The Accessibility of Assistive Technology for Students with Disabilities in Higher Learning Institutions: A case of the University of Dar-es-Salaam in Tanzania

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***Abstract*: The paper reports the findings of an investigation into the accessibility of assistive technology (AT) used by students with disabilities (SWD) in higher learning institutions (HLIs) in Tanzania. The descriptive study used a cross-section design. The study involved a total of 173 participants; 18 management officials, 35 trainers, and 120 students, including 33 SWD including students with visual impairment (ten), five students with low vision, seven students with physical disabilities, three students with albinism, seven students with hearing impairment, and one student with speech impairment. The study revealed the presence of AT distributed to SWD accordingly. The challenges included inadequate and deficiencies in some of the AT devices, shortages of staff with knowledge and skills to do maintenance, difficulties in adopting new AT, the high cost of AT devices, inadequate training, and a shortage of AT training opportunities among staff and SWD. The study suggests the allocation of enough budgets to purchase more AT, empower, extend and build the internal industries to manufacture AT devices and employ more AT trainers and internal experts for maintenance and repair of the AT that will ensure the constant availability of fully functional AT devices.**

***Keywords*: Accessibility of Assistive Technology, Assistive Technology, Students with Disabilities, Higher Learning Institutions**

I . INTRODUCTION

Technological advancement does support Persons with Disabilities (PWD) by inventing different tools for assisting them to be integrated to simplify activities that would have been impossible. Such technological tools enable the adaptation of people with special needs and disabilities in all fields including learning institutions and workplaces. These technologies create a supportive environment for people with special needs and disabilities to access education and contribute to the labour market thereby developing a more independent life for themselves (Martínez, 2011). It is by using AT whereby deliberate efforts to enable SWD to have access, integrated and enhanced with active participation in the teaching-learning process as well as have opportunity to compete in all aspects of life is made possible.

The United Republic of Tanzania, a signatory to the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) made a Public commitment to rights through the enactment of policies on disability most recently through the enactment of the Persons with Disabilities Act of 2010 whereby one of its promises is to provide them with the accessible environment to education (Tanzania, 2010, p. 5). In addition, the National Higher Education Policy (The United Republic of Tanzania, 2007) highlights inclusive education by providing all necessities to SWD including inclusive facilities and loans.

Before the issuance of guidelines for using AT in HLIs, SWD in HLIs were stigmatized and discriminated against. Guideline extended protections against discrimination and mandated full access not only to education but also to employment and necessary facilities. Assistive technology is referred to materials, pieces of equipment and some environmental settings that are important to people with disabilities to enhance communication, transportation, and recreation. The guideline further clarified the definition of a disability as a "physical or mental impairment that substantially limits one or more major life activities." This mandate reflected a shift from focusing on disabilities as a deficit to recognizing disability as a normal part of life (Asselin, 2011).

The rising compassion to the needs of PWD and increase in their enrollment at the University of Dar-es-Salaam (UDSM) contributed to the establishment of the Department of Special Education unit in the academic year 1978-1979 to support visually impaired students who were enrolled in that academic year. Later in the 1980s, the unit received students with other impairments such as albinism, physical impairment, and hearing impairment. Their number increased to 238 students in the academic year 2010-2011. (Mwaipopo *et al*., 2011).

The Tanzania Education Authority delivered some AT to the Department such as electronic note-takers, special scanners, and low vision devices which were only for visually impaired learners (Njewele *et al*., 2011). Furthermore, Dar –es- Salaam College of Education (DUCE) constituent college of UDSM,

established a special unit in 2005 whereby AT provided to the SWD were white canes tape recorders, magnifiers, computers with JAWS software, talking scientific calculators, and Perkins Braille (DUCE, 2018). In the academic year 2019-2020 a total number of 160 SWD were supported by the University; see Table 4. Although most HLIs in Tanzania offer inclusive education, numerous challenges make SWD experience some difficulties in their learning process. According to Mnyanyi (2012), most students with visual disabilities failed because they lacked the necessary AT and teaching methods. Mnyanyi (2012) further asserts that the language used in the English application makes it Swahili users difficult to use it. He added that SWD must have constant access to computers so that they do not forget the application, but most of them cannot afford it, also the technology is new in the country and only a few people are conversant with it.

