATED WORKS

2.1 Assistive ICTs and learning

Information Communication Technology (ICT) has now been recognised as the driving force and primary gadget for almost all progressive knowledge-based and skills-oriented development activities and initiatives in all spheres of human endeavour (Belay, 2005). Consequently, many people recognise ICTs as catalysts for change such as change in working conditions, handling and exchanging of information, teaching methods, learning approaches, scientific research, and in accessing information (Mikre, 2011). Just like other segments of the population, visually-impaired people have the right to expect the same standard of education. Indeed, they also have the right to access and use mainstream educational tools, including ICT-based which are tools for fostering education (Hitcock & Stahl, 2003). In this regard, Olukotun (2004: 49] opines:

> *Technology has impacted positively on the lives of persons with disabilities with regard to information use, education and lifelong learning. It would not only expand the world of the visually impaired students, it can serve as a great equalizer*.

Onukotun's statement reveals that technologies do not only enhance access to information but also promote education and lifelong learning. Additionally, technology is a tool for fostering equality as technology provides assistive, adaptive and rehabilitative devices for people with disabilities through proper selecting, locating and using of these tools depending on their disability (Belay, 2005). In fact, assistive technology has been used by blind and partially-sighted people to help increase the independence and boost their social inclusion when it comes to education access. For example, Lucky and Achebe (2012) list the most important ICT facilities that are beneficial in learning for the visually-impaired as the Kurzwell Reading Machine, Computer, Video conferencing, the Internet and the World Wide Web (WWW). Also, the application of different AT devices such as Screen reader, Braille translation software, Braille writing equipment, Closed-Circuit Television (CCTV), Braille embosser and Scanners for visually-impaired students are important to support learning. The Australian National Training Authority [ANTA] (2003), Gronlund et al. (2010) and Borg (2011) support the view that assistive technologies are powerful tools for fostering the learning of the visually-impaired students worldwide through simplified access and retrieval information, contacting friends and sharing of information as sighted people do. ICT plays a crucial role in fostering the inclusion of the visually-impaired especially in learning activities. In fact, ICTs do help decrease and may cut off the sense of discrimination and open access to knowledge in extraordinary ways. Generally, ICT is being used as a tool for improving the quality of life by improving efficiency and enhancing effectiveness in different socio-economic sphere including in learning.

2.2 Challenges to utilising ICTs among visually-impaired students

Students with disabilities may, in fact, face relevant difficulties in terms of both "accessing and in using" electronic learning tools and, depending on the type of impairment, the obstacles encountered may vary considerably. This setback arises because many of the different learning education institutions cannot boast of sufficient professional and devices capable of tapping into the potentials of the students with visual impairments (Burzagli et al., 2004; Anderson, 2006). Moreover, they lack awareness on the use of information technology devices in many of the high education institutions for visually-impairment students (Luck and Achebe, 2012) despite there being various devices designed electronically to meet the needs of such users. Generally, blind and low vision students, for instance, despite both sets simply being referred to as "visually impaired", present very different visual problems, find different obstacles and ask for different kinds of help and support (Bacconni et al., 2007). Many of these problems result from the obstacles behind the effective use of the tools and may also have a negative influence on the overall learning process. Accordingly, Wyclife and Nyambura (n.d) list down other limitations such as lack of specialised disabled friendly teacher training, limited flexibility in training options for students with disabilities, limited availability of specialised disabled friendly hardware and software resources due to financial business, lack of formal involvement of governmental organisations and ICT support structure for the disabled, attitude barriers towards people with disability, lack of appropriate disabled friendly policies and their implementation, and lack of an independent ministry for people with disabilities. Evidently, Gronlund et al. (2010) conducted a study in two developing countries of Tanzania and Bangladesh. The study's aim was to answer the question of how can assistive technology effectively be used to promote inclusive education in developing countries. The study findings show that Tanzania did not have specific policy on inclusive education. Accordingly, the study found that inclusive education is mentioned in some of the policy documents such as disability policy and education and training policy but these policies do not state how inclusive education should be implemented, let alone monitored and evaluated. The study also found that teaching and learning materials for students with special needs were lacking.

3. STUDY DESIGN AND METHODS

3.1 Research design

This study employed a mixed research design as the framework for collecting, processing and analysing data. Whereas the quantitative data was collected using survey design, the qualitative data used exploratory design such as interviews. Both quantitative and qualitative research methods were applied not only because of the nature of the study but also because the generalisability of findings can be increased and more insights can be generated than when only a single approach is applied. The use of a mixed methods design and approach increases the credibility and reliability of the data collected from research sites.

3.2 Study area and population

The study was conducted at the University of Dar es Salaam (UDSM)'s Main Campus and its constituent college of education, DUCE. The UDSM was chosen because of its established history of serving the visually-impaired students in education issues under the Special Education Units for disable students, who include the visually-impaired. The unit offers the virtually-impaired ICTs facilities and other assistive technologies as part of institutional efforts to support learning. Also, it supports the visually-impaired students to acquire ICT knowledge inside and outside the University to be familiarised with appropriate and relevant technology. The target population in this study was the visually-impaired students, readers and transcribers. Indeed, the university students with visual problems (i.e. low vision and totally blind) were the key respondents of the study. This was to gain deeper insights on the accessibility and usage of the assistive ICT facilities in learning. Transcribers were special workers trained to assist the visually-impaired students with education matters. Accordingly, the readers are responsible for reading and providing educational assistance to the visually-impaired students.

3.3 Sample size and sampling procedures

Purposive sampling was used to select a sample of four key informants on the basis of their knowledge on serving visually impaired students. The selected key informants are working in special unit and responsible to assist the visually-impaired students in accessing and using the assistive ICT facilities. Accordingly, snowball sampling was used to select university students with visual impairments and readers because it was not easy to find them in the same location (see Table 1).

Table 1: *Distribution of the sample size*

Respondents	**Population**	**UDSM - Main campus**	**DUCE**	**Sample Technique**
Visually impaired students	21	17	4	Snowball
Transcribers	5	3	2	Purposive
Readers	14	10	4	Snowball
Total Population	**40**	**30**	**10**	Mixed

On the whole, 36 (90%) of the sampled respondents participated in the study while only (10%) of the sampled respondents failed to do so because of difficulties tracing them at the time they were available. In other words, for the projected sample, the return rate was high and adequate.

