

Understanding the Uptake, Barriers, and Challenges to Using Screen- reading software for Learning Experienced by University Students with Vision Impairments in Pakistan

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ABSTRACT

The human rights model of disability views disability as the result of a bio-psychosocial construct involving physical, personal, and environmental factors, and recognises that disability is a natural part of diversity that should be respected and supported by society. It is estimated that 15% of the world's population are considered to have some type of disability and many of these people live in developing countries. People with disabilities (PWDs) have experienced marginalisation on many levels which has resulted in limited opportunities for participation in society. Although laws and policies have been formulated to address disadvantages, people with disabilities in Pakistan experience challenges accessing inclusive support and services, particularly in the education system. Modern information and communication technology devices and software can be used as assistive technology to overcome barriers to gaining an education; however, affordability, access, and attitudes are hindering the effectiveness of assistive technology solutions. University students with vision impairments use computers for learning with the assistance of a screen reader, which converts the display of a computer screen into synthetic speech through keyboard commands. Despite the availability of computer screen reading technology, students with vision impairment face difficulties in accessing learning material for studying at the university level. This research is one of the few conducted in the context of Pakistan that has sought to gain student perspectives on this problem. It aimed to discover the perspectives and challenges of university students with vision impairments in Pakistan on the use of Screen-reading software for learning at the university level and to describe challenges faced by the students in the acquisition of Screen-reading software. The research explored the benefits and challenges of Screen-reading software, and identified obstacles faced by university students with vision impairment in accessing learning content and other relevant material using Screen-reading software. A mixed method approach was adopted consisting of an online survey and semi-structured interviews. Forty-six respondents completed the online survey and ten participants took part in the interviews. The majority (97.8%, n=45) of the survey respondents were aware of and used at least one screen reader. Respondents were satisfied with the level of functionality of the Screen-reading software for learning and they considered it to be fundamental in supporting independent learning. Some respondents, such as women, and those from remote parts of the country or from low socio-economic backgrounds, reported

multiple learning barriers, such as limited access to computers, software, technical support, and training. However, respondents confirmed that for successful participation it is essential that computer-based learning is accessible. The prevailing lack of support and consideration the respondents received from teaching faculty and administrators at universities is a key barrier for them to succeed independently in their education. Respondents without support of teachers and fellow students experienced difficulties in their education, yet were found to have limited or no awareness of specific disability discrimination policy frameworks and legislation in Pakistan, such as for the provision of Screen-reading software. Thus, they did not feel empowered or supported in demanding equitable treatment or in complaining about denial of their basic rights. The findings of this study identify a need for the establishment of formal disability support mechanisms in universities in Pakistan to eradicate disability discrimination and foster more enabling conditions for disadvantaged students. The study recommends that other challenges identified in this research be addressed through participation of people with vision impairment in policy-making and in the design of Screen-reading software, which will support the promotion of university education in an inclusive and accessible academic environment.

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Definitions of Key Terms Used

Accessibility: The functionality of a product, service or building to be meeting the needs of individuals with different abilities and disabilities.

Access Technology, Adaptive Technology and Assistive Technology: Any product, equipment, instrument or technology developed or tailored to enable PWDs to function better (Borg, Larsson, & Östergren, 2011; Raziye, 2017).

Vision Impairment or Visual Impairment: People who are print challenged or who have no functional vision.

Screen-reading software or Screen readers: Software designed to enable people with vision impairments to access a computer through dedicated functionalities to use keyboard commands instead of the mouse and to convert the output content (display) of a computer into synthetic speech.

UN Convention on the Rights of Persons with Disabilities (UNCRPD): An internationally recognised disability rights instrument for the state parties that explicitly outlines the rights of individuals with disabilities.

List of Abbreviations

AI Artificial Intelligence

AT Assistive Technology or Adaptive Technology

CRPD/UNCRPD UN Convention on the Rights of PWDs

OCR Optical Character Recognition

NPA National Plan of Action

NVDA Nonvisual Desktop Access

PWDs People with Disabilities or Persons with Disabilities

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed by Muhammad Babar Shahzad (Please note that due to my vision impairment disability, I choose to sign documents using my fingerprint):



Date: 20 October, 2021

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CHAPTER ONE – INTRODUCTION

1.1 Definitions of Disability and Vision Impairment

According to the World Health Organisation, “Disability is the umbrella term for impairments, activity limitations and participation restrictions, referring to the negative aspects of the interaction between an individual (with a health condition) and that individual’s contextual factors (environmental and personal factors)” (World Health Organisation [WHO], 2011, p. 5). The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) defines disability as “Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others” (United Nations General Assembly, 2007). Therefore, disability is not the attribute of a person. Rather, external factors are causing disabling conditions preventing an individual from participating on an equal level in society (WHO, 2011).

Vision impairment is recognised as one of the most significant, often preventable or correctable disabilities that needs to be addressed as part of the United Nation’s Sustainable Development Goals (United Nations General Assembly, 2021). Vision impairment is defined and measured variously by different authorities; it ranges in degree and classification from mild vision loss to total blindness, and is characterised by having a complex matrix of causal factors, methods of diagnosis, and impacts on individuals (GBD Blindness and Vision Impairment Collaborators, 2021). However, vision impairment as a broad term can generally be described as severe reduction in vision that cannot be or has not been corrected with conventional glasses and which reduces an individual’s ability to complete activities of everyday life (WHO, 2021). Globally, WHO (2021) estimates there are 2.2 billion people with vision impairments, the prevalence of which is four times higher in low- and middle-income developing regions than in high-income developed regions. As a disability, vision impairment may result in a person being prevented from or discriminated against in participating equitably in society, for example, in accessing education, employment, accommodation, sport and exercise, transport, services, and public places (Australian Human Rights Commission, 2020; Bornman, 2021; United Nations General Assembly, 2007).

1.2 Paradigms of Disability

In defining the notion of disability, several approaches have been adopted, including the medical/charity model, and the social and human rights model of disability. Prior to the 1950s, a disability was predominantly considered to be a medical condition or a physical ailment that required some form of medical intervention or institutionalised care (Asghar et al., 2020). In the medical model of disability, persons with disabilities (PWDs) were segregated from mainstream society, and did not have equal opportunities to participate and contribute (WHO, 2011). The medical model of disability only views an individual's biomedical condition. It challenges the personhood of a person and is considered to dehumanise the individual based on their disability (Dirth & Branscombe, 2017). Because the medical model of disability is premised on the individual, it does not aim to address the systemic barriers in equal participation of PWDs in society (Dirth & Branscombe, 2017). In the medical model, there is a paternalistic relationship between disability care professionals and PWDs where the latter is considered to be the recipient of services rather than having individual autonomy (Anastasiou & Kauffman, 2011). The medical model is also closely linked with the tragedy theory of disability, which deems the individual to be the unfortunate victim of the disability (Dirth & Branscombe, 2017).

In contrast, the social model of disability externalises disability and considers social, environmental, and attitudinal barriers to be the causative factors for triggering disabilities (Goering, 2015). For instance, the medical model considers a wheelchair user through the diagnostic lens of the individual's impairment, whereas the social model focusses on the inaccessible environment or inappropriate legal/policy frameworks as the aspect that is disabling for the person (Dirth & Branscombe, 2017). The social model of disability aims to provide an enabling environment and eliminate infrastructural barriers and stereotypical attitudes towards PWDs (Anastasiou & Kauffman, 2011). By considering the dynamic interaction between the contextual factors and the health condition of a person, the International Classification of Functioning (ICF) provides a more comprehensive explanation of disability through a biopsychosocial model of disability (Jarl & Lundqvist, 2020). The ICF has significantly contributed to the adoption of present-day disability rights frameworks and has normalised and reconceptualised the connotations of disability (Griffo, 2014; Jarl & Lundqvist, 2020).

1.3 Prevalence and Impacts of Disabilities

Today, it is estimated that 15% of people around the world are living with a disability (WHO, 2011). People with disabilities are the major minority group of the world's

population who may experience discrimination, illiteracy, unemployment and lack of marketable skills, resulting in poverty, isolation and stigma (Meekosha & Soldatic, 2011).

1.4 Disability Rights Instruments

Internationally recognised human rights instruments and treaties provide general guidelines for ensuring the promotion and protection of the human rights of all members of society. However, PWDs and their representative organisations have always been compelled to explicitly promulgate rights instruments to ensure the inclusion of PWDs (United Nations General Assembly, 2007). The disability advocacy movement have persistently strived to bring about positive changes at a global level. These efforts have resulted in adoption of many international treaties and conventions aimed at ensuring the provision of equal opportunities to individuals living with disabilities (Gordon & Tavera-Salyutov, 2018). International disability rights instruments can be classified into the following categories: treaties that are binding on the member states; instruments that are not binding but are of an interpretive nature; and general comments that provide assessment and guidance for the appropriate implementation of the recognised human rights instruments (United Nations General Assembly, 2007).

1.5 Situational Analysis of PWDs in Pakistan

As in many other developing countries, PWDs in Pakistan are often overlooked and because of the prevalent systemic discriminatory practices, they are often excluded from society (Khalil et al., 2018). Owing to the lack or absence of support mechanisms by the state, PWDs are often dependent on their families to meet basic requirements and in the event of the family being from a low socio-economic background, a PWD is faced with double discrimination (Rathore et al., 2011). For example, children with disabilities have limited opportunities for gaining access to schooling (Yousafzai et al., 2011). Women with disabilities in Pakistan experience marginalisation stemming from sociocultural predispositions about one's disability and gender (Hammad & Singal, 2015). Statistics describing the prevalence and consequences of disabilities in developing countries are limited because of a lack of a consistent and comprehensive definition of disability and limited use of validated tools for measuring prevalence of disability (Somani et al., 2021). The constitution of Pakistan guarantees the provision of human rights and ensures dignity for all citizens. However, PWDs continue to experience multifarious challenges (Ahmed & Khan, 2011). As a result of no reliable estimates about the prevalence of disability in Pakistan, PWDs face challenges in the enactment of legislative and policy frameworks

aimed at ensuring equal participation of PWDs in community life (Razzaq & Rathore, 2020).

1.6 History of Disability-Specific Legislation/Policy in Pakistan

Laws to protect the rights of PWDs in Pakistan were not in place until 1981, when the first disability-specific legislation, *The Disabled Persons Employment and Rehabilitation Ordinance 1981*, was enacted in the country (Mallick et al., 2010). This legislation resulted in the establishment of a National Council for the Rehabilitation of the Disabled (NCRPD), which aimed to promote the welfare of PWDs in the country by establishing special education institutions in all four provinces of the country and specified one percent employment quota of PWDs in public and private organisations (British Council Pakistan, 2014; Government of Pakistan, 1981). The enactment of the ordinance was the first step towards the provision of services to PWDs in the country, but it failed to be implemented and, consequently, PWDs in the country were not empowered by the legislation (Khan et al., 2017). The ordinance defined disability from the medical model of disability and therefore psychosocial or intellectual disabilities were not included in the definition and continued to be overlooked in future policies (Razzaq & Rathore, 2020). As a result, PWDs in Pakistan continued to be marginalised across rehabilitation services, skill development, livelihood opportunities/employment, schooling, and social participation (Razzaq & Rathore, 2020).

As a result of persistent lobbying and advocacy campaigning organised by disability-focussed organisations and human rights groups, the *National Policy for PWDs 2002* (Government of Pakistan, 2002), was developed, which envisaged the creation of an enabling environment for PWDs (Ahmad & Ahmad, 2011). The *National Policy for PWDs 2002* brought about a shift of power in the design and execution of projects for empowering PWDs to be inclusive of individuals with disabilities (Gul, 2020). Despite the efforts of the Disabled People Organisations which was the key representative organisations of PWDs, the definition of disability in the national policy for Persons with Disabilities, 2002 considered the medical model of disability (Government of Pakistan, 2002). Later, the National Plan of Action (NPA), 2006 (Government of Pakistan, 2006), was formulated to operationalise the national policy for Persons With Disabilities, 2002 and was based on the notions of ensuring accessibility, inclusion and equal opportunities through integration and collaborative services for PWDs (Ahmed & Khan, 2011).

In 2008, the Government of Pakistan enacted *The Special Citizens Act (2008)* which guarantees accessibility for PWDs in public buildings, reserves priority seats in public transport for passengers with disabilities and required footpaths and zebra crossings to be made disabled-friendly (Ahmed & Khan, 2011). In 2009, the *Special Citizens (Right to Concessions in Movement) Act, 2009* was passed by the Government of Pakistan, which aimed to facilitate the movement for PWDs by offering special concessions for travelling by bus, trains and air travel (Pakistan Association of the Blind, [PAB], 2019).