The study aimed at investigating the available AT utilized by SWD in HLIs in Tanzania, as a part of a descriptive study that examined the Use of Assistive Technology for Persons with Disabilities in Higher Learning Institutions in Tanzania, A case of the University of Dar-es-Salaam. Specifically, the study aimed at achieving the following objectives:

- Identify the available AT at UDSM.
- Measure the adequacy of the available AT for SWD at UDSM.
- Identify the challenges of the available AT used by SWD in HLIs in Tanzania.

Research questions

- Which types of AT are used by SWD enrolled at UDSM?
- How do you rate the adequacy of the AT devices provided to the SWD enrolled at UDSM?
- What are the challenges of AT used by SWD enrolled in HLIs in Tanzania?

II. METHODOLOGY

Study design

The study was descriptive because it was sought to come up with actual answers regarding the availability of AT in HLIs and adopted a case study design. Thereafter, UDSM was selected among all HLIs. Both primary and secondary data collection methods were employed to collect data from individuals, also observations, and documentary review. The study was dominated by a qualitative approach and supplemented by a quantitative approach as it seemed right.

Study site

The target was HLIs, UDSM in particular. This case study was suitable because the University is the oldest higher learning institution in Tanzania, rich in information for the study, and accessible.

Target population

The target population involved 173 persons directly linked to the AT usage among SWD at UDSM, including students with and without disabilities, and DARUSO leaders, trainers, and management officials.

Sample size and sampling procedure

Both purposeful and random sampling methods were applied to select the respondents. The respondents included 18 management personnel who manage the special education unit and all subordinates, 120 students and DARUSO leaders, and 35 trainers. Among 120 students, 33 were SWD that included 10 visually impaired, 05 low vision, 07 hearing impaired, 03 Albino, 07 Physical impaired, and 01 speech impaired.

The instruments

In this study, the questionnaire, interview, Focus Group Discussion (FGD), observation, and documentary review were used. A questionnaire was used to collect data from students and trainers. An interview was scheduled for the management officials, and FGD was used to collect data from DARUSO leaders. Furthermore, observation was used to collect data on the availability of AT in terms of adequacy and other supporting facilities around UDSM. Also, a Documentary review was done by tracking and reviewing various documents including students By-laws, an inventory of available AT for SWD, students' accommodation guidelines, and other documents related to AT and SWD at UDSM.

Data analysis

Quantitative data were analyzed by Microsoft Excel 2010 and qualitative data were analyzed based on their content.

III. RESULTS AND DISCUSSION

Respondents Characteristics

The respondents' characteristics were based on gender, years of study, and working experience. In this study, information was collected from 173 respondents categorized as follows; 18 (10.4%) management Officials, 33 (19.1%) SWD, 47 (27.2%) students without disability, 35(20.2%) trainers and 40 (23.1%) DARUSO leaders. Table 1 shows the results.

Table 1: Respondents profile

S/n	Actual respondents				
	Category	Male	Female	Total	frequency
1	Management	9	9	18	10.4%
2	SWD	15	18	33	19.1%
3	Students	24	23	47	27.2%
4	Trainers	18	17	35	20.2%
5	DARUSO leaders	22	18	40	23.1%
	Total	88	85	173	100.0%

Source: Field data, 2020

Gender analysis

Respondents were asked to state their gender to assist the researcher in asses features of the population of respondents. From, 88(51%) of respondents were male and 85(49%) of respondents were female. There was a slight difference between the number of male participants and female participants, showing that gender issues were considered seriously during data collection.

Working experience

The researcher was interested to understand the working experience of respondents, staff at UDSM and revealed that (46%) of respondents had working experience below 5 years, (39%) between 6-10 years, (15%) between 10-15 years and no respondents with working experience of more than 16 years was observed. This expressed that most respondents had adequate experience with the institution enough to provide relevant information to the study. Figure 1 illustrates the result.

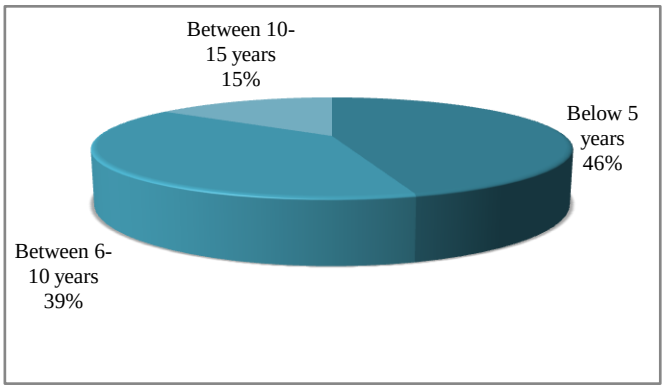

Figure 1: Working experience of the respondents

Source: Field data, 2020

Years of study

Respondents, specifically students, were asked to indicate their year of study and the result presented that (45%) of respondents were in 2-3 years, (37%) below 2 years, (18%) were in 3-4 years and there were no respondents with more than 4 years. This showed that the researcher considered information from different years of study, which made data gathered bias-free. Table 2 illustrates the result.

