

Specialized ICT Tools for Use by Visually Challenged Students in Kenyan Public Universities

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Abstract-- Kenyan public universities have been admitting students with visual challenge for a long time, yet there has been no time during the period that a study has been undertaken to determine the challenges faced by visually challenged students while using Information and Communication Technologies (ICTs) applications provided in these universities. These visually challenged students face various difficulties in accessing the most needed literature in their area of interest in academics. However, no special ICT tools have been established for use by these visually challenged students in Kenyan public universities to access the much needed information during their studies. This paper presents a review of literature on specialized tools for use by visually challenged students in Kenyan public universities. Findings revealed that JAWS based computers were the most sort for use by the visually challenged students in Kenyan public universities.

Keywords-- Human Computer Interaction, ICT, JAWS, VCS

I. INTRODUCTION

The visually challenged are among people generally classified as disabled. Such people also include those who have mental, physical, aural, or multiple disabilities. The disabled people constitute a small group whose nature of disability deprives them the opportunity to compete favourably with other members of the society with sight. Their needs are therefore not well articulated. In the past, education for this group of people was not given due attention they deserved but since 1960s, the situation changed as noted by [1]. Today, it is common knowledge that access to information is a prerequisite towards enlightenment and meaningful development at all levels of human endeavor. Any part of society that deny a section from enjoying the benefits accruing from access to information is likely to suffer from exclusion and decadence in this modern society which is largely controlled and driven by information technology[2].

Due to lack of sight, students with visual disabilities encounter certain constraints in accessing information; thus not realizing their potential achievement hence wasting the brains which would have been tapped for country's economic growth. Currently, a high proportion of ICT equipment and software designs found in the public universities don't support the visually challenged students in undertaking their studies or performing their duties to their expectation.

Table 1: Initial Survey to ascertain the number of VCS Admitted to Kenyan Public Universities

University	Number of Visually Challenged Students
University of Nairobi	1
Kenyatta University	48
Maseno University	6
JKUAT	0
Moi	2
Egerton University	0
MMUST	1

Source: Author, (2016)

Kenyan public universities have embraced technologies in maximizing access to information resources that support teaching, learning and research. Furthermore, ICT should be able to provide tools used in improving on the way human perform their day-to-day activities without limitations or boundaries [3]

However, like most universities in developing countries, ICT infrastructure has not been adapted to suit the needs of the blind, visually challenged and physically challenged students [4].

A. Statement of the Problem

Kenyan public universities do admit visually challenged students to undertake various courses; however, no specialized ICT tools have been established for their use in accessing the much needed information for their studies. Suggestion was made to the point that repackaging or reformatting of information materials on a wide scale need to be undertaken to accord people with visual challenges the information services as those available to sighted students [5]. All students have to manage their work load effectively as required by universities' regulations, but for visually challenged students a lot of time is wasted on transcribing the materials needed for their studies, demanding for good organizational skills. There is growing interest in developing effective strategies for supporting ICT adoption and implementation in Kenya, particularly within the educational sector, [5]. However, while there is awareness that access to education through ICT should be equitable for all students, individuals with disabilities, especially those with vision challenges, are generally the lowest prioritized group.

B. Significance and Scope of the Study

The study was confined to registered students of the two Kenyan public universities, Kenyatta and Maseno universities and was focused mainly on measures adopted in providing adequate academic programmes to students who are visually challenged. The decision to limit the study to the Kenyatta and Maseno universities was made with full realization that they were the only known universities with higher proportion of visually challenged students at the time of study. Survey was first conducted in the initial seven Kenyan public universities to ascertain this and the outcome is stipulated in the Table 1.1.

Identifying students with visual disabilities presented major problems as many of them live with this visual disability throughout their educational life without admitting that they suffer from the condition.

II. RELATED RESEARCH

The reviewed literature dwelt on the specialized ICT tools available for use by visually challenged students. Theoretical frameworks on ICT for visually challenged students were also explored to identify existing gaps that occur with visually challenged students while accessing ICT applications services. According to [6], higher education must start delivering on its promises of providing learning experiences that engage and address the needs of society inclusively in the twenty-first century. In the same line, the government of Botswana has fully committed to the widespread adoption of ICTs in all sectors of society by including them in the education system [7]. Subsequently, the University of Botswana developed the required technological infrastructure including the acquisition of a Learning Management System (LMS), (Blackboard/WebCT), with a view to advancing one of its aspirations to develop a student-centered, intellectually stimulating, and technologically advanced teaching, learning, and research environment [7]. Ideally, this has gone a long way in increasing the accessibility to information through the proper devices of human computer interaction which will eventually address problems faced by visually challenged students. This study was tailored around developing a framework to tap the potential of new and emerging technology by blending it with the traditional face-to-face teaching and learning environment in Kenyan public universities to help the visually challenged students at these universities achieve their academic goals with ease.