The *18th Constitutional Amendment* passed by the National Assembly of Pakistan on 8th April 2010 devolved the various ministries and department of social welfare and special education, which is the main department responsible for ensuring inclusion of PWDs, to be a provincial matter (Gul, 2020). Following the 18th amendment in the constitution of Pakistan, provinces of the country were obligated to make laws to provide an enabling environment for PWDs (PAB, 2019). Sindh was the first province which promulgated *The Sindh Empowerment of the Persons with Disabilities Act 2018*. This act is mainly derived from the guiding principles of the CRPD and has provision to address a disability from the social perspective (PAB, 2019). The Punjab province adopted the *Disabled Persons' (Employment and Rehabilitation) Ordinance, 1981* by introducing amendments, such as an increase of three percent employment quota for PWDs (PAB, 2019). In 2017, with the enactment of the *Baluchistan Persons with Disabilities Act 2017 (Act, No II of 2017)*, the provision of rights of PWDs and the importance of the concept of independent living and individual autonomy have been recognised in the province (PAB, 2019). The persistent and collaborative advocacy and lobbying strategies used by the organisations of PWDs in other provinces are resulting in the initiation of the process of legislation about providing equal opportunities for effective inclusion to PWDs in Khyber-Pakhtunkhwa (KP) (PAB, 2019).

1.7 The Paradigm Shift of Understanding Disability

The recent decades have seen a paradigm shift of understanding disabilities from only a medical condition requiring institutional-based care to an inclusive model of disability. Now, the disability of an individual is viewed as a combination of personal impairments and extrinsic condition caused by an inaccessible environment. The World Health Organisation views disability as a part of human condition and a human rights issue (WHO, 2011). The human rights-based model of disability proposes the provision of an enabling environment for all regardless of their disabilities (PAB, 2019). The persistent advocacy efforts of

organisations of PWDs and human rights agencies have been imperative in policy and legislative reforms in Pakistan.

1.8 Assistive Technology

It is important to have a definition of assistive technology (AT) as it delimits the scope of the policy or law and informs service providers about the entitlements and what to include or exclude (Cook & Polgar, 2014). In defining AT, the (United States) *Assistive Technology Act of 2004* (2004) defines AT as “any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities”. However, this definition is mainly to improve functioning of an individual and overcome the challenges of a disability and is based on the medical model of disability, meaning it does not include environmental factors (Hersh & Johnson, 2008). The International Standard Organization (ISO) (2016), defines AT as “any product (including devices, equipment, instruments and software), especially produced or generally available, used by or for persons with disability for participation, to protect, support, train, measure or substitute for body functions/structures and activities, or to prevent impairments, activity limitations or participation restrictions”. The World Health Organisation defines AT as “Assistive technology is the application of organized knowledge and skills related to assistive products, services including systems and services (WHO, 2020). “Assistive products maintain or improve an individual's functioning and independence, thereby promoting their well-being” (WHO, 2020). Assistive technology helps ensure productivity and promotes healthy living by enabling PWDs to acquire education, participate in social life and access livelihood opportunities (WHO, 2018). The use of AT minimises the need for long-term care services (WHO, 2018). According to Hersh and Johnson (2008, p. 196), AT “is inclusive of products, environmental modifications, services and processes that enable access to and use of these products specifically by persons with disabilities”. They further discuss the application of AT to assist users to overcome infrastructural barriers to enable full societal participation and accomplish activities safely and easily (Hersh & Johnson, 2008). The definitions of AT are employed by service providers and other agencies to define what constitutes AT for the provision of funding and regulation requirements to create accessible environments and services to PWDs (Cook & Polgar, 2014). Without the use of AT, PWDs may experience exclusion from participation in social life, education and the job market exposing these individuals to poverty, isolation, and disease (WHO, 2018).

1.9 Frameworks or Models for the Provision of Assistive Technology or Services

In the design and delivery of AT, the models are intended to promote person-centredness and effectiveness by collaborative decision-making during the phases of provision of AT (Jarl & Lundqvist, 2020; Zabala et al., 2000). The Human Activity Assistive Technology (HAAT) model was introduced by Cook and Hussey (1995). In the HAAT model, the emphasis is on the person (human) performing a task (activity) in an environment/context while using an AT (Cook & Polgar, 2014). The HAAT model is first and foremost person-centred, and highlights that the technology meets the needs of the person instead of the person adapting to the technology (Cook & Polgar, 2014).

1.10 Access to Technology Through Assistive Technology

According to WHO, over a billion people with disabilities (PWDs) around the world need AT for learning or social participation; however, only one in ten PWDs have access to the AT or services they need (WHO, 2018). Moreover, the availability of AT in developing countries is further hindered by factors such as the cost of the technology, the lack of capacity to conduct training, and the lack of government commitment for undertaking research and development to ensure the production and provision of appropriate AT. The design of an AT device or product or service needs to be user-centred for ensuring efficacy for PWDs (Adam et al., 2016). The CRPD has mandated the development and provision of affordable and quality AT to PWDs; however, in developing countries especially many PWDs do not have access due to financial constraints or limitations in government programs (Tebbutt et al., 2016). In 2014, the WHO in collaboration with organisations of and for PWDs, professional organisations, UN/donor agencies, industry and academia from around the world established the Global Cooperation on Assistive Technology (GATE), which aims to support countries in the provision of appropriate AT to PWDs to enable them to comply with the CRPD (Tebbutt et al., 2016).

1.11 Screen Reading Aids or Special Output Software (ISO 9999, 2016)

People with vision impairment or blindness can take advantage of the use of modern technology with the help of various assistive or inclusive technology devices, software and adaptive services (Creed, 2018). People with vision impairment or blindness can use a computer with a Special Output Software (Class 22 39 12) (ISO, 2016). The screen reading aid converts the display of a computer into human sounding synthetic speech output. Screen-reading technology can be either a software or hardware device (McCarthy et al., 2013). The key task of a screen reader is to convert the visual display of a device

into either voice output or braille through a braille display (Southwell & Slater, 2012). By using Screen-reading software, students with vision impairments can independently use word processors, send and receive emails and surf the internet (Okonji & Ogwezy, 2019). Screen-reading software enables the print challenged user to access a computer and its various functionalities through extensive keyboard commands usually referred to as keyboard shortcuts (Kouroupetroglou et al., 2008). Some screen readers can ensure access to inaccessible (visual) content which is not accessible by conventional methods. They do this through their dedicated functionality of performing Optical Character Recognition (OCR) through the conversion of image-based or paper printed text into a screen reader friendly format for print challenged individuals (Browder, 2018). The modern Screen-reading software can provide audio descriptions of visual elements, such as pictures and graphics, through their dedicated features by utilising Artificial Intelligence (AI) making it easy for sight impaired users to access content independently (Peters, 2011). There are two major categories of screen readers: those that are commercially available for purchase, and those that are free and are open source, which have been developed and distributed at no cost for the user (Kumar & Sanaman, 2015).

1.12 Importance of Accessibility and the Challenges of Using Screen Readers

The World Wide Web Consortium (W3C) outlines priority accessibility considerations for enabling a larger user base, including those users with vision impairment, to access web pages (Menzi-Cetin et al., 2017). In order for screen reading programs to work in a desired manner and meet the user's expectations, the content must be accessible and useable (Andreas Kleynhans & Fourie, 2014). The accessibility for screen reader users is important because, unlike sighted users who can visually develop an idea of a page and access relevant information, users with vision impairments are dependent on the spoken and often detailed description of the page making it harder to locate the required information (Sarwar & Eika, 2020). Digital versions of books, journals and other learning material in libraries and online are often inaccessible via Screen-reading software; therefore, there are limits on what is available for people with vision impairment (Menzi-Cetin et al., 2017). For example, according to Southwell and Slater (2012), in the United States the prevailing inaccessible digital content in libraries constitutes 58%, and only 42% of the academic content is accessible with the use of Screen-reading software. Moreover, a study about the web accessibility of twelve university websites in the US found that a majority of them were noncompliant and only one university had adhered to the guidelines of W3C (Harper & DeWaters, 2008). Consequently, Menzi-Cetin et al. (2017) argue that universities need to

ensure accessibility of web pages to enable students with vision impairments to remain updated about opportunities and events organised by the institutions. Moreover, the design of instructional material produced by all education institutions, governments, business, and professional bodies needs to be developed in compliance with the W3C accessibility standards. Otherwise, screen readers may not be able to access the content making it difficult for a person with vision impairment to learn on an equal basis (Lazar, 2019; Varonis, 2015).

Other barriers beyond accessibility of content include training and awareness about Screen-reading software. Adequate training in the use of Screen-reading software is important to support the use of Screen-reading software for learning (Lazar, 2019; Nees & Berry, 2013). Moreover, the cost of Screen-reading software is a limiting factor in the availability of the appropriate technology. People with vision impairment in less resourced countries, or from lower socio-economic families, may not have sufficient income or financial support from the state to enable them to acquire a suitable screen reader for their needs (Kumar & Sanaman, 2015; MacLachlan et al., 2018). Often, there is a lack of consultation and involvement of people with vision impairment in policymaking and implementation of measures to assist them in terms of the practicality, economic feasibility, and user-friendliness of technology they are meant to use. For example, research has shown that people who specialise in computer and related technology development are often not fully cognisant or considerate of the technical requirements of an accessible design for people with vision impairments (Babu & Xie, 2017; Bin Tuwaym & Berry, 2018). As with barriers presented by poor public building and public transport design, accessibility barriers to computers and information on the World Wide Web create inequities for people with vision impairment and prevent them from enjoying the opportunities that are freely available to others.

1.13 Screen Reader Accessibility Challenges Faced by Students with Vision Impairments in Pakistan

Despite the development of technology, people with vision impairments in developing countries face multifarious challenges in gaining access to education opportunities and following professional employment pathways (Borg et al., 2011). However, the timely and appropriate provision of AT and training on its use can minimise the obstacles faced by people with visual impairment (Creed, 2018). The accessibility challenges faced by vision impaired students who rely on a screen reader have not been sufficiently researched in the context of Pakistan (Ahmed & Naveed, 2020; Awais & Ameen, 2015). In order to

understand the availability and use of screen readers by students with vision impairments at the University of Karachi, a study was conducted by Zia and Fatima (2011) who interviewed 29 students studying at undergraduate and postgraduate levels. Interviews through questionnaires, with open and close ended questions were organised with students. According to the findings of the study, none of the interviewees had access to books because of their vision impairment. The study suggests that 62% of the students use a computer and 72% of them wished to have a support person when using the computer for education. Furthermore, 24% of the students did not understand the layout of the keyboard, which is indicative of the lack of proper training in the use of Screen-reading software. Additionally, four percent lamented the unavailability of specialised software for visually impaired students and 27 (93%) of the interviewees discussed the lack of equipment and facilities for students with vision impairments. Eight of the students did not own a personal computer and hence had limited access. Due to a lack of training, two (7%) of the students could not use a computer.

This study is one of a very few conducted in the context of Pakistan that have investigated the needs and challenges of students with vision impairments. As such, Zia and Fatima's (2011) work more than a decade ago was an important initiative. However, only a small sample of students from a single campus of one university were recruited. Therefore, generalisations are difficult to draw, meaning further questions remain about the broader population of students with visual impairments across Pakistan. In particular, it is important to investigate the process whereby students with vision impairment in Pakistan universities can access and use a computer, and the challenges they face in customising screen readers to read local languages. Moreover, the study did not consider the existence of support mechanisms or policies, financial implications, the obstacles related to web accessibility, and its importance for print challenged users to access the information using screen reading technology. Therefore, it follows that further research is needed to broaden understanding of these issues and to reveal more about the current situation for students with vision impairments studying at universities in Pakistan.

1.14 Accessibility Difficulties Encountered by Students with Vision Impairments in India

A survey study similar to Zia and Fatima's (2011) was conducted in geographically nearby India, which investigated the level of awareness of available internet learning resources among 74 students with visual impairments studying in 12 government high schools of the district in Kerala, India (Soman & Sudhier, 2015). Most (59%) of the students were familiar

with the use and application of Screen-reading software, however, they did not have formal training in the use of computers or the internet for educational purposes, such as consulting online digital databases and other electronic resources. This was reported to hinder the students from taking advantage of the computer technology to access content related to their education (Soman & Sudhier, 2015). The study did not discuss the policy and legislative frameworks in the country to ensure the provision of assistive software to students with visual impairments. Furthermore, the sample size for the research is from a limited number of schools.