Table 2: Year of study of respondent

Years of study	Number of respondents	Percentage
Below 2 years	45	37%
2-3 years	54	45%
3-4 years	21	18%
Above 4 years	0	0%
Total	120	100%

Source: Field data, 2020

A. Accessibility of Assistive Technology for Students with Disabilities Enrolled at UDSM

1) Respondents familiarity with AT

In this study,(100%) respondents said they were familiar with AT and none of them said "No'. This implied that the researcher had the right population that could provide information relevant to the study, as shown in Table 3. Webster (1985) defines a sample as a finite part of a statistical population whose characters are premeditated to gain information about the entire population.

Table 3: Respondents Familiarity with AT

Responses	Frequency	Percentage (%)
Yes	173	100%
No	0	0%
Total	173	100%

Source: Field data 2020

2) Type of AT Concerning Kind of Disability:

The study revealed the total number of SWD enrolled at UDSM in the academic year 2019/2020 as 160 whereby fifty(50) had low vision, thirty-four (34), hearing impaired, thirty-four (34) visual impaired, thirty-two (32) physical impaired, six(06) albinism, one(1) speech impaired. Those who had other special needs and challenges were three (03). The available AT concerning the type of disability are shown in Table 4.

The education for all policy (UNCRPD, 2006) and equal treatment to all citizens (WHO, 2015) had made several HLIs adopt the policy and enrol SWD. However, taking this initiative is needed first to prepare a favorable environment that could eradicate the barriers and simplify their academics and social life during the learning process (Ngonyani and Mnyanyi, 2021).

Table 4: Type of AT Provided concerning Disability

S/n	Type of Disability	Number of Students Enrolled academic year (2019-2020)	Available AT
1.	Visual impaired	34	Perkins braille, braille papers, Cut-sheet braille papers, Braille note, Braille display, Braille embosser, White cans, Optical character recognition systems, electronic notetaker, computers with software and talking programs e.g JAWS and NVDA, Voice recorder, talking watch, talking calculators, electronic talking dictionaries and Audiobooks.
2.	Low vision	50	Closed-circuit television (CCTV), computers, Optical character recognition, Electronic note-taker, and Handheld magnifier
3.	Hearing-impaired	34	Digital hearing aids, computers, Assistive listening devices (ALDs) and personal amplifiers.

4.	Speech impaired	01	Computers, Alerting devices, Augmentative and Alternative Communication (AAC) devices example speech to text software and verbal cues
5.	Physical impaired	32	Wheelchairs, clutches
6.	Albinism	06	Closed-circuit television (CCTV), computers, Optical character recognition, Electronic note taker and Handheld magnifier
7.	Challenges and other special needs.	03	They were provided with other special care
Total		160	

Source: Field data 2020

B. *The Adequacy of Assistive Technologies for SWD Enrolled at UDSM*

Rating the adequacy of available Assistive Technologies

The respondents were asked to rate whether the available AT were sufficient. The results indicated that (103)59% of respondents said moderately available, (50)34% less available and (20)7% readily available. Generally, it could be concluded that the available AT did not suffice the actual needs of SWD. Normally those facilities were not provided sufficiently since the inventory was not all purchased because of insufficient funds. However, the institution was looking forward to negotiating with the Government and other stakeholders for help. Figure 2 illustrates the results. Here are some replies,

> The available AT is not enough, sometimes in the most important moments, especially during exams, I ought to return the AT while I still need it [Resp 1].
>
> When I was preparing the AT list for my students, I was told to pick out the most needed items first since there were not enough funds, it was difficult to choose because all items were most important[Resp 2].

To add to the findings, Tungaraza (2018) pointed out that a lack of enough teaching aids could cause poor performance among SWD.