3.4 Data collection methods and instruments

In this study, primary data were collected through the use of different methods and instruments such as questionnaire, interviews and participant observations. The instruments used were designed by the researchers. In all, 36 questionnaires with both open and closed-ended questions were administered with the respondents-the visually-impaired students and readers from the UDSM Main Campus and DUCE. To increase validity and credibility the questionnaire guide was pre-tested to ten visually-impairment students. In this study, interviews were conducted with four transcribers. Through observation method, the researcher was able to observe the available, accessed and utilised ICT facilities for visually-impaired students to support their learning activities. The information generated helped to support or collaborate the data collected using the questionnaire and interviews.

3.5 Data processing and analysis

Data were collected, organised, coded and analysed using both qualitative and quantitative methods. Statistical Package for Social Sciences (SPSS version 16) was used to analyse quantitative data to generate percentages and frequencies. Content analysis was used to analyse qualitative data to provide classifications, descriptions and narrations.

4. RESULTS AND DISCUSSIONS

4.1 Demographic Characteristics of the Respondents

This part provides demographic characteristics of the respondents who participated in the study. The personal particulars of the respondents they were required to provide were category of respondents, sex, age, degree programme and year of study as summarized in Table 2.

On the whole, noticeable percent of visually-impaired students and readers participated in the study. Among them, the majority (78.9%) of the respondents were male. This might be attributed to different factors such as marginalisation of females with visual impairments, attitudes, beliefs and traditional beliefs that prompt some families to emphasise educating sons rather than daughters. Despite the existence of the Education and Training Policy of 1995 that emphasise the gender equality in education enrolment for people with disability, the majority of them are unable to access the education in different levels. Therefore, failure to facilitate the education of girls with disabilities deprives them of their right to education.

Table 2: *Demographic characteristics*

Category of respondents		Frequency	Percent
	Visually-Impaired students	19	59.4
	Readers	13	40.6
Gender	Female	7	21.9
	Male	25	78.1
Age	21 – 30	27	73.6
	31 – 40	5	26.3
Education level	Bachelor	27	84.3
	Masters	5	15.6
Study Year	1st Year	5	15.6
	2nd Year	18	56.3
	3rd Year	9	28.1
Programme study	BA with education (Social science)	17	53.1
	BA with education (Humanities)	12	37.5
	BA with education (Business)	3	9.4

Regarding age, the findings show that the majority (73.6%) of the respondents were aged between 21 and 30. This implies that the bulk of the respondents were youth enrolled at the university level of education. Further, the findings suggest that the highest percentage (84.3%) of the respondents pursuing a bachelor's degree in education. This might be because of the enrolment rate of undergraduate students and scholarship provision for undergraduate students is high. Accordingly most of undergraduate students were benefiting from the Higher Education Student's Loan Board (HESLB) and scholarships provided in the country. The HESLB statistics confirmed that in the 2013/2014 academic year 98,371 students benefited from the HESLB loan scheme. These loans enabled a large number of undergraduate students to enrol at the UDSM in 2013/2014. On the other hand, the tuition fees for the master's programmes are higher and there are few scholarships available and limited opportunities for loans. In fact, an increase of tuition fee has a negative impact in the enrolment for master's degree at the UDSM. Accordingly, the results indicate that the larger percentage (53.3%) of the respondents were in the second year of study at the University. This implies that during the 2012/2013 academic year, notable number of visually-impaired students got an opportunity to join different programmes at the UDSM.

Mistreatments and lack of opportunities to attend higher education level after attending lower levels may be the reason of dropping number in Universities**.** In this regard, Trucano (2005) found that the contributory factors to low enrolment rate of visually-impaired students could be affected by the issue of costs associated with supporting programmes with assistive technology. Consequently, the cost element can lower the number of students with visually-impaired joining the university.

4.2 Kinds of ICT Accessed and Used at the UDSM

The respondents were also asked about the kinds of ICT facilities accessed to support learning among the visually-impaired students at the UDSM. The findings show that 30 (83.3%) of respondents said tape-recorders were easily accessed and used, 29 (80.5%) indicated computers, 25 (69.4%) named the Perkins Braille, 14 (38.8%) cited the Closed Circuit TV system and scanner, 12(33.3%) mentioned the Braille embosser, 11(30.5%) the note-taker, nine (25%) special software, seven (19.4%) the PAC Mate and talking dictionary, five (13.8%) internet-connected computer and 3(8.3%) mentioned the talking watch as Table 3 illustrates:

Table 3*: ICT Facilities accessed and used at the UDSM*

Types of ICTs	Frequency	Percent
Tape recorder	30	83.3
Computers	29	80.5
Perkins Braille	25	69.4
Closed Circuit TV	14	38.8
Scanner	14	38.8
Braille Embosser	12	33.3
Note Taker	11	30.5
Special software	9	25
Pack-Mate	7	19.4
Talking Dictionary	7	19.4
Internet	5	13.8
Talking Watch	3	8.3
Typewriter	2	5.6
Radio	2	5.6

Results reveal that the tape recorder and computers were frequently accessed and used by most of the visually-impaired students at the surveyed units at the UDSM Main Campus and DUCE, its constituent college. Also, a notable minority of the respondents indicated that the Closed Circuit TV and scanner were also accessed. Other facilities mentioned to be accessed to support learning among visually impaired students were the Braille embosser and the note-taker. Accordingly, other visual impaired students cited special software such as NVDA and JAWs. This implies that the frequency of accessing ICTs facilities depends on the availability and the functionality of such facilities when it comes to supporting learning for the students with such special needs. In this regard, the findings of the study are in line with the conceptual framework on information seeking behaviour that shows that students with visual impairments make use of ICTs and other information systems available in their environment before looking for other alternative sources. The facilities frequently accessed were also those which are tailored to meeting the needs of the visually-impaired students in terms of content provided for a specific period. Independently through observation, the researchers were able to confirm the availability at the University's Special Education Units of the ICTs facilities the respondents mentioned. In fact, the available special ICT facilities for visually-impaired students at the University Special Education Unit were based on the nature and specific needs of the users. They had specific features and functionality. The findings signify that the administrative or University of Dar es Salaam Management recognise the role ICTs play in supporting the learning process of the visually-impaired students. ICT facilities allow visually-impaired students to gain from the learning process through seeking and accessing information and other learning materials.

4.3 Other Places of Accessing to ICT facilities

The visually-impaired students were also asked to indicate where they accessed ICTs which were not available at the Special Education Unit of the UDSM Main Campus and DUCE, its constituent college. The results show that nine (47.4%) of the visually-impaired students use the library computers, seven (36.8%) use the internet café, and three (15.8%) have their own computers at home as summarized in Figure 1.

