

Exploring usage of assistive technology resources by students with disabilities

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ABSTRACT

Low usage of assistive technologies is one of the critical problems despite the positive impact AT has. The study explored the usage of assistive technologies available in the School of Education Special Unit of the University of Dar es Salaam (UDSM). Using exploratory qualitative approach, 15 students with diverse disabilities, 6 student assistants and 2 instructors at UDSM engaged in semi-structured interview which was conducted through face-to-face. The findings report that access to AT resources is not a problem at the UDSM, the main problem is on the use. On perceived importance of the ATs, the findings disclose that students with disabilities perceived that the resources are useful in enhancing learning at the university. Factors such like technophobia, attitudes, low usage knowledge and skills hold back the efforts to effectively utilize the AT resources. The study recommends a close linkage between special unit and libraries, and conducting sensitization workshops.

Keywords: assistive technologies, adaptive technologies, assistive tools, students with disabilities

INTRODUCTION

Assistive technology (AT) resources are important ingredients in fostering inclusive education in higher education institutions. These are considered to be necessary conditions for an efficient pedagogical relationship (Alves et al., 2009). The technology found to offer substantial supports for students with disabilities for accessing and succeeding in education (Evmenova, 2020; Chambers, 2019), increase, maintain and improve functional capabilities of students with disabilities (Floyd, Galyon & Floyd-Norris, 2020). Along these, the technology appears to promote inclusive education through social interaction in the classroom (Chambers, 2020, 2019). Evidently, students with disabilities often use the AT to address personal needs, engage in communities and pursue educational, vocational goals (Ripat & Woodgate, 2017) and enhance lifelong learning (Eligi & Mwantimwa, 2017). In a summary, Mwaijande (2014:8) informs that:

....assistive devices are important means to empower students with disabilities. If offered accordingly it turns individuals from being dependents to independents by developing their consciousness, competence, independent life and confidence thus enabling the development of the respective individual.

From this, it is worth noting that the technology appears to promote independence in learning and self-determination of students with disabilities which in turn enhance inclusion learning process. The technology is also considered to be the concrete means to accessing information, enhancing communication, mobility and environment control just like their peers with normal abilities (Alves et al., 2009). In all, the assistive technology resources have become component in all educational development and settings notably in the area of special needs (McMurray & Pierson, 2016).

The substantial impact of AT to the students with disabilities has forced a number of stakeholders in industries, health and education to come up with numerous initiatives. For far too long, World Health Organization (WHO) has been in forefront to promote a well-being for all regardless of age and sex globally. It is more remarkable efforts in recent years whereby the organization established a global initiative known as the Global Cooperation on Assistive Technology (GATE) in 2014. This was in partnership with stakeholders who represent international organizations, donor agencies, professional organizations, academia, and user groups. The GATE initiative has a goal to improve access to high-quality affordable assistive products globally. To achieve this, the GATE initiative is focusing on five interlinked areas (5P): people, policy, products, provision and personnel (WHO, 2014). Besides, in 2015, the United Nations Member States endorsed the Sustainable Development Goals. In which promotion of well-being for all at all ages and equitable and affordable access to assistive products needs are integral part of universal health coverage. As in 2018, a total of 175 Member States had ratified the United Nations Convention on the Rights of Persons with

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Disabilities since its adoption in 2006. Ratification obliged to ensure access to assistive technology at an affordable cost and to foster international cooperation in order to achieve this (WHO, 2017). For past three decades, many countries in Sub-Saharan Africa have witnessed extraordinary progress in establishment of comprehensive rehabilitation programs for provision of assistive devices for students with disabilities. In Tanzania, collaborative efforts between the government and development agencies to enhance access and use of assistive technology are in place. Notable effort has been seen on the formulation of National Policy on Disability in 2004. The policy provides guidelines and sets parameters for services delivery and covers a wide range of important areas education and assistive devices (Mwaijande, 2014). Regarding assistive technology, the policy insists the access to and use of assistive devices by the people with disabilities. Accordingly, the University of Dar es Salaam has established a Special Unit in the School of Education to support students with disabilities by offering assistive resources for successful learning (Eligi & Mwantimwa, 2017).