1.15 Importance of Tertiary Education for Students

The acquisition of a university degree can be an important factor in ensuring employment in the increasingly competitive job market around the world (Hartley, 2006). However, despite the availability of technology, students with vision impairments do not have equal prospects in gaining employment (Varonis, 2015; Vidali, 2007). Antonelli et al. (2018) [ENREF 11](#) found this to be the case with most of the respondents that took part in their study facing difficulties in applying for jobs because of the accessibility challenges with the Screen-reading software. Similarly, Bengisu et al. (2008) [ENREF 16](#) found that the use of a computer enabled the person with a visual impairment to accomplish their job without requiring the help and support of other individuals and, thus, increasing their employability and options for career advancement.

1.16 Access to AT in Pakistan

In Pakistan, government legislation and policies related to the inclusion of PWDs have been formulated and enacted; however, they are not aligned with the UN Convention on the Rights of Persons with Disabilities, which specifically refers the requirement for provision of AT to PWDs (Ahmed & Khan, 2011; Awais & Ameen, 2015). Article 9 of the UNCPRD requires state parties to ensure equal, meaningful and barrier-free access to information and communication technology by the provision of appropriate assistive and inclusive technology to individuals with disabilities (Gould et al., 2015).

The discourse in the academic literature about the effectiveness of the use of a computer through a screen reader has gained popularity among researchers and those interested in assistive technology around the world (Ajuwon et al., 2016). However, in Pakistan interest in the topic is still quite limited. Although a number of efforts have been taken to ensure the provision of training and access of technology to people with vision impairments, they continue to face challenges in acquiring a university education (Bashir et al., 2017). These

challenges include the lack of comprehensive studies in Pakistan to include the particular viewpoints of the PWDs who are the end-users of assistive technology in the country, the unavailability of screen readers, and absence of comprehensive training programs for people with visual impairments (Iqbal et al., 2021; Hussain et al., 2020). University students with vision impairments in Pakistan face challenges because of the inaccessibility of the learning content produced by the universities, difficulties accessing the latest technology, and exclusion from policy development (Iqbal & Shahzad, 2021). Apart from these obstacles, Hussain et al. (2020) concluded that Pakistan's university students with disabilities faced attitudinal problems with fellow students and teachers, difficulty of access to classrooms and libraries, "unfriendly teaching methods", hostile environments, lack of transport to/from/inside campuses, and lack of availability of assistive devices. No surprise then that people with disabilities have lower enrolment and higher drop-out ratios than their non-disabled peers at Pakistani universities (Iqbal et al., 2021; Hussain et al., 2020).

Due to social, financial, resource, and structural reasons in many countries, including Pakistan, the provision of AT for PWDs is inadequate despite nations having agreed to international conventions and treaties on the rights of persons with disabilities, such as those promulgated by the United Nations General Assembly (2018) and the International Human Rights Commission (2020). Thus, signatories to these conventions are obligated to eliminate disability discrimination, enable people with disabilities to live independently in their communities, ensure an inclusive education system, and protect people with disabilities from all forms of exploitation and abuse (MacLachlan et al., 2018). Accordingly, access to AT helps nations meet their obligations in the first three requirements relating to equity and inclusiveness in the education system and independence for PWDs in their pursuit of a quality education. Hence, MacLachlan et al. (2018) recommends that countries focus on the development and provision of AT and ensuring access to human-centred and context specific AT based on the Matching Person Technology (MPT) model or Human Activity Assistive Technology (HAAT) model. Moreover, the authors argue that in consultation with the intended end-user groups, formulation of appropriate policy, keeping in view the local needs and available resources, can also play an important role to ensure access by PWDs to AT and in this way, to enable PWDs to participate and contribute to society while living and working independently (MacLachlan et al., 2018). Thus, countries, such as Pakistan, need to enact new laws or amend existing legislation to facilitate the development of AT policies and, perhaps even more importantly, ensure these laws are

enforced and that barriers to access for PWDs are removed (MacLachlan et al., 2018; Nees & Berry, 2013).

People with vision impairments can use a computer screen reader as an AT to have access to computer technology (WHO, 2018). Developing countries have the potential for AT innovation to address the local unmet needs of developing AT and services for enabling PWDs to become contributing members of society (Smith et al., 2018). Pakistan ratified the United Nations Convention on the Rights of People with Disabilities (UNCRPD) in 2011, which entrusts the state parties with responsibility for ensuring the formulation of policies about the provision of AT for PWDs (Ahmad, 2015). However, the required policies are limited for ensuring the access of students with disabilities and this gives rise to an element of exclusion within Pakistan and in some other developing countries (Ahmed & Khan, 2011). The prevalence of exclusion of PWDs in developing countries is because of the lack or absence of an appropriate AT policy framework and services (Samant et al., 2013). In Pakistan, the challenges experienced by university students with vision impairments in the acquisition, customisability, and effective use of Screen-reading software has not been researched from the user's standpoint (Zia & Fatima, 2011). The problems faced by university students with vision impairments in Pakistan in acquiring education need to be understood from the perspective of the end-user and whether the required support mechanisms exist and are able to meet the needs of students. The provision of appropriate and context-specific AT is instrumental for enabling students with vision impairments to have equal access to information while acquiring education (Bouck & Flanagan, 2016; Smith et al., 2018).

1.17 Purpose of the Study

The aims of this research were:

- 1) to investigate the uptake, barriers and challenges experienced by university students with vision impairments in Pakistan with respect to using computer Screen-reading software for learning; and
- 2) to learn about the legal and policy frameworks in Pakistan for providing assistive technology screen readers to university students with vision impairments.

1.18 Research Questions

The following research questions were addressed by the study.

1. What Screen-reading software do university students with vision impairments use to support their learning in Pakistan?
2. What are the challenges and barriers experienced by university students with vision impairments in the acquisition and use of Screen-reading software in Pakistan?
3. What policy and legislative frameworks pertaining to the provision of Screen-reading software are university students with vision impairments in Pakistan aware of?

1.19 Objectives

The objectives of this research were:

1. To analyse what university students with vision impairments in Pakistan know about accessing learning content by adopting the necessary AT available to them;
2. To understand if students with vision impairments studying at universities in Pakistan use Screen-reading software while they study;
3. To understand if students with vision impairments face problems when using Screen-reading software and how they overcome these challenges;
4. To investigate, from the user perspective, how the legal and policy frameworks in Pakistan have impacted the provision of user-centred and appropriate AT, especially screen readers; and
5. To examine the level of access of university students in Pakistan to Screen-reading software that can read Urdu language.

1.20 Significance of the Study

As one of the first such studies in the context of Pakistan, this research focusses on the problems faced by university students with vision impairment who use computer Screen-reading software for accessing learning content. It poses pertinent questions for guiding future studies in the realm of the development and user-centeredness of Screen-reading software. This research will help to inform universities, government authorities, and policy makers in Pakistan to enable a better understanding the specific needs of learners with vision impairments.

CHAPTER TWO – RESEARCH METHODOLOGY

2.1 Rationale for Selecting the Research Method

Given the complex nature of the research, a mixed-methods approach was employed in which both quantitative and qualitative data were gathered and analysed (Dawson, 2009; Petty et al., 2012). In conducting the study, both qualitative and quantitative methods were used because the role of these approaches is mutually complimentary (Abusabha & Woelfel, 2003).

A qualitative research method aims to understand attitudes, behavioural patterns, and experiences of people by using interviews or focus group discussions (Petty et al., 2012). Moreover, it is a way of gathering the opinions of the participants to gain an in-depth understanding (Dawson, 2009).

To strengthen the research, the quantitative research method was also used in combination with the qualitative approach. In quantitative research methods, surveys are an effective research tool to investigate the variables and their relationships. In conducting quantitative research, instruments for the research need to be designed properly to ensure reliability, data gathering should be performed correctly, the data should be stored securely, and the appropriate statistical methods for analysis need to be applied (Watson, 2015). If applied correctly, the quantitative research method significantly minimises human error; however, random errors may occur inadvertently (Watson, 2015).

2.2 Research Design

Prior to conducting the research, appropriate methods that address the research question need to be considered (Schoonenboom, 2018). A research method for undertaking a study assists in devising a roadmap and guides the development of the overall philosophy and general principle of the research (Dawson, 2009). To conduct the study, a mixed-methods approach was used which is a combination of quantitative and qualitative data (Makrakis & Kostoulas-Makrakis, 2016). A mixed method research approach is employed for understanding a complex research problem thoroughly (Leavy, 2017). The quantitative approach is derived from the objectivist and positivist philosophy (Makrakis & Kostoulas-Makrakis, 2016). The qualitative approach philosophy originates from phenomenological, inter-subjectivist, interpretivist, and social-constructivist notions (Denny & Weckesser, 2019). The qualitative research approach focusses more on context-based realities, social interpretations and processes that are not assessed under controlled environments

(Makrakis & Kostoulas-Makrakis, 2016). In a qualitative research approach, the emphasis is on interpreting and understanding context-specific socially constructed realities in a given society (Makrakis & Kostoulas-Makrakis, 2016), while in quantitative research, importance is given to testing hypothesis, measurement and understanding cause and effect relations using quantifiable data (Abusabha & Woelfel, 2003). It has recently been recognised that there is a need for combining the quantitative and qualitative paradigms instead of following just one approach to research (Makrakis & Kostoulas-Makrakis, 2016). In this study, a sequential explanatory mixed methods design consisting of two stages was followed. In the first phase of the study, quantitative data was gathered by conducting a web-based survey and the data was analysed through discriminant function analysis. Qualitative approaches through interviews allowed for developing a deeper insight into the perspective of university students with vision impairments and their experiences using Screen-reading technology for meeting learning needs.

2.3 Aims

The aim of selecting a mixed-methods approach was to investigate the perception of university students with vision impairments from Pakistan when using screen readers for accessing learning content, and any obstacles they may face. The study aimed to develop an understanding about the perspective of the students with vision studying in Pakistan universities about the existing legal and policy frameworks for ensuring the provision of Screen-reading technology and associated training for students with vision impairments.

2.4 Outline of the Selected Research Tools in the Mixed Research Method

The study was conducted in two stages consisting of, firstly, data collection through an online questionnaire and, secondly, additional qualitative data collection through semi-structured interviews.

2.4.1 Survey data collection

A. Pretesting or piloting of the online survey

Piloting of the survey was undertaken with a sample of ten visually impaired university students from the potential participant pool. Piloting is an important consideration prior to administration of the survey for data collection to ensure the questions and language are appropriate to answer the research questions and ensure appropriate language and structure is used (Boynton, 2004). Because the respondents of the survey were university students who use English as their medium of instruction and were able to complete the survey in English, the pilot survey was conducted in English. The recruitment of pilot trial

participants was achieved through connections in existing social networks. The project was approved by the Flinders University Human Research Ethics Committee (HREC), Project ID 2952 (see Appendix 1).

B. Launching online survey

Following approval from HREC, in the first stage, an online survey was distributed to explore the experiences of university students with vision impairments across Pakistan. The survey used Qualtrics software, which is accessible for people using Screen-reading software and the questionnaire included both open and closed-ended questions (see Appendix 2). After piloting, some modifications to the language used and sequencing of the questions was done to improve the next stage. Then, the online survey was distributed to potential respondents through advertising on social media and peer support groups. In response to the survey, a total of 69 responses were received. When conducting the survey, accessibility for Screen-reading software and maintaining anonymity of the participants was ensured. To reach a broader population, the survey was posted to various online forums of computer users with vision impairments from Pakistan, including Pakistani Blind Computer Lovers, Pakistan Assistive Technology Foundation, Blind Help Project, and Disabled People's Organisations (DPOs).

C. Data analysis

During data analysis, the researcher maintained objectivity at all times by reporting the voices and perspectives of respondents without mis-interpretation or bias (Sutton & Austin, 2015). Field notes taken during the interviews were used to maintain objectivity. Researcher bias can occur at any stage of a social study involving interviews with respondents, in the research design, selection of participants, interviews, recall, transfer of information, or literature review, among other elements and, therefore, the researcher was cognizant of and vigilant to avoid any personal bias or prejudice in the selection, collection, and analysis of data (Borowska-Beszta, 2017).