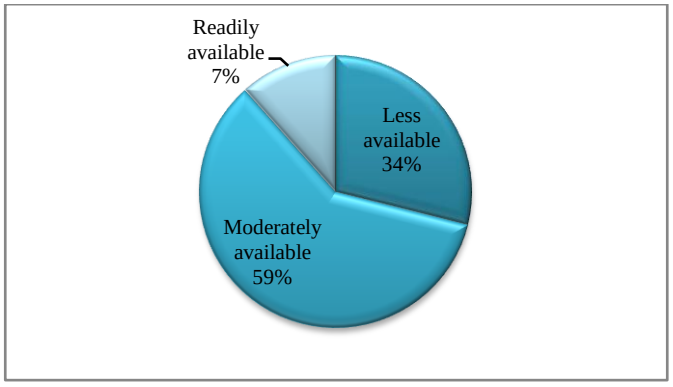

Figure 2: Rating the adequacy of available Assistive Technologies

Source: Field data 2020

C. *Challenges Related to the Available AT*

1) *Low understanding of the use of Assistive Technologies:*

Assistive technology could be used in the classroom to assist SWD in becoming successful in tasks that could otherwise be impossible. The study discovered that 27% of respondents pined out a low understanding of AT as one of the major challenges facing SWD. This had been attributed to the fact that pieces of training related to the use of AT were not provided often, the innovation of new AT and lack of background on the use of different AT among SWD, and the fact that they were normally using the facilities for a short time and returning it thereafter. Here are some of the responses,

> I need a laptop or pad that is mobile that I can use constantly for I cannot carry this desktop computer to my room [Resp 1].
>
> It is only now at the University. I have started using a computer, I have never used it before. I need more time to spend with it and frequently training [Resp 2].

Bruinsma (2011) in her study supported this finding by unveiling AT's implementation in the classroom by providing training for the students and teachers. She added that if the training was not provided then AT could not be implemented properly, or could not be implemented at all.

2) *Deficiency of some Assistive Technologies:*

Faults in some of the AT were reported by 24% of respondents. For example, tape recorder may be full because of limited storage capacity causing the remaining part of the lesson not to be recorded, power problems for power-operated facilities, while the lesson was progressing, had been observed to be a challenge and the fact that some computers lack special translation program for visual impaired (NVDA) which made it impossible for them to be useful. Here are the students' replies,

> One day my recorder was full unknowingly; after the end of the session, I realized that the remaining part of the lesson was not recorded. [Resp 1].
>
> The screen readers cannot read multimedia notes such as pictures and videos [Resp 2].
>
> Some of the computers do not have a special translation program so I have to wait to use another computer after my fellow finishes [Resp 3].

This finding was supported by Said (2017) when examining ICT accessibility solutions to persons with visual impairment at the Open University of Tanzania discovered that there were a lot of computers for the visually impaired but only a few of them had special translation programs. Also, Makoye (2017) in his findings stated that AT and infrastructures conditions especially for learners with visual impairment in accessing electronic learning were very poor and unpleasant because of

little attention to students with visual impairment in accessing electronic learning.

3) Inadequate training on the use of AT:

The findings showed that there was insufficient technical AT access support provided by the university to SWD. This was because most of the solutions provided were not relevant to the challenges. Furthermore, 19% of the respondents said that there was insufficient AT usage training because of inadequate internal specialists to train them regularly. This caused dependence on external expertise whose cost of acquisition was a bit higher and time-consuming thus caused inconveniences to the institution to conduct training regularly. The External Experts were summoned when there was a need to install a new AT, maintenance of fault AT, or for a new SWD at the beginning of the first semester. Here are some responses,

> I remember I was trained only once on the first week of my arrival and promised another training which has not yet been conducted to date [Resp 1].
>
> At the college that I was trained in, they did not train us practically so I have to put effort myself to know more because there is not enough time for on job training [Resp 2].
>
> I need more time and more training on the computer because I am familiar with braille [Resp 3].

The SWD likely needed a lot of support when utilizing AT since the use and interfacing with AT required constant training, improvement and support (Wilson & Wilson, 2001).

4) Incompatibility of AT used with the kind of disability:

There were cases of AT used not to comply with the type of disability. This was stated by 10% of respondents. Visually impaired were sometimes asked to submit a computer-typed work while they used braille, making it difficult to translate from braille and type it to a computer. Also AT programs did not suffice their requirements hence the need for a personal translator or helper. Here are some of the responses,

> The program cannot read the pictures and video notes so a personal translator helps to describe [Resp 1].
>
> I use perking's braille to read and preparing my notes but sometimes the lecturer wants the computer typed/printed assignment, so the personal translator or embosser has to translate it. This takes too much time and follows [Resp 2].