Whereas noticeable initiatives to improve the access to assistive technologies in developing countries are in place, low usage of assistive technologies appears to be one of the critical problems despite the positive impact AT has (Eligi & Mwantimwa, 2017; Mwaijande, 2014; Gronlund, Lim & Larsson, 2010). As a result, students with disabilities dependency from other students remain one of the longstanding problems in Tanzania higher education institutions. Depending on student assistants undermine independent, self-determination and participatory learning process and disempowers students with abilities to use diverse assistive technologies (e.g. Chambers, 2019; Eligi & Mwantimwa, 2017; Alves et al., 2009). Furthermore, low usage of assistive technology is accompanied with poor academic performance to students with disabilities (Bakari, 2017). Some pressing questions on what students with disabilities perceive and factors undermining the use assistive technology resources available remain unanswered by prior studies (e.g. Mwaijande, 2014; Ndumbaro, 2009; Ndijuye, 2009; Majinge, 2014). The main focuses of these studies were on the use of ICTs and assistive devices in schools and libraries. In fact, numerous studies have been conducted to examine and explore the use of assistive technologies in education context globally. The studies to examine and explore the use of assistive technology across range of disability categories in higher education institutions are few (e.g. Bouck & Long, 2020; Dorman, 1998). More to note, the study to explore the use of assistive technology by students from range of disability categories in Tanzania higher education institutions is hardly to be found. This makes little to be known on the types of assistive technology deployed to support learning, perceptions and the factors undermining the effective usage of assistive technologies in Tanzania higher education institutions particularly UDSM. To gain deeper insights, the present study explored the usage of assistive technologies available in the School of Education Special Unit of the UDSM. The specific

objectives were threefold: Examine the types of assistive technologies available to support students with disabilities; explore students' perceptions on the usage of assistive technologies; and analyse the usage undermining factors by the students with disabilities.

LITERATURE REVIEW

Types of assistive technology

AT consists of a range of devices and services used to support students with disabilities in accomplishing various education tasks. Types of assistive technology resources vary from one individual with disabilities to another although some are used across individuals with disabilities. Regarding visually impaired students, Senjam et al. (2020) reveal that tactile and sound-based assistive technology such as braille (e.g. books, slate and stylus), handheld audio recorders and screen readers were used by majority (>50%) of the visually impaired students. Other resources used by the majority of visually impaired student include abacus, walking long canes, smart cane, audible balls, braille chess and embossers, talking watch, touch screen, voice recognition systems, video magnifiers and other special software (Senjam et al., 2020; Arslan & Inan, 2010; Dorman, 1998). In specific, braille technology was used by visual impaired students for reading and writing and printing (Senjam et al., 2020). Computer, internet, tape and DVD player were also used to foster learning among the students with visual impairments (Arslan & Inan, 2010). Technology such like eyeglasses, text magnifiers, joysticks, enlarged keyboards, screen readers, magnifying computer software, talking book player, monocular, binocular, portable braille note taking are used to increase and maintain an individual students' ability to take notes, read and write while white cane GPS-based navigation device are used to help them in navigating independently (UNICEF, 2015; Dorman, 1998). In examining assistive technologies used by students with disabilities in Turkey, Arslan and Inan (2010) found that majority of students with visual impairments used computer frequently.

For students with hard hearing or deaf, the literature show that various assistive technologies are in use. The technology resources available and used permit amplification of speech and other auditory signals. These resources include devices like headphone, hearing aid, amplified telephones and hearing loop (Bell & Foiret, 2020; Rekkendal, 2012; Arslan & Inan, 2010). These are important amplifiers used in different settings be at classroom and hall of residences. For example, text telephone (TTY), closed captioning devices, real time captioning and environmental aids, assistive listening and visual alerting device support independent living skills of students with hearing problems. Assistive hearing device technologies continue to grow more complex and many of the new innovations in this field may be useful in developing countries. Innovative hearing assistive technology devices have been seen in wide range dynamic compression and noise reduction algorithms and digital speech enhancement. The devices like directional microphones, advances in acoustic feedback reduction, moisture

and dust resistant casings, and self-adjustable or trainable hearing instruments are also in use globally (McPherson, 2014, 2011). For instance, closed captioning help students with hearing challenges to comprehend television and other audio-visual (Dorman, 1998).

Regarding students with severe expressive communication impairments, a range of low to high technology devices are available. Devices such as object based communication displays, picture communication boards and books, talking switches, voice output communication, and computer based communication devices are available to aid hearing among students with hearing impairments. These devices provide students with cognitive disabilities with opportunity to access different education settings which in turn help them to accomplish different learning tasks. Other communication devices used by students with cognitive or intellectual disabilities include grips for handling materials and stabilization devices for supporting work materials. Furthermore, the students with intellectual disabilities use electronic appliance like staplers and paper shredders and an environment control unit. For example, a picture based task schedule can be used to represent all of the steps in particular activity for students with intellectual disabilities. Electronic communication devices as augmentive and alternative (AAC) devices are used to supplement or replace existing verbal communication in students with communication difficulties. For example, electronic communication boards or speech synthesizers yield speech output in the form of synthesized speech which is a reproduction of the human voice while text-to-speech devices allow the student to input the data in text form and output it in speech form (Bouck & Long, 2020; Dorman, 1998).