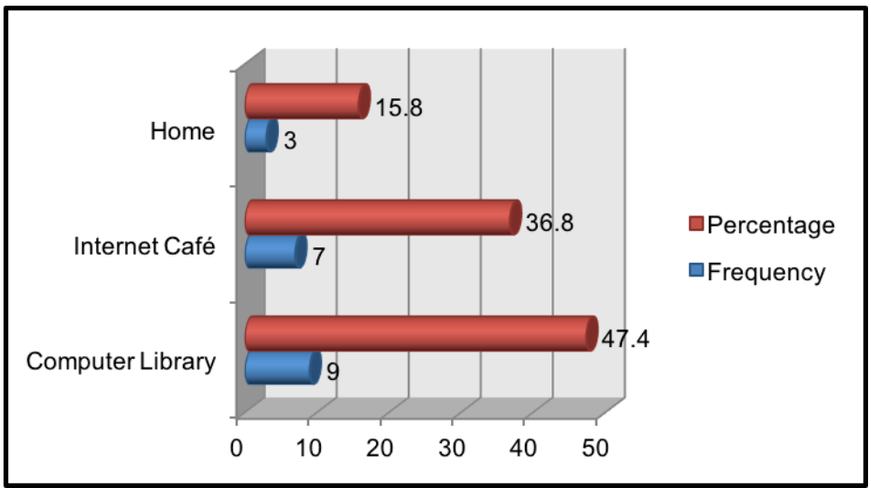

***Figure 1**: Other Places of Accessing ICT facilities*

In general, the findings suggest that the majority (84.2%) of the visually-impaired have access to the computer in other places such as in the library and the internet café. Also, the findings indicate that very few (15.8%) of the respondents had an opportunity of accessing the computer at home. This implies that, some students were able to lower some learning barriers even when at home. The conceptual framework on information seeking behaviour stipulates that when assistive special ICT resources are not accessible within the university environment, resources in the external environment such the internet cafe and residences can provide alternatives for accessing ICTs that support learning. In this regard, Burgstahler (2003) point out areas in which visually-impaired students need assistance when using computers. These include assistance in providing computer input, interpreting output and reading supporting document. In fact, readers and relatives have to assist them with using computer technology for reading and writing documents, searching for information from the internet and communicating with others.

Despite the assistance provided by readers and relatives in other places when it comes to accessing ICTs in places such as the library and the internet café, the ICTs available are inadequate to cater for the specific needs and the number of students with visual impairments at the UDSM. Luambano (2004) equally support this view by pointing out that internet-connected computers available at the UDSM were inadequate that the ratio of facilities (computer and internet) and students was disproportional. This implies that the students' level of access to such computers for accessing information was unsatisfactory. The cost of ICTs facilities such as

laptops and other assistive technologies required to enable visually-impaired students' effective learning are too expensive for many students from poor backgrounds without gainful employment to afford them. Although the university provides wireless internet services freely, without computer devices students' level of access generally remains unsatisfactory. Borg (2011) attributes this lack with the import duties and taxes on the costs of ICT required by visually-impaired. Furthermore, poor access to ICTs facilities could hamper the optimal learning of the visually-impaired students, hence deprive them of an opportunity of realising their full potential.

4.4 Frequency of using ICT facilities

The respondents were asked to indicate how often the visually-impaired students made use of the ICT facilities available to enhance the quality of their learning experience. The results show that eight (42.1%) of the responding visually-impaired students used ICTs very often, six (31.5%) used them often and five (26.3%) only sometimes as shown in Figure 2.

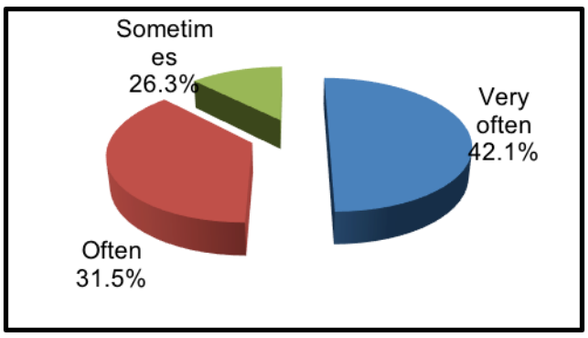

***Figure 2**: Frequencies of using ICT Facilities*

The findings in Figure 2 indicate that the majority (73.6%) of the visually-impaired students used the ICTs facilities frequently. This implies that the visually-impaired students do use the ICT facilities in learning. This uptake might be attributed to the potential contribution of ICTs to enhancing the learning process of the visually-impaired students. In terms of gender, the Pearson Chi-square test entails that there is an insignificant difference ($x^2 = 1.068$, df = 2, p value = .586) in the frequency of use of ICT facilities between male and female visually-impaired students at the UDSM. Also, the findings suggest that very few (26.3%) of the respondents were not using special ICT facilities frequently. In fact, depending on the narration of and discussion with the readers, lack or limited use sometimes resulted from the negative attitudes towards the use of ICTs facilities designed to facilities designed from the learners with special needs. Another problem they cited was lack of skills and knowledge of operating and using special ICTs to enable effective learning. In this regard, Bocconni et al. (2007) contend that the problems encountered by the visually-impaired students in accessing and using e-learning materials tend to undermine effective and frequent use of the technological tools in enhancing learning and might also have a negative influence on the overall learning process.

4.5 Preferred ICT in supporting learning

With regard to how ICTs used to support learning for the visually-impaired students, the respondents were asked to indicate how ICTs enhance the learning environment of the visually-impaired students at the UDSM. Responding, 28 (77.8%) of the respondents mentioned computers, 27 (75%) the Braille embosser, 25 (69.4%) the tape-recorder, 22 (61.1%) special software, 20 (55.6%) the note-taker, 18(50%) internet-connected computers, 12 (33.3%) a talking dictionary, nine (25%) the Closed Circuit TV system, seven (19.4%) the Perkins Braille, six (16.7%) the magnifier lenses, four (11.1%) the talking watch and three (8.3%) mentioned the PAC Mate as Table 4 illustrates.