The Statistical Package for the Social Sciences (SPSS) version 26 is not accessible for computer-based Screen-reading software so it was not possible to use SPSS for data analysis. The survey data was formatted and analysed with Microsoft Excel software package. The raw data was imported into Microsoft Excel using the 'Export' feature of Qualtrics. As a first step, the survey data was cleaned by applying filters for invalid responses, partially completed surveys with no responses about the usage patterns of Screen-reading software and duplicate entries were omitted. One of the completed

surveys was not considered because the respondent did not have a vision impairment and had never used Screen-reading software. Following the cleaning of the gathered data, the responses were summarised and categorised and recorded in a new document in Microsoft Word.

2.4.2 Qualitative data collection

A. Conducting interviews

Following the completion of the online survey, respondents were invited to register their interest in participating in an interview. Respondents were provided with information about the purpose of the semi-structured interviews and that their identifiable information would be kept confidential. Respondents were provided with a consent form for participation in the semi-structured interviews. It is a prime responsibility of a researcher to safeguard the respondents and their data (Kirilova & Karcher, 2017). Qualitative data was gathered through 10 semi-structured interviews which were undertaken between April-July, 2021.

Recruitment of respondents for the interviews continued until saturation was reached and no new information was being heard. In conducting interviews, saturation is considered to be the major determining factor for sample size and it plays a pivotal role when assessing the point in data collection at which no new insights emerge (Hennink et al., 2017). The method adopted for achieving saturation was Comparative Method for Themes Saturations (CoMeTs), in which themes from the interviews are compared and the sequence of interviews is reordered for assessing saturation (Constantinou et al., 2017; Cridland et al., 2016a). The interviews were conducted in the respondents' native Urdu language, which is the national language of Pakistan and most familiar mode of conversation for the respondents. With the informed consent of the respondents, these semi-structured interviews were audio recorded. The in-depth interviews allowed respondents to share their perspectives and experiences in detail. In-depth interviews are employed in research to develop an understanding about the opinions and perceptions of the respondents (Cridland et al., 2016b). Furthermore, semi-structured interviews are based on comprehensive discussions between the investigator and respondents during interviews, which contributes to answering the overall research question (Cridland et al., 2016b). It is important for the researcher to keep notes of the environmental context and impressions during the interviews with the respondents (Sutton & Austin, 2015). During the interviews, field notes were also taken to compliment the data collection and adding additional details relevant to the context of the interviews. The interviews were translated into English and

transcribed. Recognising that the translation from a source language to the target language is predominantly an interpretation and not a direct transfer, the researcher needed to make efforts for accurately and systematically capturing the meaning of the interviews (Al-Amer et al., 2016). Because the respondents in the study were university students who use English as their medium of instruction, subject to their willingness, the transcripts of the interviews were shared with the respondents for confirmation and any further feedback.

B. Data analysis

The use of theoretical frameworks supports complex and comprehensive conceptual understandings of things that are hard to define: why people interact in particular ways, how societies function, how institutions operate (Ferguson, 2017). The qualitative data from the transcripts of the in-depth interviews were analysed through feminist theory, the focus of which is not only women but it critically examines the intersectional perspectives about equality and discrimination within communities and groups from a holistic standpoint (Ferguson, 2017). Feminist theory helps a researcher to better understand the perspective of others and it focusses on discrimination and inequalities experienced by marginalised people of the society (Sutton & Austin, 2015). The transcripts of the semi-structured interviews were coded, and field notes taken during the interviews were used. Coding the transcripts is the process by which the researcher is able to better understand the perspective of the participants as well as identifies a topic, its similarities, any differences and issues raised from the interpretation, description and narratives of the participants (Sutton & Austin, 2015). When analysing qualitative data, Microsoft Excel software was used because NVivo software was not accessible to screen reader software. Using an Excel spreadsheet, the research questions were taken into consideration while the data was coded based on the mutual relationship, themes, and sub-themes created for analysis of the data. Coding is fundamental in the organisation of the data and deriving meaning from it (Carpenter & Munshower, 2020). Theming of the data was undertaken. Theming the data helps with triangulating data collected for analysis in a systematic way. Theming the data enables the researcher to categorise codes from single or multiple transcripts for compiling and presenting the findings systematically and meaningfully by ensuring coherence (Sutton & Austin, 2015).

2.5 Protection of Respondents' Data

The online survey did not request any personally identifiable information from respondents and therefore the individuals and their data gathered through the survey remained anonymous. The data of the respondents who gave informed consent for participation in the interviews were de-identified and the names of the respondents were not used. The confidentiality of the respondents will be maintained by storing the collected research data on Flinders University's secure cloud storage, in password protected folders, and using secure data protocols and encryption.

CHAPTER THREE – RESULTS

3.1 Survey

Quantitative data were collected by conducting an online survey through administering a questionnaire (see Appendix 2) with open and closed ended questions. A total of 69 respondents attempted the survey, which consisted of four sections:

1. Part A: demographics including age, gender, relationship status and living status.
2. Part B: support mechanisms established by universities to facilitate students with vision impairments in acquiring education.
3. Part C: challenges respondents faced during university studies in terms of accessing learning content using Screen-reading software and how they have been able to overcome those issues.
4. Part D: legislative and policy frameworks to ensure the provision of Screen-reading software to university students with vision impairments.

At the end of the survey, respondents were invited to share any additional information about their experiences as tertiary students with vision impairments and a link was provided to an online form for registering interest to participate in the online in-depth interviews. Of the 69 respondents, 23 were incomplete and removed from the analysis. A total of 46 respondents were included in the final analysis. The mean age of the sample was 29.5 (± 7.89) years (range 16–53 years). 73.9% ($n=34$) of the sample were male, 21.7% ($n=10$) female and 2.2% ($n=1$) preferred not to say.

Overall, a total of 71.73% ($n=33$) of the survey respondents were studying in public or private universities and 6.5% ($n=3$) of them received their education from foreign universities. Four (8.7%) respondents did not specify the university they were enrolled at. The majority of respondents (44.4%, $n=20$) were in their final year of study. Two (4.4%) respondents were in their first year of study, seven (15.6%) were in their second year of study, and six (13.3%) respondents were in their third year of study. There were two (4.4%) PhD scholars of whom 2.2% ($n=1$) had recently completed the degree and 2.2% ($n=1$) respondent was a prospective doctoral candidate and had qualified Ph.D. coursework.

Table 1: Demographic information of the survey respondents.

Relationship Status	n (%)
Single	29 (63%)
Married	15 (32.6%)
Divorced	1 (2.2%)
Prefer not to say	1 (2.2%)
Living Status	
Living alone	8 (17.4%)
Couple with no children	3 (6.5%)
Couple with children moved out of home	2 (4.3%)
Family with eldest child over 18 years living at home	11 (23.9%)
Family with eldest child under 18 years living at home	9 (19.6%)
Share house	7 (15.2%)
Living with parents, spouse and a child under 18 years of age	1 (2.2%)
Other	4 (8.7%)
Program	
Undergraduate	15 (34.1%)
Postgraduate	29 (65.9%)
Year of Study	
1 st year	2 (4.4%)
2 nd year	7 (15.6%)
3 rd year	6 (13.3%)
Final year	20 (44.4%)
Recently completed studies 4	4 (22.2%)
Preparing for the Central Superior Services (CSS)	1 (2.2%)
PhD	2 (4.4%)
Studies on hold	1 (2.2%)

Respondents were asked which screen reading program they were aware of. Of the 46 respondents, 97.8% (n=45) were aware of at least one Screen-reading software tool, including Jaws for Windows (JFW) (63.6%, n=28); Non-Visual Desktop Access (NVDA) (29.9%, n=13); Apple’s Voiceover (43.2%, n=19); and Microsoft Narrator 2.2% (n=1). In addition to computer-based screen readers, respondents also listed mobile screen reading applications that provide access to the various functionalities of a smartphone for people with vision impairments, such as Talkback (Android-based Screen Reader) 4.4% (n=2) and Commentary Screen Reader (CSR) 2.2% (n=1), which is an emerging mobile screen reader for the Android operating system. Furthermore, 4.4 (n=2) respondents listed non screen reader software, such as Foxit Reader, Zoom, and Google Meet.

The use and access to Screen-reading software for supporting university studies largely depends upon the availability of a personal computer. Of the 46 respondents, 82.2% (n=37) reported having a laptop computer or desktop computer and 17.8% (n=8) respondents did not own a computer.

PART B of the questionnaire aimed to discover more information about the support provided to respondents by the university. To operationalise respondents' perceptions of support mechanisms, a Likert Scale with psychometric responses was used, which contained the level of agreement of the respondents to the various statements provided (Table 2).

Table 2: Support Offered by the University

Statements	Strongly disagree n(%)	Disagree n(%)	Neither agree nor disagree n(%)	Agree n(%)	Strongly agree n(%)
A screen reader can support students with vision impairments in university education	3 (6.5%)	2 (4.3%)	4 (8.7%)	10 (21.7%)	22 (47.8%)
Having access to a personal computer or laptop is important for meeting learning needs	1 (2.2%)	0	1 (2.2%)	11 (23.9%)	28 (60.9%)
It is important to have a Screen-reading software that can read Urdu	1 (2.2%)	1 (2.2%)	0	13 (28.9%)	24 (53.3%)

As university students with vision impairment, the respondents were asked to consider their experiences and respond with how much they agree with each of the statements, as shown in Table 3.

Table 3: Experiences of Respondents at Universities.

Statements	Yes n(%)	Sometimes n(%)	No n(%)	Not sure n(%)
Whether the university provides access to computer for students with vision impairment	9 (19.6%)	10 (21.7%)	18 (39.1%)	5 (10.9%)
University offers computer training for students with vision impairments	3 (6.7%)	5 (10.9%)	23 (51.1%)	7 (15.2%)
I have received computer training and believe it meets the needs of students with vision impairments	18 (39.1%)	3 (6.5%)	15 (32.6%)	5 (10.9%)
I use a screen reader to support my university education	23 (50.0%)	5 (10.9%)	11 (23.9%)	1 (2.2%)
My university has an online learning system	21 (45.7%)	5 (10.9%)	13 (28.3%)	2 (4.3%)
The online learning system is compatible with my screen reader	13 (28.3%)	10 (21.7%)	11 (23.9%)	6 (13%)
During COVID-19, my studies moved to online learning	32 (69.6%)	4 (8.7%)	5 (10.9%)	0
My screen reader has a sufficient level of functionality for me to attend online classes	17 (37%)	12 (26.1%)	8 (17.4%)	4 (8.7%)
My university provides textbooks in accessible formats	9 (19.6%)	10 (21.7%)	21 (45.7%)	0
My university provides readings in accessible formats	11 (23.9%)	12 (26.1%)	16 (34.8%)	2 (4.3%)
My university provides other learning content in accessible formats	9 (19.6%)	14 (30.4%)	16 (34.8%)	1 (2.2%)
I prefer to use a screen reader for notetaking in class	18 (39.1%)	10 (21.7%)	10 (21.7%)	1 (2.2%)
I use a computer screen reader for completing the answer sheet during an examination	9 (19.6%)	7 (15.2%)	23 (50.0%)	0
I complete university assignments using a computer screen reader	20 (43.5%)	8 (17.4%)	12 (26.1%)	0

Of the respondents, 82.2% (n=37) had access to a computer for university studies, 61% (n=28) preferred to use a personal laptop, 4.4% (n=2) had a university allocated desktop in the library, and 2.2% (n=1) used a computer in the AT room at the university. Respondents primarily reported using personal resources to acquire a computer (n=8); however, one respondent received a computer through government funding. Jaws for Windows and NVDA were the most commonly used Screen-reading software to support university study, using either only JFW (n=3), or a combination of JFW and NVDA (n=2). Jaws for Windows was used for writing research papers, reading books, consulting reference material, and

completing other assignments One respondent used a smartphone (iPhone) for university studies.

Half of the respondents (n=21) acquired a free copy of the Screen-reading software used for university studies, six respondents were supported by a not-for-profit organisation, five used personal funds, four received a copy of the software from the university; however, none of the respondents reported receiving support from the department of Social Welfare and Special Education to purchase Screen-reading software. Two respondents reported accessing pirated versions of the Screen-reading software.