Apart from that, students with physical disabilities are not left behind when it comes to assistive technology use. For example, students having challenges with fine motor skills use larger keyboard and speech recognition while using computers. The devices such like head trackers, touch screen serve as alternative to computer mouse (Ahmad, 2015). Along that, the devices such as wheelchairs, computer desk adjustment, wheel trays, walkers, scooters, crutches, canes, adaptive seating devices and orthotic devices help with mobility (Mouse4all, 2019; UNICEF, 2015; Arslan & Inan, 2010; Rigby, 2009). On this, Coleman (2011:4) summarises that:

For students with physical disabilities, AT devices may include those which increase physical access as well as items which increase the capacity for communication or performance of academic tasks. Such devices range from low technology, which includes none electronic items such as pencil grips or paper communication boards, to middle technology including battery operated devices such as calculators or hand-held spellcheckers, to high technology, which includes items which are electronic or mechanical in nature such as computers with assistive software.

On the whole, the types of depend on the severity and type of mobility impairment. This implies that a different device can be used by individual students. For example, an individual with

quadriplegia may use an electric wheelchair controlled by an adaptive switch, a mouth stick or a head wand and an injured veteran may use a prosthetic device (Mouse4all, 2019). Other devices that are used by students with mobility problems include input devices, switches, computer and software. Whereas input devices help students with mobility problem to control computer, switches permit students with movement difficulties and disorders to activate computers and other appliances through simple motions (Bouck & Long, 2020; Dorman, 1998).

Perceived importance of assistive technologies

The benefits accompanied with the utilisation of assistive technology resources in education by students with disabilities are many (Chambers, 2019). It is evident that “the use of appropriate AT is a key facilitator within the educational environment and has a positive impact on the educational outcomes for students studying at college or university” (Bell & Foiret, 2020: 1). That’s why WHO (2017: 3) opines that “the impact of assistive technology goes beyond the benefits of health and well-being to individual users and their families.” In all, AT works to support students to augment existing abilities and compensate for or bypass difficulties they may experience (Chambers, 2020). Numerous extant studies (e.g. Chambers, 2019; Ahmed, 2018; Eligi & Mwantimwa, 2017; Alves, 2008) documented the importance of AT in education context. For example, Ahmed (2018) in studying the perceptions of using assistive technology for students with disabilities in the classroom found that 96% of participating respondents perceived that AT makes a significant difference in students’ performance. Specifically, the technology found to help students to perform different learning tasks (MacMurray & Pierson, 2016) such like writing, rewriting and correcting texts (Ahmed, 2018; Arslan & Inan, 2010), taking notes (Eligi & Mwantimwa, 2017), assimilate and communicate text (Nordstrom et al., 2019). These findings corroborates with those found by Alves (2008), whereby 84.2% of the respondents perceived that the assistive technology resources were very important to enhance reading, writing and communication skills. The author further revealed that the access and use of AT facilitates the overall learning process and enable students with disabilities to better adjust to regular learning processes and academic domains. In support, Arslan and Inan (2010) report that AT permits students with disabilities to effectively communicate with others. WHO (2017) reveal that the appropriate use of AT resources such as hearing aids improve language skills while wheelchairs increase access to education environment. The contribution of AT on the development of diverse skills is also reported by Kamei-Hannan et al. (2019).

Apart from that, the access and use of AT resources have been found to foster inclusive classroom for all students regardless of the abilities. More importantly the use of the technology enhances independent and participation in learning process (Nordstrom et al., 2019; Ranada & Lidström, 2019; Ahmed, 2018; Arslan & Inan, 2010; Riemer-Reiss, 2000; Phillips & Zhao, 1993). McMurray and Pierson (2016:59)

summarises that “...the assistive technology promotes greater independence by enabling students with disabilities to perform tasks that they were formerly unable to accomplish or had great difficulty accomplishing.” It is also important to note that the use of AT improve the students' quality of life, with autonomy and privacy, and promote the inclusion of students with disabilities and social interaction in the school environment (Nordstrom et al., 2019; Alves et al., 2008). Regarding learning environment, McMurray and Pierson (2016) inform that AT help students with disabilities to maximize the learning environment by enhancing the functional performance. Along these, the AT resources have been found to provide students with disabilities with opportunities to achieve optimal functional ability (Chambers, 2019; Perfect, Jaiswal & Davies; Riemer-Reiss, 2000), ability to perform programming, designing product work and overcoming barriers caused by specific impairments (Arslan & Inan, 2010).