***Table 4**: Preferred ICTs in supporting learning*

Preferred ICTs	Frequency	Percent
Computers	28	77.8
Braille embosser	27	75
Tape-recorder	25	69.4
Special software	22	61.1
Note-taker	20	55.6
Internet	18	50
Talking dictionary	12	33.3
Closed Circuit TV system	9	25
Perkins Braille	7	19.4

Magnifier lenses	6	16.7
Talking watch	4	11.1
PAC Mate	3	8.3

The findings reveal that, the most required ICTs facilities include hardware and software that matches the user needs and preferences of the visually-impaired students to facilitate their learning and allow them to participate effectively in an inclusive learning environment. Also, they prefer most the ICTs which are portable and those that have multiple functions. The following is the detailed discussions on ICTs used to support learning environment among the visually-impaired students.

4.5.1 Computer

The findings indicate that most (77.8%) of visually-impaired students require computers to support learning. The desired attributes were reported to be its multiple functions, for example writing, reading, listening and serving. Also, by using different software and programmes supporting recording and listening to audio-visual lecture notes, e-books and other contents accessible in PDF and HTML formats. Furthermore, they can use of alternatives to the visual display such as screen readers like JAWs, NVDA and Windows Eyes programmes, using software including MS Word and Open Office Writer during learning activities. BECTA (2001) support the findings that computer operating systems and common word processing applications usually have a range of accessibility options. These adjustments are important for the visually-impaired students' learning process, thus providing them with higher contrast and can enlarge icons, display fonts and mouse cursors can be enlarged.

4.5.2 Braille

Braille was also one of the most the required ICT facilities to support the learning process of the visually-impaired students. This was identified by 75 percent of the respondents primarily because the Braille is efficient and effective medium for visually-impaired students to read and write independently and interactively. With the use of the Braille embosser, the visually-impaired students can benefit much as they can print out Braille using an embosser (see also 19). Indeed, the Braille is highly required in learning as it saves time in producing lecture notes and paper exams for the visually-impaired students as it simplifies the work which can be tedious when using the Perkins Braille and Slate and Stylus.

4.5.3 Tape-Recorder and Note-Taker

The findings suggest that the majority (69.4%) of respondents identified the tape-recorder and others (55.6%) identified note-takers as required facilities in supporting the learning of the visually-impaired students. Tape-recorders and note-takers enhance the learning process among visually-impaired students as they used them for recording and listening to lecture notes. In the same line, Malburg (2012) found that these devices support recording lecture notes, class discussions and visual presentations. Also, they offer detail descriptions to the visually-impaired students for making copies and listening to them again. Other favoured attributes include the computer's portability for the students to hold it without worrying about its bulkiness and be able to listen to lesson notes anywhere where they were.

4.5.4 Special Software

The findings indicate that 61.1 percent of the respondents indicated that they preferred special computer software such as JAWS and NVDA. Such assistive computer and software reduce problems of accessing learning materials among those with vision impairment. These findings validate the observation made by Cullen et al. (2012) to the effect that the Dolphin Guide software significantly increased the visually-impaired person's versatility and assurance in using certain computer technology functions. In fact, the special software was considered as alternatives to the visual displays. Accordingly, BECTA (2001) supports the view that software such as JAWS, NVDA and Window Eyes are important for the visually-impaired students as they provide screen reader alternatives which speak out the text and display on the screen the text and provide a refreshable Braille display which translate text into Braille. Additionally, they are measured as an assistive technology that creates new room for learning for students by allowing the voice to be heard that otherwise could not be heard.

4.5.5 Internet

The internet was also considered by 50 percent of the respondents as the most required, as it facilitated learning among the visually-impaired students. Indeed, the internet provides a wide range of learning because of its multiple-functional online environment and the resources it provides. In this regard, UNESCO (2012) asserts that the use of the internet's cloud-based solutions such as content and applications includes assistive technologies and, in fact, the internet presents the possibility of overcoming issues of affordability and availability. Moreover,

the internet provides other alternatives for visually-impaired students when it comes to accessing different relevant formats that support learning activities. On the whole, website and web applications have proven to help improve the visually-impaired students' access to a wide range of learning materials. Indeed, ICTs facilities for the visually-impaired students support communication, improve access to educational materials in addition to serving as curriculum tools for development concepts of subject areas and means of production of learning materials in alternative formats (BECTA, 2001).

4.6 Effectiveness of ICTs in supporting learning

The visually-impaired students were also asked about the effectiveness of ICT facilities in supporting their learning activities. The findings show that 15 (78.9%) of the visually impaired students agreed that ICT facilities were effective in supporting their learning, two (10.5%) indicated very effective but another two (10.5%) said they were ineffective as Figure 3 illustrates.

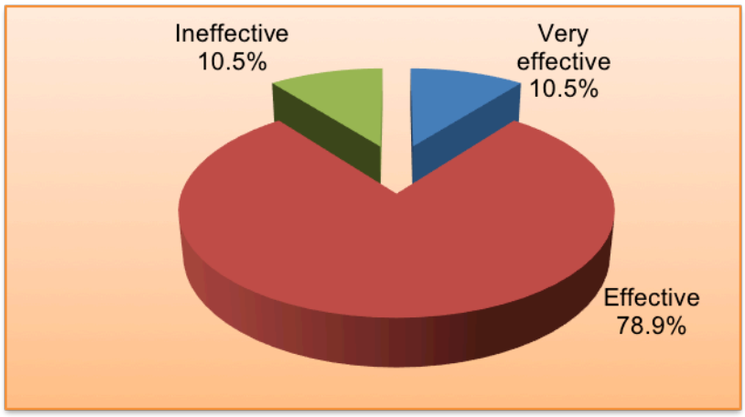

***Figure 3**: Effectiveness of the ICT facilities*

The academic achievement of students with visual impairments measured through independently, participatory and collaborative learning. In this context, the findings reveal that the majority (78.9%) of the visually-impaired students agreed that ICTs facilities were effective in supporting the learning process. One could argue that ICT facilities are key ingredients in the effective learning of the visually-impaired students as they facilitate and foster active learning. Consequently, ICTs tend to unlock the hidden potential for learning difficulties and improves students' independent learning in addition to helping them accomplish their tasks alone and in their own place. In the same vein, Ong'eta and Nyambura (2013) found that the presence of multiple alternative media such as audio tapes, Braille outputs electronic texts, tactile drawings and aural descriptions enable greater learning autonomy. Indeed, ICTs enable the visually-impaired learners to access the learning materials alongside the sighted people, hence gain confidence and increase learning aptitude. During an interview one of the respondents said:

> *ICTs device enhance learning through accessing learning materials in different formats; they enable collaborative work between students and educators and also enhance quality learning processes.*

Indeed, visually-impaired students can gain access to many learning materials through special assistive technology that allow them to take notes, read and answer examination questions. Freedman (2011) asserts that ICT places all the learners on an equal footing. In this regard, another student confirmed during an interview:

> *If we are provided with the right hardware, software and curriculum activities, even severely visually-impaired students including the blind and low sighted students can achieve the same degree of success as anyone else.*

This argument reveals that ICTs simplify the learning process by transforming notes into a form that the visually-impaired students can read, restore sound from lecture room notes and save a lot of time in the process. Indeed, an effective and sustainable access to appropriate and special ICT resources can lead to effective use of education information, hence generate satisfaction by both the learners and the educators and foster sharing of knowledge with fellow students in addition to helping them to accomplish academic tasks. The following section presents analyses and discusses the factors constraining the access to and use of ICTs.