Regarding the need for the provision of training for enabling university students with vision impairments, 36.9% (n=17) respondents considered the role of universities (36.9%, n=17), not-for-profit organisations (43.5%, n=20), and the Department of Social Welfare and Special Education (30.4%, n=14) to be instrumental in organising training on the use of Screen-reading software for university students with vision impairments. One participant suggested university libraries would be appropriate places to arrange computer training for students with vision impairments. Respondents suggested that training should include the use of Microsoft's Office applications in combination with JFW, converting print content to accessible formats using optical character recognition (OCR), and how to install software independently. Two respondents highlighted the need for training of university teachers about meeting the specific needs of students with vision impairment using assistive technology.

Respondents reported that universities communicated to students through online learning systems (34.8%, n=16), social media platforms (30.4%, n=14), and email (43.5%, n=20). Other types of communication reported included direct (face-to-face) contact, class representatives, and the use of mobile text messaging services.

The majority of respondents 52.2% (n=24) suggested that universities could provide support to students to ensure equal access to online learning content using Screen-reading software. Ten respondents stated the importance of insuring accessibility for teaching and learning content and in designing the online learning portals, with two respondents stressing the importance of making the university's online portals accessible for Screen-reading software. Respondents recommended organising awareness raising workshops and training for students with vision impairments and teachers pertaining to the importance of online learning for students with vision impairment (19.6%, n=9).

Respondents supported the provision of Screen-reading software, personal computers and

laptops, and other facilities to enable university students with vision impairments to have unparalleled access to learning content and also ensure independence in undertaking assessments and evaluations. One respondent mentioned the importance of establishing electronic libraries and making them compatible with screen reader software.

The majority of respondents (58.9%, n=27) reported that they did not think that any Screen-reading software was available for accessing Urdu, half of the respondents (n=23) considered it important to have a Screen-reading software for Urdu, three participants were unsure of the importance and one respondent viewed it unnecessary to have such a software. Nine respondents (20.9%) were aware of Screen-reading software that can support reading content in Urdu language through eSpeak (Open-source free speech synthesiser), NVDA, and Google text to speech engine (Android platform). Two respondents believed that the quality of synthetic speech produced by eSpeak was not clear and needs to be improved. Seven respondents (15.2%) stated that the level of support for Urdu sufficiently meets the needs of university students with vision impairments majoring in Urdu and related studies. Two respondents reported that they did not think the support for Urdu met the requirements of students. Four respondents (17.4%) reported that efforts to customise Screen-reading software for accessing contents in Urdu have been made, 4.4% (n=2) did not consider those efforts to be sufficient, and 2.2% (n=1) viewed it to be irrelevant.

PART C of the survey aimed to identify challenges that the respondents had experienced when using Screen-reading software, and how they have been able to overcome those challenges. Nineteen (41.3%) respondents believed that the Screen-reading software had sufficient level of customisability to meet their needs as university students. Eight respondents (17.4%) were not satisfied with the functionality. When using a screen reading program, 58.9% (n=27) of respondents believed they were able to keep pace with their sighted counterparts while studying at the university level. Fourteen respondents (30.4%) received learning content in an accessible format from their universities, however, 26.08% (n=12) did not receive the content in accessible format from the universities. Eleven respondents (24%) mentioned their Screen-reading software had functionality to describe non-textual elements. Of these, 6.5% (n=3) thought it to be excellent and 15.21% (n=7) believed that it was fair. Nearly half of respondents (47.9%, n=22) reported that their screen reader could not convert visual or non-textual text into screen readable format, and 17.4% (n=8) were not sure about this functionality.

Solutions to accessibility issues included using scanning (4.4%, n=2), requesting assistance of a classmate to convert the content into an accessible format (19.6%, n=9), assistance from families (10.9%, n=5), downloading content from online sources (8.69%, n=4), and receiving the learning material from the local library (n=2). None of the respondents reported receiving help from a not-for-profit organisation.

Nearly half (45.5%, n=21) of respondents experienced discomfort as a result of the extensive use of Screen-reading software. These respondents specified overall physical and mental exertion coupled with irritability, headaches and migraine. Seven (15.21%) respondents preferred taking regular breaks, 6.5% (n=3) changed either the speech synthesiser or decreased speaking rate to avoid the associated challenges, two (4.4%) respondents preferred to either switch Screen-reading software or to ignore the exertion and keep working with it. Thirteen respondents (28.9%) did not report having any challenges. One respondent reported feeling comfortable using Screen-reading software for extended durations because they had extensive experience using the technology for many years. One participant mentioned that screen readers are the only source of learning, and they need to adjust to using them for longer durations.

The majority of respondents (78.9%, n=36) believed the voice of the Screen-reading software was clear enough in pronouncing words. Four respondents (17.4%) reported they thought it to be unclear. Two respondents stated that they knew about the function to improve the pronunciation by changing the speech dictionary of the screen reader, and two respondents did not know about this functionality.

Sixteen respondents (34.1%) did not report experiencing any complex issues with their Screen-reading software. Of the 14 (30.4%) respondents who did report complex issues with the use and installation of Screen-reading software, four (8.7%) stated that they used the help topics and searched online, three (6.5%) reported needing to request assistance from friends, two received help from the university, and one respondent reported that they preferred to contact the developer of the Screen-reading software

PART D aimed to discover more about the thoughts of how the legal and policy frameworks in Pakistan have impacted the provision of user-centred and appropriate screen readers. The respondents were asked about how much they agreed with a set of statements about legal and policy frameworks related to the use of screen readers (Table 4).

Twelve (32.4%) respondents reported that their universities had specific policies to support the learning of students with vision impairments, while 53.8% thought the universities need to improve the policies to better meet the needs of students with vision impairments. One respondent viewed the provision of software to be an important consideration of the policies at the university level. One respondent suggested to modify the existing policies at the university level to enable students with vision impairments to attempt examinations independently, learning portals to be made accessible, and accessibility to be ensured. Three (6.5%) respondents did not deem it necessary to reform the existing policies and 6.5% (n=3) respondents were unsure. Sixteen (34.1%) respondents viewed the policies to be sufficiently meeting the needs of the students with vision impairments. Four (17.4%) respondents suggested establishing monitoring committees, 32.60% (n=15) recommended to have students with disabilities and representative associations involved, and 4.4% (n=2) suggested to ensure a mechanism for appropriate implementation on the policies. A total of 19.6% (n=9) of respondents were not sure what modifications to policies would assist in the access and use of Screen-reading software to support university studies.

Table 4: Legal/Policy frameworks in Pakistan.

Statements	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
National policies to support the provision of screen readers for vision impaired students in Pakistan	10 (29.4%)	12 (35.3%)	11 (32.4%)	0	1 (2.9%)
Provincial policies to support the provision of screen readers for vision impaired students in Pakistan	9 (28.1%)	11 (34.4%)	11 (34.4%)	0	1 (3.1%)
The existing policy frameworks in Pakistan sufficiently address the provision of computer Screen-reading software for people with vision impairments	9 (29.0%)	14 (45.2%)	7 (22.6%)	1 (3.2%)	0
There are policies at the University that provide access to students with vision impairments to Screen-reading software	13 (40.6%)	7 (21.9%)	8 (25.0%)	3 (9.4%)	1 (3.1%)
The implementation of the policies about provision of Screen-reading software sufficiently meets the needs of the students	4 (12.5%)	11 (34.4%)	13 (40.6%)	2 (6.3%)	2 (6.3%)

3.2 Interviews

3.2.1 Demographics of the respondents

Ten respondents, with the mean age of the sample being 34.5 (± 12.2) years (range 20–62 years), took part in semi-structured interviews. Nine respondents were male and one female. Six respondents reported their relationship status as single and eight reported living with parents and siblings in a joint family system. respondents were from different localities in Pakistan, including from Punjab (n=4, 40%), Khyber Pakhtunkhwa (n=5, 50%), and Gilgit Baltistan (GB) (n=1) Provinces. All respondents were studying at undergraduate (n=3) or postgraduate (n=7) levels. Postgraduate studies (n=5) were Masters by coursework, including Special Education, Development Studies, linguistics, History, and English Literature. There were two respondents in PhD programs. The respondents were studying at public sector higher education institutions in Pakistan. Areas of study mainly consisted of English literature, Islamic Studies, Urdu, Special Education, Development

Studies, and political science. Five respondents were full-time students, while four were part-time students and one had temporarily halted education due to financial and support challenges. One respondent was preparing for the central superior services (CSS) examination, which is the elite civil service responsible for the operation of the bureaucratic apparatus in the country. In addition to being students, four respondents had some form of employment including two lecturers and assistant professors in public sector universities, one staff at an administrative level and one part time teacher in a private school. All respondents described dependence on Screen-reading software to use a computer because of their total blindness or having only light perception. Five of the respondents were congenitally blind and had no functional vision. Five of the respondents experienced late onset blindness who had developed complications related to the eye, such as retinitis pigmentosa, or glaucoma and cataracts.

3.2.2 Themes that emerged from the interviews

Eight themes emerged from the thematic analysis of the ten interviews: access, awareness, and availability of Screen-reading software; attitudes of fellow students and teachers towards the use of Screen-reading software; barriers encountered while using Screen-reading software for learning; benefits of using Screen-reading software and drawbacks of not using it; customizability and user-centredness of the Screen-reading software; features and functionalities available in different Screen-reading software; legislative and policy frameworks about the provision of Screen-reading software; and support and training about the use of Screen-reading software for learning at the university level.

Access, awareness, and availability of Screen-reading software

1) Access. Respondents said that they had access to multiple Windows-based Screen-reading software including Jaws for Windows (JFW), Nonvisual Desktop Access (NVDA) and Microsoft Narrator. The majority of respondents said that they were able to access pirated versions of commercial Screen-reading software either from their circle of friends who were already proficient and experienced computer users. Smart phone-based Screen-reading software is available free of cost and is often built into the operating system. Some respondents mentioned the availability of an Android-based Screen-reading software called Talkback, available from the Google Play store. A few respondents talked about VoiceOver, which is a Screen-reading software for Apple products and comes preinstalled on iPhones. While respondents used smartphone-based screen readers, such as Talkback

(screen reader for android operating system) and Apple VoiceOver (iPhone's Screen reader), they mostly relied on computer-based Screen-reading software for their learning needs. A few respondents from remote parts of the country mentioned that they had very limited access to a computer because of frequent power outages in their area. They had very limited access to the Internet, while connectivity was hindered by low speed and frequent disconnections, which negatively impacted their learning.

2) Accessibility of content. While all respondents had access to smart phone Screen-reading software for day-to-day communication use, only one respondent had to use it for learning purposes, recording lectures using the smart phone. This respondent came from a remote part of the country where awareness and information about computer Screen-reading software was limited. In explaining this problem, the respondent said, "*We have limited access to electric supply which do not let us use computers as regularly and phones are better for us*". They felt overburdened because of the heavy reliance on smart phone technology and audio recorded lectures. Access to learning content was said to be limited and often the smart phone could not support this respondent's education at the university level. They viewed it as being very important for university students with vision impairments to have accessibility of learning content, computer and Screen-reading software.

3) High cost of screen readers. Discussing the high costs of assistive technology, especially Screen-reading software, a respondent said, "*If after purchasing a computer, a typical computer user does not need to pay extra, why do people with vision impairment and specially students have to incur enormous amount?*". Another respondent said "*Purchasing a copy of Screen-reading software is not possible for us because we are financially dependent on our family and it is way too expensive*".

4) Awareness. Several respondents had access and awareness of free Screen-reading software that was available to download from the respective websites of the companies that produced them. Participants reported that they did not prefer this software because of limited availability of training or tutorials. All participants said that their teachers, friends, and family were not aware about the possibility of using a computer with the help of a Screen-reading software. A participant narrated the reaction of his family when he told them about the possibility for them to use a computer, saying that "*My father asked me in total surprise about how can a blind person use a computer*". Some participants came to know about a particular Screen-reading software through other friends who are blind or

visually impaired and who have access to a computer either for learning or for leisure activities. Other respondents were informed by their teachers or local community-based organisations about the possibility of using computers.

Some of the respondents considered the role of civil society, organisations of persons with disabilities, and government agencies responsible for ensuring inclusion of people with disabilities to be instrumental in raising awareness and advocating on the rights of persons with disabilities. Some of these respondents further added that the role of electronic, print, and more significantly, social media, is vital for raising awareness about inclusion of individuals with disabilities, with one participant stating *“The society is totally unaware about what we as blind individuals are able to do and we are often presented to be unfortunate and incapable individuals who deserve the sympathies of others”*. A respondent suggested to include specific chapters in the syllabus of general education pertaining to accessibility and the inclusion of students with disabilities and the role of students in mainstream educational institutions in Pakistan.