A. Specialized ICT Tools for use by Visually Challenged Students

Today ICT is being used as a tool for improving the quality of life by improved efficiency and enhanced effectiveness. Different types of ICT tools assist the people with disabilities by providing them with learning opportunities, capabilities and also increase potential of the disabled in different walks of life. ICT makes them capable by providing the ability to access knowledge with the help of suitable digital media and software. It does this by playing the very important role in communicating with peers, thereby promoting collaborative and social learning environment. ICT also helps the challenged students in many forms like reading, writing, hearing and seeing process [8].

The new digital ICT for the visually challenged students is not a single technology but a combination of many technological components and devices like hardware, software and multimedia for multiple service delivery [9]. Today, ICT in education encompasses a great range of rapidly evolving technologies such as desktops, notebooks, and handheld computers, digital cameras, local area networking, Bluetooth, the Internet, cloud computing, the World Wide Web, streaming, DVDs and applications such as word processors, spreadsheets, tutorials, simulations, email, digital libraries, computer-mediated conferencing, video-conferencing, virtual environment, simulators, emulators and many technologies that go in a way or the other in improving the way certain community undertakes its day-to-day activities. According to [9], the following specialized ICT tools were considered to offer better services to visually challenged students hence being specific to the study.

1. **Window-Eyes** -this is one of the most established and powerful screen reader tools available today. This tool gives total control over what you hear and how you hear it. It also provides enhanced Braille support. Window-Eyes provides key to opening the doors of unlimited information to the visually challenged. The application converts components of the Windows operating system into synthesized speech, allowing for complete and total access to Windows based computer systems to the visually challenged user. When Window-Eyes is integrated into Windows operating system, it provide seamless instant access to the operating system without having to learn a complicated set of keystrokes.
2. **Jon Access With Speech (JAWS)** is a powerful accessibility solution for visually challenged, that reads information on computer screen using synthesized speech. It provides many useful commands that make it easier to use programs, edit documents, and read Web pages. With a refreshable Braille display, JAWS can also provide Braille output in addition to or instead of speech. It provides provisions to be customized to the individual user needs and preferences.
3. **TOBII Eye Tracking System** is a specialized eye tracking and eye control technology. This technology makes it possible for computer to know exactly where users are looking. Tobii's eye tracking technology work on principles of advanced image processing of a person's face, by using eyes and reflections in the eyes of near-infrared reference lights to accurately estimates the 3D position in space of each eye. It finds the precise target to which each eye gaze is directed towards. It is a fully automatic eye tracking technology with high tracking accuracy and tolerance of head-motion.

B. ICT Facilities at the Universities

According to the information gathered through focused group discussions, ICT facilities were available in the universities including computers with fully multimedia enabled interface devices and software. However, the much needed specific software and devices, like the JAWS, Non-Visual Desktop Access (NVDA), Windows Eyes, to provide the visually challenged with access to information for fully usability have not been installed and yet some of these screen reader software such as Window Eyes and NVDA are Free and Open Source Software (FOSS), which may be downloaded by the general public. The researcher further observed that most students at Kenyatta University with visual challenges had preferences to using the JAWS as compared to Windows Eyes and NVDA because of its user-friendliness.

Shruti-Drishti is a computer Aided Text-to-Speech and Text-to-Braille system for persons with Visual challenge. It was developed at Media Lab Asia research hub at IIT Kharagpur in collaboration with CDAC Pune and Webel Mediatronics Ltd. (WML), Kolkata to enable persons with visual challenge to access conference websites. It has an option of presenting the displayed information in a verbal mode using a speech synthesizer or in the Braille format. The verbal mode of information representation provides descriptive information on all events of a web page, including links, buttons, check box, text etc. It is keyboard event driven and provides 'keyboard only' accessibility using a minimal set of keys, [10]

In Kenya, the Ministry of Education at central government level has a special unit that deals with aspects of special education with the aim of focus on matters related to the education of disabled people in general. The objective of the special education unit is to facilitate persons with special learning needs to be able to function as productively and as independently as possible in their communities and families through early intervention, equal participation, normalization and placement [11].