4.7 Potentials of ICTs to support learning

The respondents were also asked to indicate how the ICT facilities were used to facilitate the learning of the visually-impaired students. The data show that 17 (47.2%) of the respondents agreed that ICTs enabled independent learning, 16 (44.4%) indicated that they facilitated taking lecture notes, 15 (41.7%) said they provided a wide range of learning materials, 13 (36.1%) said they enabled serving lecture notes, nine (25%) said they helped to accomplish assignments and examinations, seven (19.4%) said they helped to save time as shown in Figure 4.

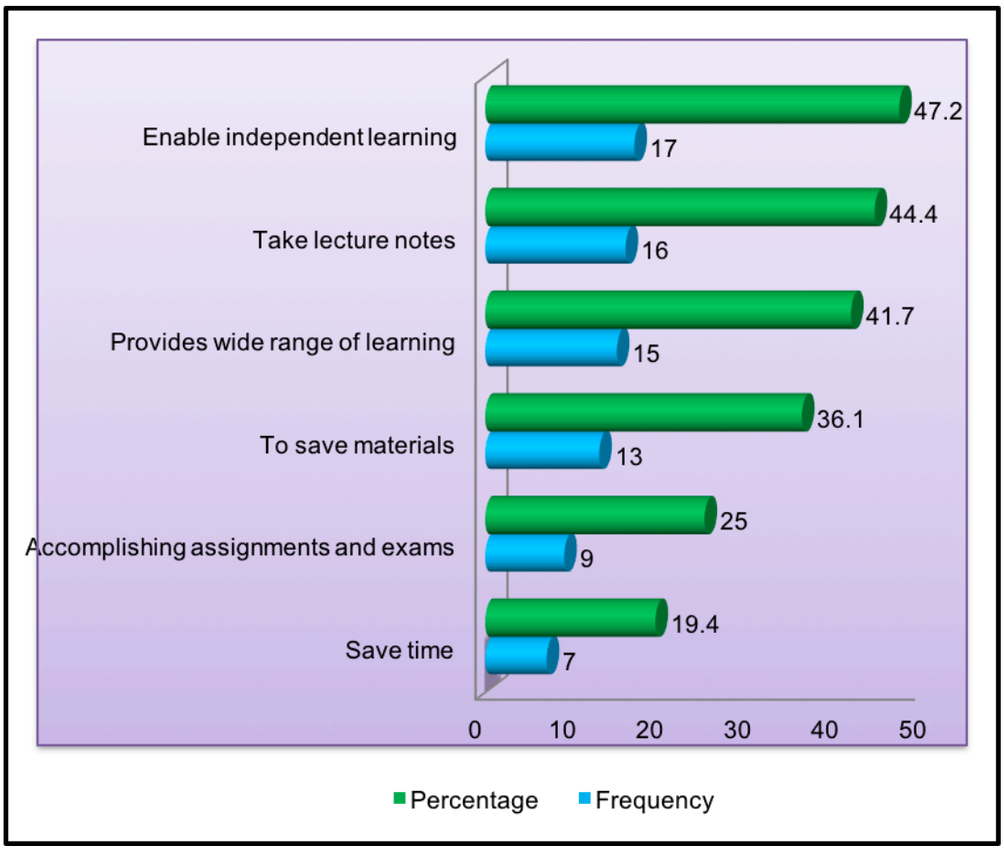

***Figure 4**: Use ICT facilities to facilitate learning*

The findings presented in Figure 4 suggest that the application of ICTs in education enhances the learning process. For example, 47.2 percent of respondents pointed out those ICTs enhanced independent learning among the visually-impaired students. The findings further suggest that ICTs facilities support lecture note-taking, provide a wide range of learning materials, and tools for serving different learning materials in different formats. Indeed, ICTs allow for flexibility in learning and, hence, accommodating the educational needs of the visually-impaired students to encourage independent learning, creativity, and exploratory inquiry-based learning. Selinger (2008) affirms that the use of ICTs can provide access to learning in new ways which for many were previously inaccessible. Also, the use of ICTs can facilitate communication between educators and learners and increase access to information. Generally, ICTs contribute to increasing the students' level of access and learning success by allowing them to access new ways of learning hitherto unavailable.

4.8 Satisfaction on accessed ICT facilities

The statistical outputs show that 11 (57.8%) of the visually-impaired students were not satisfied with the ICTs available, seven (37.8%) were satisfied with them, and only one (5.2%) was very satisfied with the technological learning tools as Figure 5 illustrates.

The findings suggest that the majority (58%) of visually-impaired students were not satisfied with the ICT facilities available at the UDSM. This implies that the facilities were too inadequate to enhance the effective learning of the visually-impaired students. Although the university has made efforts to provide special ICT facilities to the visually-impaired students, the facilities remain too inadequate to satisfy the needs of the visually-impaired students. Wilson (1981) explains that satisfying that need demands upon formal or informal information sources or services. The need may be satisfied if the required ICT facilities are available in required quantity and quality in their learning environments. Conversely, if they are few the visually-impaired students will remain unsatisfied.