Attitudes of fellow students and teachers towards the use of Screen-reading software

1) Positive university learning experiences. All respondents agreed that generally the attitude of their teachers and friends was positive and supportive. The teaching staff and fellow students showed great interest in how a person with a vision impairment can use a computer without being able to see. Observing the respondents being efficient in learning, the fellow students considered them to be highly talented individuals endowed with special qualities and extraordinarily intelligent. Two respondents said that people are pleasantly surprised to see them using a computer or a smart phone especially in cases where the screen is turned off. A respondent said, *“When I am using phone having screen turned off, people ask me if I am listening news and how can I understand my screen reader”*. Another respondent said, *“My friends laugh when I use my smartphone without looking at it”*.

2) Negative university learning experiences. Situations where people were not supportive were discussed in relation to how difficult it was to get the required level of support from the university administration or teachers. A number of respondents described how some teachers were not supportive, explaining how they displayed attitudes that made students with vision impairment feel as though they were an extra burden or additional liability. A respondent recalled how they were ridiculed and asked, *“Why you*

and your parents want to study? of what benefit will it be for you to learn?". Another mentioned the humiliation at the hands of a teacher and said, *"on the first day of university, a teacher said to me that he does not know how to help me in studying and he has no time for understanding about the learning needs of students"*. Some respondents suggested that it would be impossible to change the negative attitude of their teachers towards the use of the Screen-reading software during class. Another respondent commented on the negative attitude of invigilators and other staff conducting examinations, suggesting that many often assumed that the student with a vision impairment using the services of a scribe was not a valid attempt of the paper because the scribe was thought to complete the work on behalf of the student with a vision impairment. According to these respondents, the absence of a positive attitude towards university students with vision impairment was a major barrier during their learning and they had to devise various strategies to overcome this seemingly impossible obstacle. However, in the absence of a formal university support system, respondents felt they received help on a personal level due to compassionate grounds and not as an entitlement based on equity.

Barriers encountered while using Screen-reading software

1) Cost. Respondents thought it a difficult and debilitating challenge to have enough financial resources to acquire a laptop computer for their learning. Some respondents received a laptop through the Pakistan government's scheme for the provision of laptops to all university students. Respondents said that the computers provided by the government scheme did not have Screen-reading software preinstalled and they had to do this themselves to make the computer usable. Some respondents mentioned that their families provided funds for the purchase of a laptop for their learning.

2) Support. Many of the respondents said that by using their connections with experienced blind computer users and trainers, they were able to access Screen-reading software. However, because of the lack of awareness about how people with vision impairment can take advantage of information and communication technology for learning, not all universities in Pakistan had systems to provide formal support in the provision of Screen-reading software. Thus, a respondent said *"I am lucky to have the support of personal friends who are long time users of JFW and they are able to provide guidance to me"*. Another said *"At the time of my admission, the university said that they do not know about how blind individuals can use a computer for learning"*. Some respondents mentioned that they experienced problems fixing technical difficulties when using their Screen-reading software. Because their Screen-reading software was a pirated version,

meaning they were not entitled to receive technical support or troubleshooting instructions from the company that made the software. Eventually, these individuals had to solve those problems with “trial and error” and sharing of experiences with other screen reader users. This caused significant delays in addressing certain complex issues while learning at university and resulted wasted time. Due to COVID-19 restrictions on attending campuses, some of the respondents were forced to quickly familiarise themselves with the online mode of learning, this sudden transition, combined with a lack of appropriate support services to the students with vision impairment, made it difficult and challenging to learn on an equal basis. Consequently, a respondent said “*adapting to use the online mode of learning was full of confusion and I had to explore the compatibility of my screen reader with NVDA which wasted too much of my time*”.

3) Infrastructure. Only three respondents mentioned a public sector university in a major city of the country to have specifically customised computer laboratories and support mechanisms for ensuring the inclusion of students with disabilities. These respondents expressed a wish that the same level of support services be made available by replicating the disability support services desk in the university located in remote areas of the country. Some of these respondents viewed organisations of people with disabilities to be important in improving the standard of education and convenience for students with visual impairment during their university studies.

4) Learning Content. Some respondents mentioned that their universities did not have enough resources to ensure equal access to learning content or screen reading technology. A respondent discussed the provision of books and readings by the teachers in scanned images converted into PDF format. For them, “*It was difficult to convert a reading image based Portable Document Format (PDF) into a screen readable format.*” Some of the respondents mentioned that the lack of provision of learning content in an accessible format was a challenge for them and they had to often seek help from either their classmates or family members. According to one respondent, “*Constantly requesting friends and family for help was a major barrier*” during their education. Another respondent said that they needed to wait for the time when others would be able to dedicate time for reading a particular text and it often caused unnecessary delays in learning.

5) Functionality. Two respondents mentioned that during classes the teachers prefer to use a whiteboard to explain different concepts, which could not be accessed by their screen reader and, ultimately, they had to rely on their friends to help them to understand what was being taught. These respondents wondered whether any Screen-reading software provides such functionality. Some respondents faced difficulties in accessing

content being presented in the class using a multimedia projector. They had to rely on their friends' taking notes during class. They requested their teachers to provide them with presentations delivered in the class using projectors. Four respondents mentioned that because of the lack of ability of the Screen-reading software to describe images, pie charts and other visual content, their learning was significantly hindered at the university level. These respondents talked about the books and learning content provided to students in a very low resolution or untagged and inaccessible format, and that they could not use a screen reader's OCR functionality to access the learning content. Few respondents were aware of Screen-reading software's OCR functionality, so they had to enlist the help of friends or family to read the material, which they then recorded. One respondent found it difficult to understand the pronunciation of the Screen-reading software when it read a long text. They had to read the text using word by word reading functionality of the screen reader, which was time consuming and cumbersome.

6) Obstacles encountered by respondents from remote areas. Some respondents from remote areas of the country said that they experienced several challenges ranging from the time of admission, the absence of admission forms in accessible format, to participation in the class and sitting for examinations. These respondents further mentioned that the educational institutions in their area were not ready to accept them because of the perceived risk of failure and a total absence of knowledge and the possibility of using computers to learn at the tertiary level. Respondents with late-onset blindness and those from rural areas reported a lack of knowledge about the possibilities of using a computer with Screen-reading software for learning. Due to financial constraints and a lack of appropriate training in the use of Screen-reading software, a respondent with late-onset blindness from a rural area had to put his PhD studies on hold.

7) Problems of females with vision impairment. Because of the multiple disadvantages of gender disparity that exists in Pakistan and vision impairment, a female respondent who had a very supportive and encouraging family and circle of friends experienced multiple barriers in acquiring appropriate training to use computer Screen-reading software. She said that her parents, siblings, and other relatives were overprotective when it came to her safety and security, since they considered her to be "vulnerable". Because of her vision impairment, she needed to have someone with her for support while visiting another city, so her family did not allow her to attend training being offered in major cities. She added that according to her family, *"we don't want you to be exposed to any vulnerability or challenges while on your own and please avail all self-enrichment opportunities within the*

city". Mentioning her experiences at the university level as a female student with a vision impairment, she said she had a very supportive circle of friends who included her in all activities. However, she experienced a multitude of "debilitating challenges" ranging from searching for a scribe to assist her to take exams, to converting textbooks into accessible format.

8) Technical issues. Respondents mentioned the technical problem of frequent lag or the 'sudden and unexpected' absence of speech output by JFW such that, in some circumstances, they needed to seek some sighted assistance to identify why the screen reader was silent. For respondents with more experience, it was not a great challenge to address the sudden and often unexpected silence of their Screen-reading software and they had developed several strategies to address the problem. However, for new users and those not familiar with the intricacies of using Screen-reading software, it was reported as an overwhelming and often distressing situation characterised by uncertainty.

9) Challenges in class participation. Respondents shared difficulties about their participation in the classroom, particularly how difficult it was to keep pace with fellow students. Many felt they had to minimise the possible disturbance caused by the speech of the Screen-reading software during class work. One respondent discussed the importance of using earphones. A respondent had to simultaneously use a screen reader for notetaking and "*Remain attentive to the lecture being delivered*". In case of technical difficulties of JFW, they had difficulty participating during classes. They said "*it was very difficult to listen to screen reader and the lecture at the same time.*" They further said, "*I have to cope on multiple fronts of understanding the concepts the teachers explain and ensure the proper functioning of my laptop and JFW during classes and if I miss anything, my friends support me.*" This resulted in lower involvement in learning activities in the class and compromised the quality of their study notes. However, they had a supportive network of fellow classmates who were always ready to extend help and support during their education.

10) Fatigue caused by the use of screen readers. For some of the respondents, the mechanical speech of the screen readers caused physical and mental exertion when used for extended periods and reading long materials. This was addressed by taking regular breaks.

11) Accessibility of online learning portals. Some respondents discussed the difficulties encountered in accessing the university online learning portal and the perceived lack of interest from universities in addressing these accessibility challenges. A participant had

tried to approach the authorities of the universities to raise concerns about accessibility, but the relevant department did not take any concrete actions.

Benefits of using Screen-reading software and drawbacks of not using it

1) Importance of using a computer. All the respondents expressed satisfaction with being able to use a computer with Screen-reading software and stressed the importance of its promotion especially for university students with a vision impairment. Many of the respondents were able to use a computer and access information available to their sighted counterparts, which gave them confidence and a sense of independence. One respondent provided an example of the convenience to use a computer over other mediums of instructions, stating “*unlike Braille, a computer is portable, convenient, and more inclusive.*” Another experienced user of Screen-reading software discussed how, through the use of a screen reader, they were able to cope with the demanding tasks at their university and were able to complete the evaluations independently.

2) Challenges of using audio tapes for learning. One respondent discussed how difficult it was to consult textbooks prior to the advent of computers. They had to identify and request someone to get the book recorded onto an audio cassette. They said that “*Purchasing cassettes was expensive and purchasing them in large quantities was a major challenge.*” While using audio cassettes for learning, it was very difficult to specify points or bookmarks and the individual had to constantly play multiple audio tapes to reach a particular point. The extensive use of audio tapes had a significant and often negative impact on the quality of the recording. Hence, the respondent said that a textbook would consist of many audio tapes that made it practically difficult to carry and maintain. The pronunciation and reading style of the person recording the books played a pivotal role and inadvertent errors in pronouncing words, expressions or other issues were common. The reader also needed to dedicate extensive time and energy to read the textbooks, which are often bulky. Only one respondent had to pay the reader for reading and recording the learning material.

3) Issues faced during examinations. Some respondents mentioned the difficulties they experienced during different examinations. In order to sit examinations, they had to identify a junior student who could work as a scribe; however, these students were often busy with their own examinations and studies and many were not available to provide services as a scribe. This made examinations a major challenge. The use of a scribe in examinations had to be formally approved by the respective educational board or university and multiple official procedures and documents were required, which further increased the challenge

and frustration in this process. These difficulties added to the already mounting pressure of studying and preparing for examinations. A respondent who had been using the services of scribes for a long time mentioned “*my grades were negatively impacted because of the low performance of the scribes.*” They said that if the scribe was not able to pronounce a word, terminology, or jargon correctly, “*we have to face the negative consequences of it*” in terms of low grades. Furthermore, the legibility of handwriting and writing speed were important factors for the successful and proper completion of an examination. The respondents said that the use of Screen-reading software can minimise these difficulties; however, they stated that very few universities in Pakistan allow students with vision impairments to use Screen-reading software in final exams.

Customizability and user centredness of the Screen-reading software

1) Customizability. All respondents considered the present level of functionality of their Screen-reading software to be meeting their basic learning needs. However, one respondent found it difficult to memorise the multiple keyboard commands for using a computer with Screen-reading software and they were not aware of any source or quick user manual from which they could learn the keyboard command. The majority of the respondents used JFW for their learning needs but stated that the software was not open source and that it was not customised to meet the local needs of people from Pakistan. Respondents did suggest that the multiple speech synthesisers available in JFW improved the functionality of the Screen-reading software.