Furthermore, the technology resources have been found to foster the access to and use of information resources among the students with disabilities to the same information source their peer use. For instance, the use of computer by a low-vision and blind students help them to communicate and access information resources from various databases, libraries and stores. The AT resources made information sources available and the content of the teaching materials more attractive than the traditional resources (Alves, 2008). In investigating the effectiveness of assistive technology to enable internet access for individuals with deaf blindness, Perfect et al. (2019) revealed that AT foster e-learning among individual students with deafblind. Particularly, the assistive software permits access to e-learning module and library information resources (Perfect et al., 2019; Gorodnitsky et al., 2011). Along that, the technology have been found to permit the students with disabilities to access and navigate web pages via Morse code vibration (Norberg et al., 2014), access and read various electronic documents (Ozioko & Hersh, 2015; Veal & Maj, 2011). With the use of AT, students with disabilities have ability to access electronic journals, books and other electronic resources (Arslan & Inan, 2010).

Factors undermining the use of AT resources

Despite the substantial impact AT resources has, factors undermining the access to and use of assistive technology by students with disabilities are many (Chambers, 2019; Eligi & Mwantimwa, 2017). These factors are broadly categorized under economic, information, knowledge, social, political and cultural contexts. These seem to affect the use of assistive technology, which in turn lead to unsatisfaction, underutilization and abandonment of AT usage (Ranada & Lidström, 2019). For example, lack of awareness of the existence of affordable assistive products, unsatisfaction and problem of sustainability are the factors undermining the access and use (WHO, 2017; UNICEF, 2015; Okonji & Darlington, 2019). This has negative implications to many people with disabilities. Evidently, many people with disabilities have little or no access to basic AT resources such like hearing aids (WHO, 2017). Apart from that,

unavailability of assistive technology training opportunities have been found to constrain students with disabilities to utilize AT in learning process (Said, 2018). Inadequate training opportunities on the use of assistive technology resources are associated with shortage of experts to facilitate training (Ahmed, 2018; Eligi & Mwantimwa, 2017; Flanagan, Bouck & Richardson, 2013; Edyburn, 2004; Copley & Ziviani, 2004; Gumbo, 2003). It appears that competent instructors, librarians and system administrators are inadequate (Said, 2018). A study by McPherson (2014: 360) avows that:

Three key barriers to widespread access to hearing device provision in many low and middle income countries (LMICs) are identified: lack of trained personnel, the high cost of many existing devices marketed in LMICs and limited public awareness of the benefits of hearing assistive technologies.

It appears that out of the three barriers identified by McPherson (2014), lack of suitable training constitutes a major barrier to effectively access and use of assistive technology (Todis, 2001). This is associated with the fact that many teachers are not adequately trained on how to use technology effectively (Ahmed, 2018; Hasselbring & Glaser, 2000). It is evident that some of the AT resources require a great deal effort in order for students with disabilities to access and properly use. This entails that the possibilities of using them without training is low (Ahmed, 2018).

The literature also discloses that negative attitudes, difficulty of obtaining and managing assistive facilities, financial and time constraints are critical problems undermining the access and use of AT among students with disabilities. For example, the assistive technology resources have been found to be very expensive (Gumbo, 2003). This indicates that numerous individuals with disabilities cannot afford to acquire them. Besides, the use of assistive technology resources has been found to increase labeling students with disabilities negatively which in turn causes emotional harm (e.g. Ahmed, 2018; Flanagan et al., 2013). Other factor associated with poor access to and use of AT include poor internet service, poor network connectivity, poor electricity infrastructure, illiteracy (Gumbo, 2003), unreliable design, unfriendly regulatory frameworks such like legislation, policies and procurement (UNICEF, 2015). Regarding unreliable design and availability, UNICEF (2015) opines that “although a wide range of types of assistive products are available globally, they are not available everywhere and all designs are not appropriate in all settings.” Besides, challenges such as insufficient assistive technology resources to cater for the needs of students with disabilities have been seen to constrain the use (Eligi & Mwantimwa, 2017; Gumbo, 2003).

The access and usage problems appear to increase dissatisfaction and discontinue use of assistive technology resources by the students with disabilities as noted by some of extant studies (e.g. Riemer-Reiss, 2000; Phillips & Zhao, 1993). In which, Tewey, Barnicle and Perr (1994) empirically found that abandonment rates of assistive technology by people with disabilities range between 8 to 75 percent. One of the attributing factors for abandonment of assistive technology resources use

by people with disabilities is unsuitability of the resources (Carey & Sale, 1994) and insufficient experts to enhance application of the assistive technology resources (Reed & Kanny, 1993). In different note, the other prior literature cite unfriendly environment, poor transport services and infrastructure (e.g. roads), physical barriers such as stairs, poor lighting, unclear symbols and complexity of operating the AT are also critical factors to undermine the access and use of assistive technology resources (UNICEF, 2015).