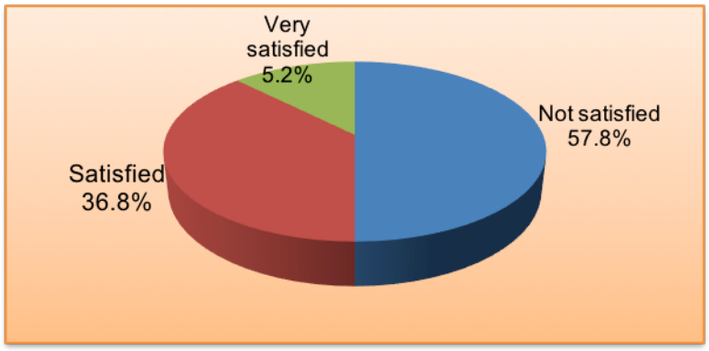

***Figure 5**: Satisfaction on accessed ICTs*

These study findings are consistent with Wilson's model that suggests that a large percentage of the users were not satisfied while noticeable percentage was satisfied. These findings concur with Wildeman and Nomdo's (2007) postulation that ICTs inadequately address the specific learning needs of visually-impaired students, hence condemning them to an optimal disadvantage. The possible influencing factors might be the attitude, lack of serious consideration of the visually-impaired students' special needs in education access and inclusive education provision, lack of formal involvement of different education stakeholders and the visually-impaired students in preparing the University's plan, budgeting and policies.

4.9 Challenges constraining access to and use of ICTs by the visually-impaired

The respondents were also asked to indicate the challenges the visually-impaired students faced when accessing and using ICT facilities in learning. The data collected show that 28 (77.7%) of the respondents stated inadequate ICT facilities, 20 (55.5%) lack of effective ICTs training provision, six (16.6%) power cut off, four (11.1%) outdated ICT facilities, three (8.3%) indicated shortage of technicians for repairing ICT facilities and two (5.5%) cited poor internet connectivity as shown in Figure 6.

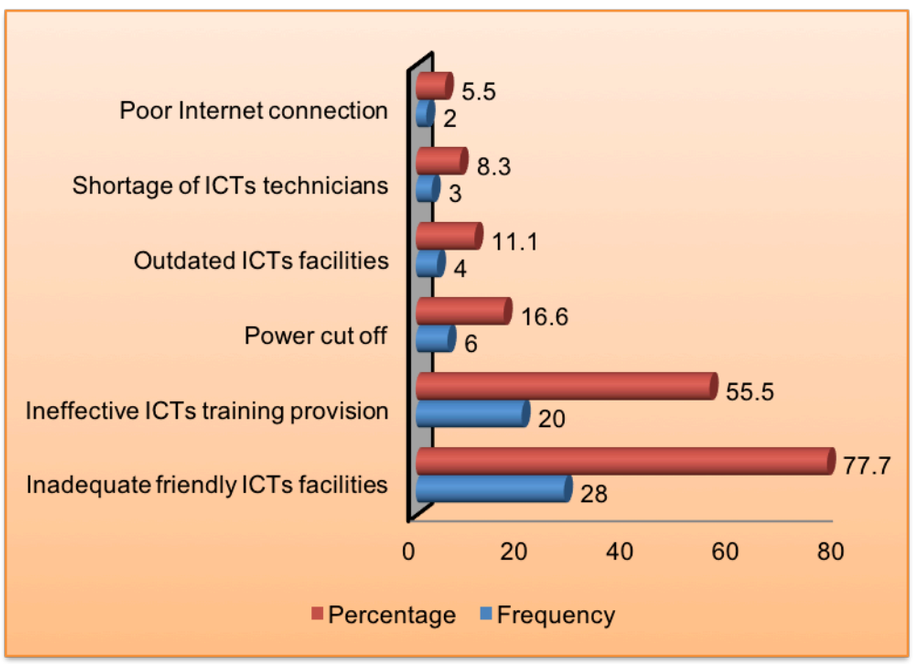

***Figure 6**: Challenges constraining the use of ICTs*

4.9.1 Inadequate ICTs

The findings presented in Figure 6 indicate that the majority (77.7%) of the respondents cited inadequate ICT facilities as one of the challenges the visually-impaired students faced when accessing and using ICTs facilities for learning. In this regard, one of the respondents said:

> *The ICT facilities available at the Special Education Unit are not sufficient to enable effective learning. This limits the flexibility of learning. Computers, note-takers and PAC Mates available are not enough to cater for the needs of the general population;*

> *there is also lack of magnifiers and lenses. This is coupled with a shortage of talking watches.*

This implies that ICT resources at the disposal of the visually-impaired students are inadequate despite the University's efforts to mainstream the visually-impaired students at the institution. Thus the shortage of ICTs facilities friendly to the visually-impaired students limits their prospect of being independent learners, and this situation can lower their confidence and self-esteem, which in turn might finally make them fail to acquire the required skills and knowledge. Similar findings were also observed by Eloff and Kgwete (2007) to the effect that insufficient resources in Braille format and relevant ICTs were the challenge the visually-impaired students faced. In general, the shortage of user-friendly ICTs facilities for the visually-impaired students such as important assistive devices and lack of classroom adaptations for supporting learning and communication were the major impediments to the effective learning processes of the visually-impaired students.

4.9.2 Training

Despite the importance of training in enhancing skills and knowledge, training on the application of ICTs and reading skills were not effectively offered at the Special Education Unit of the UDSM. The findings reveal that 55.5 percent of the respondents agreed that training was not effectively offered by the Special Education Unit. In other words, ineffective ICT training for the visually-impaired students constitute a challenge to enjoying learning as much as the sighted students do. In particular, ICT facilities can be effective in enhancing learning opportunities for visually impaired students if they possess adequate and appropriate skills and knowledge to operate them. These findings also imply that training for some of the ICT facilities was not productive in the sense that the demand for ICTs was higher than the actual supply. As a result, training in these facilitative ICTs might not necessarily translate into actual usage in the face of scarcity of ICT facilities. During an interview, one of the visually-impaired students contended:

> *I do not have enough skills and knowledge on ICTs. Without having the JAWs programme, it is difficult to access these facilities. I don't see what appears on a screen, I only depend on being told what is visible by my fellow.*

One of the transcribers reinforced this view:

> *Most of the visually-impaired students have no technical knowhow for some of ICTs facilities and the majority cannot operate computers effectively*.

Burgstahler (2003) found that training on special ICTs skills constitute an important component of university education for the visually-impaired students. Indeed, properly co-ordinated training in ICT skills development in university programmes helps the visually-impaired students to gain positive experience, develop good career development paths and attain independent learning. Thus, the accessibility of ICT and training to the use of the accessible ICTs should aligned parallel.