Three respondents said that NVDA, an open source and free Screen-reading software, offered enough functionality and flexibility to meet their particular learning needs and they showed optimism for the development of free and open-source AT, especially screen readers. According to respondents, the promotion and development of free Screen-reading software and other AT is crucial for ensuring that the maximum number of people with vision impairment are able to access and use it.

2) Advantages of NVDA. One respondent explained how easy it was to install NVDA and that it was not too heavy for computers with low hardware resources, thus enabling people with limited financial resources to use the latest technology with minimum investment. The respondents mentioned how the functionality of NVDA can be enhanced to meet specific individual needs by installing the additional add-on features free of cost. Talking about NVDA and its various functionality, one respondent said, “*I have only been using NVDA because of its versatility and customisability*”.

3) Functionality of screen readers to read Urdu. Respondents said that computer-based Screen-reading software did not offer sufficient level of support in reading text in Urdu language. The commercially available Screen-reading software (JFW) could not read Urdu, whereas NVDA (Open source and Free Screen Reader) does provide functionality in accessing Urdu. This support is not enough because the text to speech called eSpeak is not fully developed and cannot pronounce many words properly. Mentioning the effort to design and develop a Screen-reading software for reading Urdu, a respondent said that they were aware there has been an effort to create such a software. However, it has not yet been realised because of the lack of technical knowledge about the production and funding.

4) Accessing Urdu through mobile-based screen readers. Some respondents preferred to use mobile-based Screen-reading software with Google text to speech engine, which according to them, provides better support in reading content in Urdu. Respondents also reported that the Google text to speech engine is better in pronouncing Urdu words and overall reading. They were able to access printed text in Urdu and English through the OCR apps available for mobile phones.

5) Reading print using mobile-based OCR. Some respondents preferred to use Seeing AI which is developed by Microsoft for the Apple iPhone. However, the respondents could only read printed content in English using Seeing AI. Most respondents did not use the OCR functionality for reading long text but believed that their Screen-reading software had some level of ability to perform OCR on an image-based text.

Features and functionalities available in different Screen-reading software

1) Features for supporting learning. The respondents discussed the use of Screen-reading software allowing successful accomplishment of their academic goals. Today's Screen-reading technology has evolved to the extent that the various voice output attributes can be changed to meet the individual needs of a person. A participant gave an example of how they were able to change the pitch and speaking rate of the screen reader they use. The majority of respondents said that their screen reader had provided them with the flexibility to read long documents and books, which they said has been pivotal for improving their learning. For example, a respondent stated, "*The ability to access books, academic journals and other learning content has never been easier and flexible.*" All respondents discussed their ability to consult multiple sources of information by using the World Wide Web, ensuring efficient and quick communication with their university and the ability to format university assignments without often requiring sighted assistance. Giving

an example of how the use of the Screen-reading software has enabled respondents to learn from the comfort of their home, one respondent stated “*The transition to an online mode of study has been a wonderful experience for me because it enables me to learn at my own pace from the comfort of my home*”. Some of the respondents were advance users of word processing applications, spreadsheets, and other useful applications.

2) Need for functionality of screen readers to describe visual content for learning. A respondent said that his Screen-reading software could not access video tutorials, for which more research is needed, and that introducing this functionality will be imperative for strengthening the learning process of university students with vision impairment. According to some respondents, the inability of the Screen-reading software to elaborate or describe diagrams has been a major challenge for university students with vision impairment pursuing qualification in subjects related to sciences and the arts. A respondent suggested “*The screen reader should have inbuilt capability to either elaborate the particular diagram or at least provide a basic description of what it aims to possibly convey*”. Another respondent said “*There is a need for screen reader developers to introduce inbuilt functionality that could enable us to perform OCR on the fly without the need to perform any specific keyboard command or installation of an additional add-on*”. Some respondents mentioned the challenge of learning mathematics and related topics with Screen-reading software.

Legislative and policy frameworks related to the provision of Screen-reading software

1) Awareness about policies. Most respondents were aware that there are policies and legislative frameworks to support students with disabilities in their country. However, they were not specific about the policy to ensure the entitlements of rights to university students with vision impairments. Only one of the respondents was completely unaware of any policy frameworks governing the regulations for persons with disabilities at the university level.

2)The role of students with vision impairments. A few respondents discussed the proactive role of university students with vision impairment in terms of their advocacy efforts for the establishment of resource centres for meeting the special needs of students with disabilities in major cities of the country. These respondents stated that the establishment of the resource centre for students with disabilities in the major cities of

Pakistan is not because of any policy framework, rather it was due to the persistent efforts by the individual students.

3) Implementation of policies. Nearly all respondents lamented that the implementation of the existing policy frameworks needs to be streamlined. They said that for the policies to be effective, meaningful inclusion of persons with disabilities needs to be ensured at the policy-making level. A respondent suggested “*policies should be developed through a proactive approach rather than reactive*”. According to some respondents, the universities in remote areas of the country were not ready to adopt the policies concerning inclusion of students with disabilities in tertiary education formulated by the higher education commission of Pakistan. They further added that there was a need for a shift of paradigm in addressing the needs of university students with vision impairments.

Support and training about the use of Screen-reading software for learning at the University level

1) Training. Most respondents mentioned the lack of training opportunities offered by universities in the use of Screen-reading software specifically for academic purposes. This inadequacy particularly affected respondents from remote areas who had no opportunity to participate in the training being offered in major cities. Due to inability to pay for accommodation, one respondent discussed the difficulties they had experienced finding accommodation while participating in training organised in other cities. They had to rely on relatives or friends with whom they could stay for the duration of the training. They further lamented that in situations where they had no acquaintances, they had already missed a few important training programs. Some respondents had received basic training, which they stated was not sufficient for their needs. They had to make personal efforts to strengthen their knowledge and understanding about the various functionalities of the Screen-reading software. Respondents said that the content of the training being offered was often not based on the latest version of the screen reader they were using.

2) Role of government in provision of training. Some respondents suggested that the government needs to ensure the provision of appropriate training on the use of computer Screen-reading software for learning at the university level. They suggested that the promotion and development of Screen-reading software needs to be prioritised by the government and humanitarian organisations for the benefit of students with vision impairment.

3) Awareness about training programs. Most of the respondents were not aware of any training program for teaching the use of free Screen-reading software. One respondent mentioned the training being offered on the use of computer Screen-reading software is only related to the commercial screen reading programs, and they were not aware of any training institution that provides any training or support program for open source and free Screen-reading software. However, one participant had an opportunity to attend various online training about the use of NVDA free of cost.

4) Help topics. According to respondents, using NVDA and other free screen reading programs, the freely available and open-source Screen-reading software, did not have sufficient and appropriate help topics built within the program, which caused enormous challenges for new users. Users of NVDA did not have access to appropriate and well organised help topics. They had to consult various online forums and posts to get help in a particular aspect of the use of Screen-reading software. Only one participant was satisfied with the currently available help topics on the use of Screen-reading software. However, the respondents who were regular and experienced users of free Screen-reading software did not have any challenges accessing relevant help topics or tips for using the program. Moreover, users of commercially available Screen-reading software had the opportunity to consult the help topics built within the program. They considered them to be comprehensive and systematic for easy understanding and navigation. Some respondents were able to develop their skills by self-learning and exploration through online available tutorials produced by seasoned users of Screen-reading software.

CHAPTER FOUR – DISCUSSION

4.1 Introduction

Chapter Three – Results presented the results of the online survey and the semi-structured interviews. Survey responses were used to formulate the questions for the interviews to further explore and answer the research questions. Eight themes emerged from the analysis of the interviews:

- Accessibility, awareness, and availability of Screen-reading software
- Attitudes of fellow students and teachers towards the use of Screen-reading software.
- Barriers encountered while using Screen-reading software for learning
- Benefits of using Screen-reading software and drawbacks of not using it
- Customizability and user centredness of the Screen-reading software
- Features and functionalities available in different Screen-reading software
- Legislative and policy frameworks about the provision of Screen-reading software
- Support and training on the use of Screen-reading software for learning at a university.

Based on the above themes, this chapter focuses on the discussion, interpretation, and implications of the findings.

4.2 Summary of the Key Findings

4.2.1 Screen-reading software to support learning in Pakistan

Screen-reading software enables individuals with vision impairment to use computers with the extensive keyboard commands or shortcuts used to perform tasks a sighted user does using a mouse or touchpad (Babu & Xie, 2017). The findings of this study indicate that university students in Pakistan have access to Screen-reading software for their university studies and a large majority of students rely on Windows-based computer Screen-reading software, such as JFW (63.6%), NVDA (29.5%), and Apple's Voiceover (43.2%). This aligns with previous findings that 62% of respondents at the University of Karachi in Pakistan who were university students with vision impairment preferred to use computer Screen-reading software for learning needs (Zia & Fatima, 2011). Of the total of 46 respondents, six percent (n=3) reported using smart phones, including the Android-based and Apple phones with inbuilt Screen-reading software, for learning at the university level.

Smartphones have similar functionality to a computer and individuals with vision impairments can use mobile phone-based screen readers through special touch gestures to operate a smartphone (Buzzi et al., 2017). While 29.9% of survey respondents prefer to use NVDA, which is the open source and freely available Screen-reading software, most (63.6%) of them used a “cracked” (pirated) version of JFW, which is a commercially available Screen-reading software. They considered the screen reader technology to be very important for the successful accomplishment of their education in an inclusive environment with independent learning experiences. The use of Screen-reading software facilitates students to sit for an examination without needing to have the services of scribes. The findings of the study are indicative that students with vision impairment studying at various universities in the country were aware of different Screen-reading software for computers and smartphones. This was in agreement with the findings of McCarthy et al. (2013) [ENREF 59](#) who found a majority of students with vision impairment at the tertiary level were aware of and frequently used Screen-reading software for learning. Similarly, the respondents had awareness of the various Screen-reading software. However, according to the respondents of the study, the teachers and families did not have awareness of how an individual with a vision impairment could use a computer for learning at the university. The students stated that the lack of awareness among teachers and fellow students were causing hurdles during their studies, especially during class participation. The attitude of the teachers and fellow students towards students with vision impairment have been positive in general. However, in some cases the attitude has been less supportive and occasionally negative, which the students had to address by negotiations on a personal level. The respondents reported needing support from teachers and administration staff in getting access to learning content, extensions for the submission of assignments, additional time during examinations, and obtaining permission to use a laptop computer during classes. The students were forced to address these issues on a personal level through requests on compassionate grounds, since there were no effective policies or formal practices in place to allow for these considerations.

4.2.2 Challenges and barriers experienced by university students with vision impairments in the acquisition and use of Screen-reading software in Pakistan

Based on the findings of the study, the use of a computer for learning at the university level is fundamental for ensuring independent learning experiences for university students with vision impairments in Pakistan. The use of a computer can reduce the burden on families and friends in terms of providing support to students with vision impairment and will promote independent learning. By adopting the use of a computer, students with vision

impairments will be able to have equal access to today's available information on the World Wide Web, international electronic libraries, encyclopedias, dictionaries, and other learning sources. The students considered it to be very useful for them to have Screen-reading software for studying at the university level. However, the students faced barriers to the use of a computer with Screen-reading software because of the lack of training opportunities, limited funding for the acquisition of a laptop computer, and no formal policies or mechanisms established by the universities to ensure the provision of appropriate training in the use of a computer for their learning needs. The lack of university policies and procedures to accommodate the special needs of students with vision impairment in classrooms, lectures, and examinations results in those students needing to individually negotiate agreements with teachers or faculty, which shows that the universities have not taken steps to align their practices with the legislation meant to prevent discrimination of persons with disabilities.

Financial challenges in acquiring AT

Since the purchase of a computer requires the availability of financial resources, the socio-economic background of the student is an important determinant as to whether the student can pursue further education. Students coming from lower or weaker financial backgrounds had to face a multitude of challenges in the acquisition of a computer, relevant training in its use, and access to Screen-reading software. Talking about the financial difficulties in the acquisition of a computer, one respondent who received a laptop computer through a government scheme said *"as a student coming from a middle class, the purchase of a laptop computer could have been a major challenge my family faced"*. Apart from computer acquisition, the respondents faced other major challenges as university students with vision impairments due to difficulties in accessing and using Screen-reading software for learning.