MATERIALS AND METHODS

Qualitative approach integrating exploratory research design was employed as a framework for collecting, processing and analyzing data. This was used to collect in-depth information to increase understanding on what students with disabilities perceive about the use of assistive technology resources available in the School of Education Special Unit and the factors undermining the usage. The main explanations why exploratory design was used were twofold. Firstly, the design was appropriate for collecting data on opinions, attitudes and perceptions for assistive technology use by students with disabilities at UDSM. Secondly, it was deemed appropriate due to the fact that a topic in question was little explored, so there is little information about the relevant constructs (Tavakoli, 2012) on usage of assistive technology perceptions.

Regarding the study area, the study was conducted in the School of Education Special Unit at the University of Dar es Salaam in June, 2018. The UDSM was chosen because of its well established history of serving students with disabilities in education issues under the Special Education Unit in the School of Education. The unit offers students with disabilities with assistive technologies resources and training as part of institutional efforts to supporting learning. Besides, the unit facilitates the access to diverse information which foster learning among students with disabilities. The target population in this study was students with disabilities, instructors and student assistants. This was mainly to gain deeper insights on the use of assistive technology resources in supporting learning.

To get a sample, convenience and purposive sampling procedures were employed. Purposive and convenience sampling procedures are appropriate to the study that intends to explore in-depth information and help the researcher to get optimal data (Mwantimwa, 2020). Whereas students with disabilities were conveniently chosen, instructors and student assistants were purposively selected as the key informants of the present study. Basically, instructors play a key role in helping the students with disabilities by providing training on the use of assistive technology resources. Student assistants are providing assistance to the students with disabilities in daily basis such like taking notes, translating, reading services and taking them to classes, markets, cafeteria and hall of residences. A total of 23 key informants were involved in the study. Of these, 15 were students with disabilities, 6 were student assistants and 2 were instructors. Students with diverse disabilities such as visual (Female = 3, Male = 5), hearing (Female = 1, Male = 0), and

physical (Female = 2, Male = 4) impairments took part. In all, the number of students with visual impairments was larger compared to other students with disabilities like hearing and physical.

Accordingly, the study mainly used semi-structured interview and observation methods to collect data from the key informants. The semi-structured interview sessions were administered by the researchers and research assistants through face-to-face interview which took 30 to 40 minutes. Only open-ended questions were administered to the key informants. The questions such like 'What types of assistive technology available in the unit? What types of assistive technology do you use frequently, how do you perceive about the importance of assistive technologies? How assistive technology foster learning process? What factors undermine the use of assistive technology available in the unit?' Along that, the researchers got opportunities to observe the assistive technology resources and supporting infrastructure available in the unit. The data collected was transcribed, organised, coded and subjected to thematic analysis which based on the study objectives. Finally, narration form was used to present the results.

RESULTS

Types of AT resources available and used

Table 1: Types of AT resources used by students with disabilities

Type of AT	Frequency of use		Usage by students with disability			
	F	NF	VI	PI	CI	HI
Audio tape recorder	√		√			
Typewriter	√		√			
Magnifier lenses		√	√			
Braille Embosser		√	√			
Closed circuit TV		√	√			
Perkins Braille	√		√			
Note taker computer		√	√			
Scanners		√	√			
Screen reader	√		√			√
Laptops		√	√	√	√	√
Hearing loop		√				√
Wheel chairs	√			√		
Walking sticks	√		√	√		
Three wheeler motorcycle		√		√		
Note: F = Frequently; NF = Not Frequently; VI = Visual Impairment, PI = Physical Impairment, CI = Communication Impairment, HI = Hearing Impairment						

Table 1 summarises types of resources available, used and needed. The students with disabilities were asked to indicate the types of assistive technology resources accessed, used and needed in the School of Education Special Unit at the University of Dar es Salaam. The question was asked to get clear understanding on the types of assistive technology resources available and used to support learning.

The results suggest that there are various types of assistive technology accessed through the Special Unit. Resources such like audio tape recorder, typewriter, screen reader, Perkins Braille were frequently used by visually impaired students while wheel chairs were frequently used by physical impaired students. It is also worth noting that most of the resources accessed by students with visual disabilities. Regarding the access to, one of the key informants (P22) informed that:

The unit acquire AT resources for students with different disabilities. The resources that are not available the university through the special unit acquire them when the need arise. No students with disabilities are left without assisted. The university has invested a lot of money to support the acquisition of ATs. To enhance the use of AT resources, the unit organizes training at the beginning of the academic year of each year. Training such as typewriting skills and use of computers is organized.

This shows that university is committed to serve students with different disabilities as narrated by one of the instructors.