4.9.3 Power Supply

ICT facilities need a steady power supply for them to operate. In this study, power cuts and erratic sully of electricity were also mentioned as a challenge the visually-impaired students faced when using ICT facilities. Indeed, power-cuts were found to limit the effective use of facilities and undermined the learning process due to the disruptive nature. The researcher observed one such power-cut when she was at the Special Education Unit during data collection. The generator available is not automatic. The manually switched on and off generators normally demand that a man operate them and this may fail to guard against the disruptiveness of the power-cuts to learning activities, especially when there are incessant delays in switching on the emergency power. In fact, lack of automatic generators limits the continuation of learning when power is cut off. This implies that the University faces a challenge of ensuring there was a stable electricity power connection through the use of proper power backups and automatic generators.

4.9.4 Shortage of ICTs Experts and Technicians

Shortage of technicians and experts for repairing damaged ICT facilities and innovating various software to enhance the learning experience of the visually-impaired students is one of the challenges visually-impaired students were facing. The findings suggest that the University has a shortage of ICT experts and technical support. Eloff and Kgwete (2007) found that adequate training of educators to teach students with disabilities was generally lacking. Also lack of the repair and maintenance of the ICTs hindered the effective utilisation of ICTs in learning activities of the visually-impaired learners, which reduces the number of working ICTs, with far-reaching implication for students with visual impairments who need more of such special learning support.

4.9.5 Internet Connectivity

Poor internet connectivity at the UDSM also tends to discourage the visually-impaired students during their learning activities since the internet is viewed as an alternative to access different

important formats for supporting effective learning. The running cost of ICT facilities might also be a challenge due to university budgetary constraints that affect the acquisition and maintenance of ICT facilities and software that meets the special education needs. Many students shared the bandwidth which slowed down the speed of internet access particularly in the absence of a wireless access point at the UDSM's Special Unit's building. Also, the wireless access points were installed in a few buildings and spots. In the face of few wireless access points including in the library, the students found it quite difficult when the LAN internet was so busy in the absence of the wireless connectivity (BECTA, 2001). In consequence, there was poor access to alternative formats for learning, hence limiting access to materials.

4.10 Results of shortage of ICT facilities

Poor access to user-friendly ICTs tends to undermine the learning of the visually-impaired students. The statistical output shows that 28 (77.7%) of the respondents cited time constraints, six (16.7%) cited over-dependence on the readers, five (13.9%) indicated lack of wide access to learning materials as Figure 7.

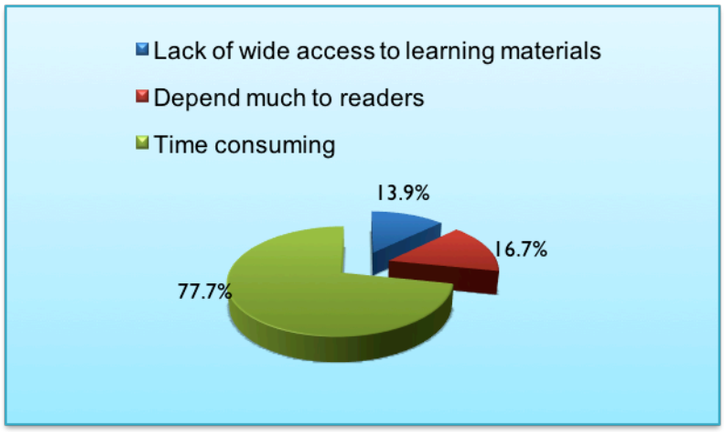

***Figure 7**: Shortage of ICT facilities*

The results suggest that poor access to ICT facilities among the visually-impaired students affected their learning process. For example, they found learning activities time consuming, they experienced an increase in dependence on the readers and they faced limited access to a range of learning materials are a result of poor access to the needed ICTs that support learning among the visually-impaired students. In other words, the shortage or absence of ICT facilities makes the learning process very challenging and limited the output of the visually-impaired students, who had to endure an inflexible education routine. Burger (2013) concurs with these findings that the shortage of ICT technology remains a significant barrier which is observed in all areas of development. The major sticking point remains the cost of assistive technologies which also include training and support service beyond the availing of such technological tools. In fact, the shortage of ICTs in many learning institutions is still a major barrier that prevents the attainment of full benefits in the learning process for the visually-impaired students. Indeed, the shortage of special ICTs facilities translates into spending a lot of time on learning activities and this hinders effective access to a wider range of educational materials. As a result, the learners with visual impairments ended up being more and more dependent on the readers, which also strained the readers as well. Indeed, poor accessibility of ICTs facilities at the UDSM's Main Campus and DUCE forces many students with special learning needs to be over-dependant on others.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

On the basis of the study findings, it can be deduced that the visually-impaired students face some limitations in accessing and utilising ICT facilities to enhance the quality of their learning experience. As the study findings demonstrate there is a need to continue not only providing learning opportunities for the visually-impaired students but also in the provision of assistive technologies that add value to their learning activities and outcomes. As students with visual impairment problems are few in the total population of the University of Dar es Salaam, it is possible to provide them with effective ICT-based learning support, particularly when sound strategic plans and practice are in place. Though the UDSM provide some assistive technology at its Special Education Units, there is still much more that needs to be done to ensure that the visually-impaired students lessen their over-dependence on the readers and become more independent learners through the use of ICT-based assistive technologies.

5.2 Recommendations

Based on the study findings and conclusion, the study provides a number of recommendations for the parent institution to improve the access to and use of ICTs facilities to support the learning activities of the visually-impaired students.

5.2.1 ICT Facilities and Software

The university and responsible agencies and ministries should shoulder their responsibilities of providing enough state-of-the-art ICT-based facilities to enable the visually-impaired students to access and use standard tools to complete educational tasks. Also, the use of resources and ICT technology should be aligned with the use of appropriate assistive technology, research, referencing and study skills.

5.2.2 Training

Visually-impaired students need special training classes to learn the application of special ICTs skills. Therefore the University should find a way to ensure every student attends trainings provided for enhancing their competency in ICT application for learning purposes. Training should be also provided to transcribers and readers to empower them to effectively assist the visually-impaired students to develop skills for independence rather than dependence.

5.2.3 Education and ICT Policies

Efforts should also be made to monitor the implementation of education and ICT policies for the visually-impaired students in particular and persons with disabilities in general. The education policy and ICT policy should specify how the visually-impaired students are to be provided with equitable access to ICT-based assistive tools to enable them to learn effectively.

5.2.4 Collaboration

There should be successful collaboration between the University and different stakeholders sharing of responsibilities to foster education excellence for the visually-impaired students. For example, collaboration between the universities and the Ministry of Education in-planning for the visually-impaired students to receive great benefits from ICT-based assistive tools in learning activities.