To achieve this objective, the government recognizes the importance of establishing the exact number of visually challenged persons in the country by type, age, academic levels and special needs to enable it plan and provide for their needs and services. However, noble the intentions are, this has remained on paper without any sign of effort towards implementation. [12] has exhaustively looked at the educational needs of all disabled persons in the country and made a number of recommendations. However, these are yet to be implemented since then.

In the same vein, the University of Zimbabwe Library has embraced technologies in maximizing access to information resources that support teaching, learning and research. However, like most libraries in developing countries (Kenya included), ICT infrastructure has not been adapted to suit the needs of the deaf, blind and visually challenged. University of Zimbabwe therefore sought to harness Free and Open Source Software (FOSS) in meeting the needs of the visually challenged, [13].

III. RESEARCH METHODS

This section discusses the methodological approach including the research design, instruments used, data collection techniques, study location, and target population.

A. Research Design

The study adopted a multi-case study approach where descriptive and explanatory were the most appropriate design for finding facts and arriving at the right results in pertinent principles of knowledge and solutions to fundamental problems as stated by [14]. Research design is the plan and structure of investigation conceived so as to obtain answers to the research questions or test the research hypotheses [15]. The

Table 2: Sample Frame

Subject	Population Size	Sample Size	Percentage (%)
Visually Challenged Students	54	44	90
Lecturers	10	9	90
Visually Challenged Guides	4	3	90
ICT Experts	4	3	90
University Policymakers	2	2	100

Source: Author

D. Data Collection Instruments

The study used questionnaire designed to be administered through interview schedule, observation guide and content analysis, because of the nature of the respondents. The interview schedule comprised of a list of both open and closed-ended questions to the respondents. The observation guide was reinforced by the use of cameras to capture picture of activities of the visually challenged students in ICT laboratories as the appeared. Content analysis entailed analyzing of past literature on visually challenged students in the two universities.

plan in this study involved the overall strategy used in collecting and analyzing data in order to answer the stated research questions.

B. Target Population

The study targeted all registered students with visual challenges at Kenyatta and Maseno universities who were 54 during the period of data collection process. The researcher also considered key informants among them, 10 (5,5) lecturers of the VCS; 4 (2,2) ICT experts; 4 (2,2), visually challenged students guides and 2 (1,1) senior administrators from each university for further interviews.

C. Sample Size

According to [18], Cochran's sample size formula for continuous data was used to calculate the sample size of the research population. The following explanations show how the decisions were arrived at.

$$n_0 = \frac{(t)^2 \times (s)}{(d)^2} = \frac{(1.96)^2(1.16)^2}{(5 \times 0.05)^2} = 118$$

For a population of 74, the required sample size is 90. However, since this sample size exceeded 5% of the population ($52 \times 0.05 = 2.6$), Cochran's (1977) correction formula was used to calculate the final sample size. These calculations were as follows:

$$n_1 = \frac{n_0}{(1 + n_0/\text{Population})} = \frac{118}{(1 + 118/74)} = 73$$

Where population size = 74

Where n_0 = the required sample size according to Cochran's formula = 118.

Where N_1 = the target population because sample size is > 5% of population.

The number of 46 respondents was chosen basing on the sampling table guide for sample size decisions provided by Cochran formula to estimate the sample size. This is further explained in Table 3.1.

IV. RESULTS AND DISCUSSION

The research was concerned with establishing specialized ICT tools for use by visually challenged students in Kenyan public universities.

A. Response on Course Specialization for VCS

The researcher sought out to assess the specialization of the courses the respondents were specializing in at the university. The researcher found out that most of the respondents were specializing in education which involved 39 students accounting for 84.8%. The rest of the respondents were students specializing in Arts 15.2%. The findings clearly show that majority of VCS prefer education and Arts courses

to sciences and engineering based subjects which require practicals. Table 3 shows the study findings:

Table 3: Respondents' Course Specialization

		Frequency	Percent
Valid	Education	39	84.8
	Arts	7	15.2
Total		46	100.0

B. Response on the Year of Study for the VCS

The researcher also collected information pertaining respondents' years of study which included First Year, Second Year, Third Year and Fourth Year. Majority of the respondents were in second and thirds years which tallied at

35.56%. First years were at 20.0%, while fourth years stood at 8.89%. This implies that many students stagnate in year three and four resulting to very few graduate visually challenged professionals.