Students' perceptions on the use of assistive technology

Based on the results from the interview session, almost all students perceived that AT are useful to them while only one perceived not useful. In all, the results suggest that the students with disabilities perceive that AT are useful to supporting their learning. In particular, the assistive technology appear to foster learning through accessing online information resources, accomplishing learning tasks, reading and writing abilities, and enhancing performance. For example, one of visual impaired student [P1] cited that:

The assistive technology resources available in the special unit are useful because without them how could I possibly make it? The resources helps us to perform our daily academic activities such as doing assignments, taking notes and personal studying because are made to suit our needs as visual impaired people.

In his words, one of the instructors (P23) narrated that:

The development of computer technology has changed the way we used to assist students with disability. The computer is becoming important liberating tools for students with disabilities. That is why most of students are opting for computer usage rather than Perkins Braille. Previously, it was difficult for students with disabilities to prepare notes, read and write examinations. With the use of computer technology, students may prepare notes, read, communicate and write examinations.

When responding to the question on how perceive about assistive technology available in the special unit, student with hearing disability (P9) added that:

I perceive that assistive technology resources are useful to support us in accomplishing various learning tasks. For example, they help us to take notes, writing our assignments and accessing learning materials from various sources. So I prefer to visit the special unit because it is easy to get assistance more closely. I'm not totally deaf but I cannot be treated like other students who have no hearing problem, so I use the assistive technology resources available in the special unit for enhancing performance.

This is also supported by the student with physical impairment [P10] that the assistive technology available in the unit helped them to support their learning through searching online materials, doing assignments and getting notes. In his words, summarised that:

I spend much time in the special unit for accomplishing various assignments, searching online library materials from different databases. The special unit provides conducive environment and quietness for studying. I also prefer using the computer lab for studying. There is no way that students with disabilities cannot be favored by the assistive technology resources in the unit because they are meant for us.

It is important to note from these quotations that the assistive technology resources accessed from the special unit are very useful to support learning process among the students with disabilities. This is not the case to one of students with physical disability [P6]. This student had different perception on the usefulness of assistive technology resources available in the unit. The following were narrated:

I cannot establish to what extent the assistive technology resources available in the special unit are useful to support my learning process. Despite of my physical disability I can independently move to different university environment. I see others using the special unit but I can say they might be important or not. I don't think if I have to use the special unit resources because my mobility difficulties do not limit me to go wherever I want. So I can use other gadgets (such as smart phone and computer) and access library service like other students without disabilities.

A follow-up question was asked by the research to this student on why he was not using the special education resources while they are given privilege. The following were his words:

I think I can manage to use the library resources like other students as I said. I don't want to feel like being isolated. I like socialization with others. I feel like having a special unit for students with disabilities is like isolating them from others. Why do I need to feel lonely while I can manage to move despite of my physical disability? Having the unit at the university discourages inclusive education system.

These clearly disclose that attitudes of some of the students with disabilities undermine effective usage of assistive technology acquired by the university. According to the responding student, introducing the special unit at the university is one of the factors for isolation.

Factors undermining the use of AT

All key informants (i.e. students with disabilities, student assistants and instructors) were asked to provide their opinions on the factors undermining the use of AT resources that available at Special Unit. Generally, the results suggest that there are numerous factors undermining the usage. Factors such like poor internet service, inadequate application knowledge and skills, portability problem, inconvenience, unreliable power service, shortage of assistive technology were mainly cited. For example, one of the visually impaired students [P3] narrated that:

During lectures we have to use tape recorders, but sometimes we find that there are no batteries. As a result we just sit in lecture rooms, but we cannot take notes. We try to listen, but we cannot remember everything at the end of the lecture. Sometimes we fail to perform well, not because we are not intelligent, but because we lack the necessary equipment and materials.

This narration discloses that inconvenience is one of the factors undermining the usage of assistive technology resources. Besides, another visually impaired student [P4] testified that:

Assistive technology resources are very useful but accompanied with diverse challenges because sometimes I find other computers not working or sometimes occurs technical problem which takes time to solve it. In many circumstances it is not easy to get immediate assistance. System administrators are not always there to help if technical problem occur. Sometimes we find it awkward to use these special tools due to being hard to use them. This forces us to consult experts whereby sometimes you find them busy, it gets difficulty to ask for assistance while attending others. Previously, the unit had inadequate number of experts to serve students with disabilities. The unit has few staff who are very knowledge with AT applications.

In her words, student with visual impairment [P13] said that:

We do not frequently use assistive technology resources because we do not need them but we need them. The main problem that discourages the use is the speed of some assistive technology. For example, I always use Perkin Braille but it is not fast as Braille Embosser machine. I only have to use it when I find that the Braille Embosser is in use. Really, the Perkin Braille is very slow and needs much effort to use.