5.2.5 Funding

In this regard, governmental and non-governmental organisations as well as the general society should pool their resources together to provide appositive learning environment for the visually-impaired students have access to assistive ICT-based technologies that enhance the quality of their learning opportunities.

REFERENCES

Anderson, P. 2006, “Future of human-computer interaction in emerging technologies for learning”.Accessed12July2015from:http://becta.org.uk/corporate/publication/documents/Emerging_Technologies.pdf

Australian National Training Authority. 2003, “Assistive technologies for online training delivery for people with disabilities: Access and equity in online learning training delivery (R012R)”.

BECTA. 2001, “Information Sheet on: Visual Impairment and ICT”. Accessed 5 September 2015). From: http://www.becta.org.uk/technology/infosheet

Belay, T.E. 2005, “African perspective on visual impairments and polices: personal experience, a variety of perspectives and technological solutions”. Accessed 12 August 2015from:.http://www.unesco.org/new/fileadmin/multimedia/hq/ci/ci/pdf/wsis_tunis_disabilities_tamru.pd

Bocconni. S., Dini, S., Ferlino, L., Martinoli, C. & Ott, M. 2007, “ICT education tools and visually impaired students: Different answers to different accessibility needs”. Accessed 8 July September 2015 from: http://researchgate.net/...ICT.../79e4150bfb2f89cc03

Borg, J. 2011, “Assistive technology in developing countries: national and international responsibilities to implement the convention rights of persons with disabilities”. Accessed2June2016from:http://www.thelancetglobalhealthnetwork.com/wpcontent/uploads/Disability REV-3.pdf

Burzagli, L., Bill, M., Gabbanini, F., Paolo, P., & Enrico. 2004, Use of current content management systems for accessibility: In: Klaus J, Meisenberger K, Zegler WL, Burger D (eds.). Computer helping people with special needs. In: 9th International Conference on Computers Helping People with Special Needs, July 7-9, 2004, 331-338, ICCHP: Paris, France. Accessed 10 September 2016 from: http://link.springer.de/link/service/series/0558/bibs/3118/31180331.htm

Burger, D. 2013, "Putting e-accessibility at the core of information systems**:** business case, WhitePaperSeries".Accessed16September2015from:http://g3ict.com/resource_center/G3ict_Publications#sthash.V7VT0A09.dpf

Burgstahler, S. 2003, "Role of technology in preparing youth with disabilities for postsecondary education and employment". *Journal of Special Education Technology*. Accessed 18 August 2015 from: http://www.staff.washington.edu/sherylb/

Cullen, K., McAneney, D., Dolphin, C., Delaney, S. & Stapleton, P. 2012, "Research on the provision of assistive technology in Ireland and other countries to support independent living across the life cycle", Report. Dublin: Work Research Centre.

Eloff, I. & Kgwete, L. 2007, "South African teacher's voices on support in inclusive education: Childhood education". South Africa: NPC.

Freedman, T. 2011, "Thirteen reasons to use educational technology in lessons". Accessed 21 September 2015 from: http://www.ictineducation.org/home-page/2011/3/3/13-reasons-to-use-educational-technology-in-lessons.html

Gronlund, A., Lim, N. & Larsson, H. 2010, "Effective use of assistive technologies for inclusive education in developing countries: issues and challenges from two case studies". *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*, *6 (4)*, 5-26.

Hitchcock, C. & Stahl, S. 2003, "Assistive technology, universal design for learning: improved learning opportunities". *Journal of Special Education Technology, 18(4)*. Accessed21September2016from:https://pantherfile.uwm.edu/edyburn/www/JSET224.pd

Lucky, A.T. & Achebe, N.E. 2012, "Information service delivery to the visually impaired: case study of hope for the blind foundation in Wusasa, Zaria (Nigeria)". *Research Journal of Information Technology 2012; 5(1)*, 18-23.

Malburg, S. 2012, "Looking through their eyes: teaching suggestions for visually impaired students". Accessed16July 2016 from: http://www.brighthubeducation.com/special-ed-visual-impairments/62427-ideas-for-how-to-teach-visually-impaired-students-seeing-the-big-picture/

Mikre, F. 2011, "Role of information communication technologies in education: review article with emphasis to the computer and internet". *African Journals Online (AJOL); 6 (2)*. Accessed 16 January 2016 from; http:**//**www.ajol.info/index.php/ajesc/**…/**62437

Ndijuye, M. 2009, "Information and seeking behavior of pupils with visually impaired case study of Buigiri Primary School in Dodoma Region*,* Tanzania". Masters of Arts Dissertation, University of Dar es Salaam, Tanzania.

Ndumbaro, R. 2009, "Library and information services provisions for people with visual impaired in selected university and public libraries in Tanzania". Masters of Arts Dissertation, University of Dar es Salaam, Tanzania.

Olukotun, J. O. 2004, "The need for expanded core curriculum for visually impaired learner in Nigerian Schools". *Journal of Association of Libraries for the Visually Impaired**,** 3(1)*.Accessed22March 2015 from: http://www.techlearning.com/news/0002/interactive-whiteboards-for-interactive-teaching-and-learning/64934.

Ong'eta, W. & Nyambura, S. 2013, "Inclusion and participation: The teaching of biology to visually impaired learners". In: The 2nd Annually International Interdisciplinary Conference, 25th -29th June, 2013, held at Catholic University of E.A.

Selinger, M. 2008, *Information communication technology in schools*. Cambridge: Cambridge University Press.

Trucano, M. 2005, *Knowledge maps: ICTs in education*. Washington, DC: World Bank Group.

UNESCO. 2011, "Accessible ICTs and personalized learning for students with disabilities: a dialogue among educators, industry, government and civil society". Accessed 11

September2015from:http://www.unesco.org/.../accessible_ict_personalized_learning_2012%20.

Wildeman, R.A. & Nomdo, C. 2007, “Implementation of inclusive education: How far are we?” Accessed 12 October 2015 from: http://www.idasa.org.za

Wilson, T.D. 1999, “On user studies and information needs”. *Journal of Documentation*. Accessed 18 January 2016 from: http://informationr.net/tdw/publ/papers/1999JDoc.html (1981.

Wyclife, O. & Nyambura, S. n.d, “Use of ICT to promote access and participation of students with disabilities in higher education: benefits and challenges”. Accessed 15 August2016from:http://www.cck.go.ke/.../Use_of_ICT_to_Promote_Access_and_Participation.

Original article at: http://ijedict.dec.uwi.edu/viewarticle.php?id=2274