Fig. 1 presents a summary of the findings.

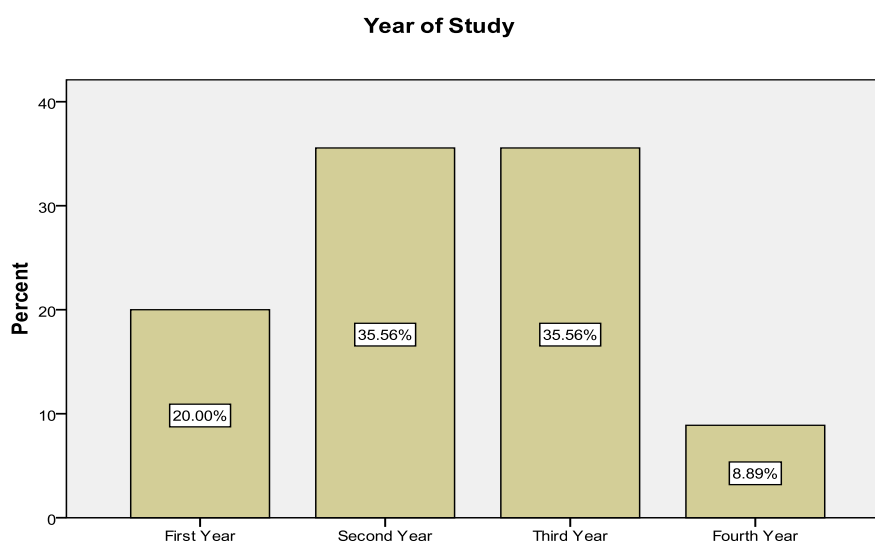


Figure 1: Year of Study Distribution

C. Response on ICT Application by VCS

The research collected information on mode of computer interaction used by VCS. The available media examined

were: JAWS based computers; Talking Computer, Braille Keyboard and Voice Input were available with most respondents indicating their presence. Table 4 gives a summary of the findings.

Table 4 ICT Applications Distribution

		Responses	
		No	Percent
ICT Applications	JAWS based computer	43	26.2%
	Talking Computer	40	24.4%
	Braille Keyboard	42	25.6%
	Voice Input	39	23.8%
Total		164	100.0%

This indicates that JAWS based computers is the most used media of interaction by VCS with 26.2%; followed by the Braille Keyboard with 25.6%, Talking Computer had 24.4%, and Voice Input 23.8%. CCTV was also cited to be one of the applications in use but not captured in this summary. This implies that most of VCS learning institution recognize JAWS based computers interaction.

D. Response on Use of ICT by the VCS

When respondents were asked whether they were using any ICT applications when teaching and learning of VCS, the results were as follows.

Table 5: Use of ICT Distribution

		Frequency	Percent
Valid	Yes	45	97.8
	No	1	2.2
	Total	46	100.0

Findings from Table 5 reveal that majority of the respondents agreed to be using the ICT applications available for other sighted students a fact that indicated high dependence on guides for most of their academic activities. 45 of the respondents which represents 97.8% of the total respondents agreed that they use ICT application as opposed to 1 2.2% who denied to be using any ICT application.

E. Response on the Availability of ICT Resources

The researcher sought to understand the disparity between the satisfactory levels of ICT services availability on an array of ICT applications shortcomings relating to the same services. From the findings, it is possible for the researcher to infer that visually challenged students, depended on others to access information for their studies are unlikely to criticize the very system they depend on. Table 6 gives details of the finding.

Table 6: Availability of ICT Applications Resources

		Frequency	Percent
Valid	Yes	9	19.6
	No	32	69.6
Missing	System	5	10.9
Total		46	100.0

Table 7: ICT Applications Needed by VCS.

		Responses	
		N	Percent
ICT Applications Needed	Braille Keyboard	7	25.0%
	Talking Reading Materials	7	25.0%
	AT	7	25.0%
	FOSS Applications	7	25.0%
Total		28	100.0%

F. Response on the ICT Applications Needed for VCS

The researcher further sought to find out the impact of specialized ICT tools in learning and if there was any to improve on VCS studies. Majority of the respondents agreed that the visual condition negatively affects the general academic performance of VCS. All the respondents who were lecturers handling the VCS agreed that these VCS encounter

difficulties when going through their academic work. The summaries of this are shown in the Table 7.