Regarding inadequate application skills and knowledge, student with visual impairment [7] narrated that:

Most of the assistive technology resources require adequate application knowledge and skills. Most of us we don't have adequate knowledge and skills to use them. This is associated with the fact that we don't receive adequate training to foster the use of assistive technology resources. We only receive instructions from our instructors without appropriate training. Sometimes we fear to use some of the assistive technology available in the unit.

In contrary, one of the instructors (P23) informed that:

We are organizing training for students with disabilities but most of them are not attending the training. As a result, very modern and expensive note taker computers available in the unit are not effectively utilized. For students with disability to use computers need adequate knowledge. Another problem accompanied this is attitudes of students with disabilities.

One of the student assistants [P18] informed that

We are always there to assist students with disability because most of them are not using assistive technology resources effectively to support their learning. The software that can help them to read and write is not frequently used. That why we are there to providing reading services. I think they are not competent to use the resources. As a result some students avoid using the available AT resources.

Besides, one of instructors [P22] has informed that:

The number of students with disabilities who come to use the available resources is too small compared to the number of students who are registered by the university. More than two third of them are not coming to use the resources. I used to see the same face coming to use the resources. This is not associated with lack of awareness because during the orientation week we used to inform them about the resources available in the special unit. Attitudes could be the main factors for not visiting our unit.

Noting from these narrations, difficulties of using the technology and speed of some technology resources such like Perkin Braille are the factors undermining usage. Difficulties of using them seem to be a critical factor to undermine the usage since effective use of AT resources requires adequate knowledge and skills. Poor internet service was also exposed by the students with disabilities as the factor hampering effective use of the resources. This was exposed by one of the student [P5] with physical impairment that:

The internet is not always with high speed. Experience shows that early in the morning the internet is with high speed because there are few users at that time. So it is possible to download materials from different databases. In fact, during the day time the internet becomes slow which limit the possibility of effectively accessing and downloading learning materials from different databases. This tendency discourages us to go there and use the AT resources available in the unit. I opted for my mobile phone internet rather than internet service at the university. Nowadays, I used to search learning materials through my own smart phone. When it is necessary sometimes I visit the unit during the morning where the internet is faster.

In the same note, another student [P11] with physical impairment had the following to say:

I use internet for online learning resources but much time taken for loading internet and downloading materials. The other time I have to use the desktop computer for typing but suddenly disruption of power happen. If there could be strong internet I could finish my assignment before the other problem of electricity to happen. I have to wait for the other time. Worse still, the available generator is not automatic. It is manually operated which need someone to switch on. When the person who is responsible to operate the generator is not there, no way out for power to gets back.

These show that unreliable internet and power are the attributing factors to undermine the use of assistive technology resources in the special unit. These also limit students with disabilities from accessing the learning resources from different databases. Regarding problem of portability, one of the students [P12] with visual impairment insisted that:

Most of the assistive technology facilities are not portable. Sometimes we need to study not necessarily on the specialized environment but we cannot move with some of the facilities. We also need to interact with others for discussion but makes us difficulty to move with the facilities that assist us to read and write. I wish the tools such like CCTV could have been portable

like laptops to allow me to use them anywhere and those which are portable are time consuming and difficulty to use like lens magnifier and Perkin Braille

Apart from portability problem, inadequate assistive technology was seen to be one of the factors undermine the usage. A student (P9) with hearing impairment exposed that:

The assistive technology resources we need are inadequate. In most cases we don't find the technology resources support our hearing problems. This is the main reason for not visiting the special unit. Along this, the information the types of assistive technology available in the unit is not effectively communication. Sometimes lack of awareness limit us to visit the unit.

This clearly show that the problem of portability of some of the assistive resources have been found to deter the effective use of the technology resources. This implies that being hard to carry some of the assistive technology limit the usage by the students with disabilities. In addition, shortage of assistive technology and lack of awareness were also cited as the factors undermining the access to and use of the resources. Other factors identified by the instructors include technophobia among the students with disabilities, attitudes and their perceptions.

DISCUSSION

Noting from the findings, diverse types of assistive technology resources are in use by the students with disabilities. While some of the assistive technology resources are used across students with different abilities, others are meant for particular type of disability. For example, computers were used frequently by students with different disabilities such as physical, hearing and communication. In surprise, responding students with visual disabilities confirmed to use computer frequently to support learning process which was not expected in the present study. On why computer was used frequently by students with disabilities, extant literature (e.g. Perfect et al., 2019; Eligi & Mwantimwa, 2017; Gorodnitsky, 2011; Alves, 2008; Hasselbring & Glaser, 2000) associate frequency of use with multiple applications such like word processing, communication, research and access of library materials. Basically, computer appears to enhance the utilisation of other accessories, devices and software. Furthermore, the findings from the present study disclose that most of the available AT resources are used by students with visual impairment than those with physical and hearing impairments. This is not frequently reported by the prior literature (Evmenova, 2020; Chambers, 2019; Ripat & Woodgate, 2017; Gronlund et al., 2010). The main explanations for this are twofold. Firstly, the number of students with visual impairment is large than those with other disabilities such as physical, hearing and communication impairments. Secondly, most of the AT resources acquired by the special unit are made for students with visual impairment. Let alone that, few students appear to visit the unit frequently due to the quietness, friendly environment and assistance provided by the instructors. In contrary, UNICEF (2015) reports that AT resources are