To add to these findings, the study of Makoye (2007) stated about the generalization of the AT used by SWD without understanding specific needs for each SWD taking an example of low vision and visually impaired, who had different degrees of disability and require different AT to satisfy their needs.

5) The need to return AT yet needed for use:

Assistive technology as an aid to the everyday lives of SWD must be distributed constantly to each SWD to improve their performance. The study shows that 11% of respondents said they were required to return the AT while they still needed them. The challenge arose since all the learning notes were saved in the required AT that needed to be transferred to another portable device. Sometimes students could not have such devices and the available ones could not accommodate all the data. This could lead to poor performance for SWD since they needed such devices for exam preparations. Some of the responses were:

> I was required to return the recorder during the exams while I still needed it for my preparation [Resp 1].
>
> I was asked to return the laptop because it was needed for exams, yet I needed it [Resp 2].

In addition, Mnyanyi (2012) proposed that the SWD need AT continuously for more practices to improve their abilities on AT.

6) Lack of internal specialists for maintenance and repair of AT:

About 6% of respondents pointed out the scarcity of internal experts for the maintenance and repair of AT. There was no person to service the AT for they needed regular service. This accumulated malfunctioning AT leaving only a few at work. This fact was supported by the study conducted by Mwaijande (2014) on access to education and assistive devices for children with physical disabilities. She reported the insufficient services related to the provision of AT among SWD whereby lack of specialists for maintenance and repair was among them. Others included referral, funding, user training product preparation and adjusting. Here are some responses,

> This new modern embosser is here but there is no expert to configure it so we still use the old model which is too slow [Resp 1].
>
> There is the accumulation of functionless AT because there is no one to repair and service them. If this will take a long time the devices will become obsolete [Resp 2].

7) Difficulties in adapting AT since they are new and unfamiliar to others:

Advancement and introduction of new technologies had implications related to acceptance and utilization. 9% of respondents reported that they faced hurdles on the use of AT since they had not used them before. Some SWD did find the devices new completely; others could have used devices different from ones previously offered by the institution as well as those who became disabled while already at university. Also, emerging technologies made it difficult to transform from braille to note taker. Some of the respondents

replied,

> I had some difficulties in using screen readers because I already knew computer operations before I become blind I tried using experience but I couldn't do it hence I had to accept and learn to use the NVDA [Resp 1].
>
> I prefer braille to computer because I have been using it since primary school, computer is complicated because I must be trained intensively [Resp 2].

This fact was also supported by Maaga (2016), whereby 24.3% of the learner respondents agreed that lack of adequate computers inhibited the full adaption of computers as an AT for the visually impaired learners. The inadequate number of computers posed a great challenge to both teachers and learners in adapting to AT.

D. Overcoming the Challenges

1) Training related to AT usage should be provided:

Providing training on the use of AT could facilitate the proper use of devices that tend to reduce damage to the facilities. 25% of respondents proposed that training on AT should be conducted regularly and not only when the semester began or when the new AT was installed. Also, it could help them to detect any fault on devices and report it immediately for action. Frequent training could evolve new competent trainers on AT and its usage as well as organizing and supporting SWD. Here were some of the replies,

> Some of the devices are damaged because the user lack knowledge to use the devices. Training will solve this problem [Resp 1].
>
> Provision of frequent training will build confidence in both trainers and the SWD [Resp 2].
>
> If frequent training will be provided in our college, I will concentrate on other campus productive activities here instead of wasting too much time to find AT training elsewhere [Resp 3].

This finding was supported by the study of Careen (2016) on teacher's use of AT in inclusive classrooms. The study emphasized providing training to teachers to harness features of modern technologies like tablets for education to provide flexibility in the learning process.

2) Provision of adequate AT:

There was a need to provide enough AT to improve the learning process for SWD. 23% of respondents said provision of enough AT to every SWD could increase the chance of more understanding and use of AT that led to good performance in both studies and social life around the university. Also faulted AT should be replaced by new ones so that there could be a good ratio of the available devices to the SWD.

Some respondents said,

> The government should allocate enough funds for purchasing the AT [Resp 1].
>
> There should be enough AT so that every SWD use constantly to increase knowledge, experience and avoid sharing [Resp 2].

According to Kabuta (2014), for achieving high development of science and technology, it was vital for every HLI to have a sufficient number of facilities that correspond with the number of students so that every student including those with disabilities could have their computers for study.