The research also sought to find ways in which information materials are transcribed or presented to VCS. The findings reveal that 53.8% of total respondents agreed that Braille is used while 30.8% said they use Assistive Technology, Talking book and Free and Open Source Software tallied at 7.7% as summarized in Table 8.

Table 8: Information Material Presentation

		Responses	
		N	Percent
Information Material Presentation	Braille	7	53.8%
	Talking Book	1	7.7%
	FOSS	1	7.7%
	AT	4	30.8%
Total		13	100.0%

The research also revealed that lecturers receive complains from visually challenged students regarding inadequate ICT applications. This view is supported by all respondents. 85.7% of respondents said that they received complains on daily basis while the remaining 14.3% said that they received complains always as shown in Table 4.32.

A good number of respondents said that the range of ICT Applications available for Visually Challenged Students affect academic performance negatively as shown in Table 9.

Table 9: Effects of Performance

		Frequency	Percent
Valid	Positively	1	14.3
	Negatively	5	71.4
	Total	6	85.7
Missing	System	1	14.3
Total		7	100.0

V. DISCUSSION OF FINDINGS

The researcher sought to establish special ICT tools for use by visually challenged students in Kenyan public universities. The researcher collected information on mode of computer interaction used by VCS. The available media examined were: JAWS based computers; Talking Computer, Braille Keyboard and Voice Input which existed in the study with most of respondents indicating their presence.

A. Specialized ICT Tools

Table 4 indicates that JAWS based computers is the common media of interaction used by VCS with 26.2%; followed by the Braille Keyboard with 25.6%, Talking Computer had 24.4%, and Voice Input 23.8%. CCTV was also cited to be one of the applications in use by VCS but not captured in this summary. This implies that most of the VCS and learning institutions where they are admitted, are aware of the existed of special ICT tools which can make learning manageable through accession of the needed information in line of their studies. JAWS based computers were in use in some universities like Kenyatta, but not to the required maximum to benefit all the VCS.

a. Inadequacy of ICT Applications

The findings further revealed that lecturers received complaints from the VCS regarding inadequate ICT applications due unavailable or not enough specialized ICT tools (devices and software) to cater for the their special needs. This view was supported by 85.7% of respondents who said that they received complains on daily basis while the remaining 14.3% said that they received complains always as shown in Table 9.

The good number of respondents said that the range of ICT Applications available for Visually Challenged Students affect academic performance negatively as shown in Table 9.

b. Quality of Achieved Academics for VCS

Table 9 findings further revealed that most of the visually challenged students depended on other sighted students to access information and do class assignments for their studies which adversary affected their performance and quality of education in the end.

c. Benefit of the Study

The study found out that the Kenyan public universities do admit visually challenged students to undertake various academic programmes at different levels and actually the numbers have increased greatly but no frameworks in place to help to alleviate the problems faced by these students hence the solutions from the study. During the study, specialized ICT tools for use by visually challenged students were availed.

CONCLUSION

The population of visually challenged students enrolled at Kenyatta and Maseno universities at the start of the study was less than 100. This constitute to approximately 0.3% of the total student population in these two universities. This number is likely to increase as learning conditions for the visually challenged students improve with impending Bills on Person with Disabilities in parliament are enacted. This was attributed to perceived benefits of ICT applications services for visually challenged students in Kenyan public universities.

In the study, the VCS were found to be more aware of specialized ICT tools and modern communication technology and the potential it has in ICT applications services for the visually challenged students than their lecturers and ICT experts. They were also aware that the technologies that were available at the universities were inadequate in meeting their ICT applications needs and that the quality and quantity of the services needed to be improved to serve them better.

Further findings showed that visually challenged students relied heavily on fellow sighted students to access and do their academic activities. Given that the same sighted students have their own workload, this reliance on other fellow students in most cases inconvenience visually challenged students and made them fail to submit assignments in time.

VI. SUGGESTION FOR FURTHER STUDY

(i) The study established that majority of VCS were using ICT applications available to them which accounted for 97.8% of the respondents in the two universities; Kenyatta and Maseno despite the overwhelming evidence to the contrary. Further research should be undertaken to determine this underlying reasons behind such responses.

(ii) The study found that VCS depended on fellow students to guide and do some of the activities including

reading and take away assignments for them. The effects of this informal arrangement on both the VCS and those with sight are not known. This calls for need to conduct research to establish what effects in any this dependency has on VCS and the sighted students who are their colleagues.

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