accessed in unfriendly learning environment in most of education institutions. Besides, the findings reveal that students' ownership of smartphone and laptops is associated with low usage of assistive technology resources available in the unit. It is undeniable fact that smartphone and computer technologies are integrated with diverse assistive tools, software and accessories. Multi-functions of the smartphone and computer technologies are the pulling factor for their use by the students with various disabilities.

Furthermore, the findings clearly expose that the impact assistive technology resources have on the educational for students with disabilities is immensely. Access to and use of assistive technology resources have been found to foster learning directly and indirectly. Whereas some of the AT resources increase freedom of movement in different education settings such as hall of residence and restaurant, others facilitate actual learning process in the classroom, library and laboratory. In generic, the resources seen to play a potential role in supporting learning such as increasing independent, confidence and performance. These findings tally with what have been found by extant literature (e.g. Bell & Foiret, 2020; Nordstrom et al., 2019; Ranada & Lidström, 2019; Ahmed, 2018; Arslan & Inan, 2010). This implies that much reliance on student assistants is lessening by the use of AT resources. It is evident that effective use of the resources empower students with disabilities with abilities to take notes, read, write assignments, and communicate with others students. It is also important to note that AT resources provide an avenue to search online library materials conveniently from diverse databases which either subscribed by the library or open access (see also Ozioko & Hersh, 2015). More importantly, the access and use of AT resources believed to increase freedom and flexibility in learning.

The findings further disclose that not all available assistive technology resources are effectively and frequently accessed and used. The number of students with disabilities registered at the university is not matching with number of students with disabilities who frequently use the AT resources available in the unit. A number of factor appear to undermine effective access to and use of the available assistive technology resources. Inadequate competences on the use of available assistive technology resources is one of critical factors undermine usage by students with disabilities. This is mainly caused by scanty application training offered to them which in turn increase technophobia among students with disabilities. Worse still, students are not equipping themselves through attending the few training organised by the unit. Also, unreliable power supply and low internet bandwidth do not only hamper the use of AT resources but also hamper the access to learning resources from different databases. The problem of low internet bandwidth and unreliable power supply is not reported by significant number of prior studies (e.g. WHO, 2017; UNICEF, 2015; Okonji & Darlington, 2019). Besides, attitudes of some of students with disabilities hold back the efforts to foster the usage of AT resources available. Prior studies (e.g. Ahmed, 2018; Flanagan et al., 2013) support that the use of assistive technology resources has been found to increase labeling students with

disabilities negatively which in turn causes emotional harm. For example, in the surprise, the presence of specialized learning environment believed to undermine inclusive learning process. The findings also inform that portability problem limit the flexible use of the resources. In connection to inadequate AT resources, outdated resources have been spelled out as the factors to undermine the access and use. Despite the availability of AT resources, shortage of experts to facilitate training appears to limit its access and use which is also documented by the existing literature (see Ahmed, 2018; Said, 2018; McPherson, 2014; Flanagan et al., 2013).

CONCLUSION

Regardless of low usage, assistive technology has been found to be a very essential ingredient that plays a key role in fostering an inclusive learning environment to students with diverse learning needs. The effective access to and use of AT decrease students' isolation and dependence from other students and student assistants, increase social interaction and allow them to become part of regular learning settings in higher learning institutions.

IMPLICATIONS OF THE STUDY

The findings are expected to help the Ministry of Education, Science and Technology, Higher Education Institutions and funding agencies to formulate policies that favor students with disabilities by gaining new understanding on types of AT resources needed and frequently used to facilitate learning. The findings are also expected to be useful to administrators, librarians, ICT experts and other education stakeholders in creating readiness environment that foster the awareness, access and use of the AT resources in friendly manner. Accordingly, the study add new and extend the existing knowledge on the subject under study.

RECOMMENDATIONS

The results generated from the present study should be regarded as exploratory due to the small sample size drawn from the UDSM. There is a need to conduct a study extensively explore the phenomena. Furthermore, the study recommends that training on the use of AT resources such as note taker computer should be compulsory to all visually impaired students. To foster learning among the students with disabilities, the special unit should interact closely with the university libraries to increase the access to and utilisation of AT and library resources and services. Accordingly, the libraries should set aside the budget to acquire of teaching and learning materials such as talking books.

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