3) There should be regular checking and servicing of AT

Constant maintenance of AT was very important, as responded by 17% of respondents that regular checking and servicing of AT together with a workshop for maintenance and servicing were always in good working condition which could ensure adequate availability of AT. Some of the respondents suggested,

> Some faulted devices can be fixed if serviced and maybe able to work again [Resp 1].
>
> There must be constant servicing and oiling the mechanical devices example braille to make them operate smoothly [Resp 2].
>
> Some software needs to be updated continuously if not the device will not work [Resp 3].

Jacobsen (2012) suggested how to remove the barriers related to the provision of AT by considering the cost and the budget for acquiring, maintaining and repairing AT devices and the cost of providing AT services. Also, the AT should only be considered after examining the learner and the environment, investigating the device and checking for durability, for ease of repair and its portability.

4) Increase number of AT experts:

The study observed that 20% of respondents suggested increasing the number of internal experts. Having internal expertise would simplify handling all queries related to training, use, installation, servicing and maintenance of AT. With internal experts, all those could be easier and at minimum cost. Here were some responses,

> The government should introduce an institution that will train our own AT professionals instead of expert's importation [Resp 1].
>
> It is very expensive to accommodate external AT experts, we should have one of our own instead [Resp 2].
>
> Each institute must have its own AT professionals to insure constant training, servicing, and repair of the AT [Resp 3].

To support this fact, Khalid (2019) suggested the presence of AT experts in the institution to provide

technical assistance and support that could solve the challenges of trainers with insufficient knowledge on AT usage, limited training on AT use, complexity, and difficult to use AT.

5) Students with disabilities should be provided with efficient AT:

The chance to access and utilize AT efficiently would allow SWD to amplify their performance and accomplish tasks more efficiently and independently.11% of respondents added that the provision of reliable and appropriate devices would make SWD feel safe and comfortable to cope with school life, learning process and perform their tasks as required. Here are some responses,

If the competent devices are provided together with effective training on how to use them, the SWD will surely work independently [Resp 1].

The availability of well-organized AT and related services will help the SWD to achieve its goals [Resp 2].

In addition to that, Jacobsen (2012) suggested the need for an efficient system of AT service delivery that provided devices and services promptly. The stated plans would provide subcontracts to protection and sponsorship organizations to engage in litigation activities that could have a dramatic impact on the way the country delivers AT and the supporting services to SWD (Jacobsen, 2012).

6) Emerging AT should be adapted:

Technology was not stagnant. It advanced and enabled discoveries. On the findings, 4% of respondents pointed out that, the improvement of the learning process among SWD could be achieved by introducing standard AT that comply with emerging technology. The application of standardized AT builds a good basis for SWD towards the application of new invented facilities wherever they go across the globe. Here are some suggestions,

We should be updated with new emerging AT that performs better than the current AT [Resp 1].

The special education colleges in Tanzania should train to use the computer with a special translation program instead of being trained on braille alone because here we mostly use computers than braille when facilitating the SWD [Resp 2].

In his study, Francis (2004) proposed that a modern trainer must influence student's motivation to learn and understand the effects technology had on inclusive education to create an effective modern teaching space and updating teaching techniques to better support inclusive education that met the needs of SWD.

IV. CONCLUSION

Based on the findings that emerged, the study concluded that the SWD were provided with AT devices each based on the type of disability such as computers which were available for all, hearing aids for those with hearing impaired, braille, braille embossers, screen readers, and tape recorders for the blind, clutches and wheelchairs for the physically impaired, magnifier glasses and CCTV for those with albinism had low vision. The study also revealed insufficiency of AT devices which was likely caused by lack of enough funds, AT specialists for servicing and maintenance of the faulted AT.

V. RECOMMENDATION

Following the findings, the study recommends the following:

Higher Learning Institutions in Tanzania:

- There should be the inclusion of trainers and SWD in all levels of curriculum planning and evaluation.
- All future designs and planning of the University infrastructures should support the use of AT for the SWD.

Government:

- There should be enough funds that will enable the availability and affordability of AT for SWD.
- There should be integration between the ministry of education and vocational training, ministry of Health, Community Development, Gender, Elderly and Children, and Ministry of Labour, Youth, Employment and Persons with Disability to ensure that the SWD is provided with AT relevant to the type of disability and related services.
- The government should develop institutes that will produce AT experts.
- The government should invest more effort and funding in the development of internal industries to manufacture AT devices for the SWD.

Further studies:

- Future studies can be done to encourage the design and production of AT devices in Tanzania

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