4.2.3 Access to Screen-reading software

A prior study conducted by Kumar and Sanaman) (2015) [ENREF_53](#) found that students with vision impairment in higher education in India could not afford to pay for commercial screen readers and used pirated versions of JFW. The participants in their study also used NVDA, which does not require financial resources or reverse engineering for using its full functionality and is an open source and free screen reader (Kumar & Sanaman, 2015). In the same manner, because most of the respondents of this study were either relying on pirated copies of a commercially available screen reader or used the freely available and open-source Screen-reading software, they did not mention financial challenges while

obtaining a copy of the Screen-reading software. However, during the discussions, some respondents mentioned their willingness to use an authorised and non-pirated copy of the Screen-reading software were they to have access to one. Some students experienced technical difficulties while using the pirated version of the software because of the absence of support systems from the manufacturers. Although the study found that the majority of students did have access to Screen-reading software, the legality of the software remains a major concern as the majority of students used pirated software. Due to the reverse engineering of the Screen-reading software, certain aspects of the functionality or features of the software may be absent or limited and defective, which proved difficult to troubleshoot. Consequently, one of the respondents said “*Because of the cracked version of JFW, I often experience lag of speech and it leads to confusion*”. The illegally acquired copies of the software are not entitled to receive updates from the companies that produce them, therefore, these users are not able to take advantage of the performance improvements.

4.2.4 Functionality

Most of the respondents used JFW for learning and deemed it necessary for the completion of university assignments, reading textbooks and other learning content. Respondents were able to use word processing programs and the screen reading program offered support in using the advance features of the word processors including changing font size, style, and colour. They liked the pronunciation of the speech synthesizer used by JFW. Users of the freely available and open-source screen reader NVDA discussed the challenge of the speech synthesizer of the Screen-reading software to be mechanical or robotic, and occasionally mispronouncing words, which caused physical and mental exertion making it difficult to use for extended duration. The findings of a previous study on the use of Screen-reading software in libraries of Delhi in India found similarly that users preferred a more human-like voice for their Screen-reading software (Kumar & Sanaman, 2015). Some students discussed difficulties faced in accessing untagged and poorly designed inaccessible PDF documents provided by the university, were difficult or even impossible to read. According to the paper by Darvishy (2018), which [ENREF_32](#) provided an overview of the various possibilities of ensuring accessibility for Screen-reading software when designing PDF documents, this problem of inaccessible PDF documents could be overcome by universities in Pakistan if due equitable consideration was given to the needs of all students.

Despite facing the many challenges described by the respondents in this study, many of the students found the present level of functionality of the screen reader they used to be optimally beneficial for their learning needs. Therefore, it is clear that screen readers provide the best option for the students with vision impairments to succeed at university studies, provided that they have computer access and availability of appropriate training.

4.2.5 Support for Urdu

The respondents of this study who were students pursuing studies in the Urdu language medium of instruction faced particular difficulties in accessing learning content with their Screen-reading software. The present level of support for accessing content in Urdu is not sufficient, the voice of the text to speech engine is mechanical, often sounding robotic, making it difficult to understand the pronunciation. The functionality of Screen-reading software to read Urdu language is important for the students to be able to have access learning content produced in the national language of Pakistan. Without having the support for accessing content in Urdu, the students aspiring to pursue Urdu literature, Pakistan Studies, Islamic Studies, and other subjects relating to culture and society may not have independent access to learning content.

4.2.6 Support for converting graphical content (OCR/Image Description)

A total of 47.9% (n=22) of survey respondents did not realise their screen reader had the functionality to access visual content (OCR), which demonstrates a lack of awareness about the advanced functionality offered by the Screen-reading software. Only 6.5% of survey respondents used and considered the functionality of Screen-reading software to be excellent while scanning and performing OCR. Therefore, the students in this study reported the lack of ability of Screen-reading software to describe images, graphics, diagrams, multimedia presentations, and other visual content to be posing significant challenges during learning at the university level. Likewise, Butler et al. (2017) found that university students in Australia were unaware of or had difficulty in accessing information in graphical (visual) format, which is an integral part of learning in some disciplines. Thus, this problem (inability to access Optical Character Recognition using a screen reader) is not confined to students in Pakistan and the difficulty may be more widespread than might be assumed (Butler et al., 2017).

4.2.7 Physical and mental exertion

The extensive use of Screen-reading software caused 45.5% of respondents to experience physical and mental exertion. To address the exertion, the respondents preferred to have regular breaks and reported benefit from changing the speech synthesiser or voice.

4.2.8 Training

Students from remote areas faced complex issues in accessing training or technical support related to the use of Screen-reading software for university studies. Because of the lack of funding and training Institutes, the study found that students from remote areas had limited opportunities to acquire training often organised in the major cities of the country and access to computer Screen-reading software making it difficult for them to acquire tertiary education. Moreover, in another study done at the University of Karachi, which is a major city of Pakistan, it was found that university students with vision impairments mentioned the lack of training to be the major challenge in using Screen-reading software for university education (Zia & Fatima, 2011). Because of gender disparities based on the local culture, female respondents from remote areas reported that they were prevented from participating in the training programs to improve the capacity of people with vision impairment to use a computer with Screen-reading software, especially if these programs were offered in the major cities of the country or in places some distance from home towns of students. One female respondent further reported that gender disparity in Pakistan results in significant challenges for females to acquire education, which negatively impacts their lives and hinders their learning. Gender-based inequality in Pakistan's education system, while not the focus of this study, has clear implications for women with vision impairment as their disability causes multiple disadvantages.

4.2.9 Support

Most of the users of Screen-reading software were satisfied with the help topics and user guides provided pertaining to the use of their Screen-reading software. They had the support of friends who were proficient users of Screen-reading software and were well-versed in addressing the issues faced by respondents. Some of the respondents discussed the online forums of users of Screen-reading software to be useful for identifying solutions to the problems they faced. A few respondents preferred to use the online available downloadable audio tutorials produced by veteran users and trainers of computer Screen-reading software. However, some of the respondents discussed the lack

of help topics within freely available and open-source Screen-reading software. During the discussions, it emerged that the presently available help topics within the freely available Screen-reading software were not organised and lacked uniformity. In some cases, it was pointed out that these help topics were not available in organised form and this presented a challenge.

4.2.10 Support mechanisms and accessibility at the university

For some students, the universities did not have a system for ensuring accessibility of the online learning portals and their screen reader faced numerous challenges in navigating those inaccessible pages. In general, the Screen-reading software used by participants was able to access the learning content. However, this access was hindered by a number of factors. For example, there was no formal mechanism for ensuring accessibility for students having disabilities, no awareness among the teaching and administrative staff about the rights of inclusion of students with vision impairments, and a lack of infrastructure for the capacity building of the students to use Screen-reading software for university studies. These problems were mentioned to be the important factors often causing insurmountable challenges for students. In cases of experiencing difficulties, the students had to rely on the compassion or sympathies of the teachers to address the problems on an individual basis. As echoed by some respondents, the support being provided on sympathetic grounds, rather than as an established practice, may not be sustainable, was inequitable, and was often limited to some, more considerate teachers, or other staff. For example, a respondent said that if the teaching staff were not willing to support them, they had to be “*on their own*” eventually compelling them to seek support from fellow class mates, friends, or family members, which made them feel dependent. One respondent described this dependence on others “*an ordeal*”, which resulted in the students with vision impairments having no alternative but to wait for assistance from others who often had no time to help. This problem ultimately consumed enormous time, placed added pressure, and unfairly affected the respondents’ academic performance.

Although the provision of Screen-reading software is fundamental in terms of the facilitation of students with disabilities while learning at the university level, the findings of the research suggest that the availability and access to Screen-reading software alone is not sufficient for insuring the smooth learning experiences for university students with vision impairment in Pakistan. For the students to be able to effectively use a computer for learning, it is pivotal for them to have a formal support mechanism for ensuring the user

centredness of the Screen-reading software as well as the provision of appropriate training in its use. Furthermore, evidence from the study suggests that universities in Pakistan are failing in their legislated duties under law to provide equitable support for education of persons with disability.

4.2.11 Awareness of policy/legislative frameworks pertaining to the provision of Screen-reading software

In addition to the recent legislation about the inclusion of PWDs, Pakistan ratified the United Convention on the Rights of Persons with Disabilities (UNCRPD) in 2011, which makes the state responsible to ensure the education system provides maximum inclusion and the promotion of a barrier free environment for PWDs (Ahmed & Khan, 2011). The respondents of the study demonstrated basic awareness about the existing legal and policy frameworks pertaining to the availability of facilities for students with disabilities. Even though the respondents generally discussed the policy and legal frameworks pertaining to the provision of university education to students with vision impairment, most could not specifically identify the policies, which shows a lack of awareness about existing policy frameworks in the country. Importantly, without the awareness about existing legal policy frameworks pertaining to ensuring smooth learning experiences for students with vision impairment, the respondents could not claim their essential entitlements, which forced them to rely on the compassion of the teachers, administration staff, friends, or family members. Apart from lack of student awareness, there is also the finding from this study that teachers and faculty at Pakistan universities are lacking in awareness of their responsibilities under legislation to provide equitable and enabling consideration of the special needs of PWDs.

Under the CRPD, Pakistan has obligations to facilitate and promote the provision of Screen-reading technology for minimising barriers in learning at the university level (United Nations General Assembly, 2006). To address the challenges faced by students with disabilities while acquiring a university education, there is a requirement for the development of comprehensive and human rights-based policy for promoting inclusive education through the provision of user-centred affordable AT and allocation of fiscal and human resources. Such a policy would provide important guidelines for stakeholders about improving the educational outcomes for students with vision impairment. These policy frameworks should be developed in meaningful consultation with stakeholders, especially PWDs and their representative organisations, to ensure they may be flexible enough to respond to the ever-changing specific needs of the students. Additionally, the policies

should be effectively implemented and rigorously reviewed to ensure monitoring of outcomes and continual improvement.

The respondents often mentioned the need to negotiate on a personal level with the teaching and administration staff of the universities for facilitation of their special needs in learning. This finding demonstrates the importance of students being fully aware of and understanding their rights under policies and legislation pertaining to ensuring inclusive education for university students with vision impairment in Pakistan. This knowledge will be fundamental in enabling these students claim their rights and have their grievances addressed through formal systems. Universities will be bound to develop mechanisms for the elimination of barriers in learning and for improving the enrolment, academic performance, and successful graduation of students with vision impairment. Effective policy-making and its proper implementation is crucial for realising the provision of internationally recognised human rights of PWDs (Ahmed & Khan, 2011). The awareness about laws and policies will enable stakeholders to be cognisant of their obligations in the service delivery for students with vision impairments and students with multiple disadvantages, including gender-based inequities. Under the policy frameworks, students will be able to claim their rights regarding the accessibility of learning content, infrastructure modifications, provision of laptop computers with preinstalled Screen-reading software, and address any other challenges they face owing to their disability. Having appropriate awareness and understanding of the policies will facilitate universities to comply with the articles of the CRPD about the creation of equal opportunities for learning in an inclusive and least restricted environment (Ahmed & Naveed, 2020; Awais & Ameen, 2015). This will eventually improve the systems for the provision of education to students with vision impairment and will minimise the prevailing gap in service delivery between the universities in major cities and remote parts of the country, which was reiterated multiple times by respondents.

4.3 Implications of the Study

Research about the provision of person-centred and appropriate assistive technology for students with vision impairment has become a topic of considerable interest in the body of literature on special education needs in the 21st century. Yet, in developing countries very few studies have been undertaken in this critical area of research (Jarl & Lundqvist, 2020; Khan et al., 2017). Globally, with the ever growing and changing landscape of the AT market, more research is required for ensuring the user centredness and localisation of AT

in terms of applications for languages, speech, and terminology. Research is pivotal for the affordability of AT products, their optimum use, and sustainability, especially in low-income countries with scarce resources. This study aims to inform and provide an important step in exploring the perspective of end users about the expectations vis-a-vis the present level of functionality of their Screen-reading software while studying at universities in Pakistan. It specifically focused on the benefits of using Screen-reading software, and identified the many barriers and challenges faced by the students with vision impairments attending universities in Pakistan.

The study will be useful to inform policymakers and to assist them to understand the perspective of university students with vision impairments for better addressing higher education needs for this special group, in the context of Pakistan. This is one of the few studies of these issues in Pakistan, and will encourage further studies pertaining to the provision, availability, and access to screen reading AT in other developing countries. Designers and producers of AT will also be informed and gain a better understanding of the perspectives of university students with vision impairments from Pakistan about their needs, challenges, and benefits of using Screen-reading software.

4.4 Recommendations

Based on the findings of this research, there are a number of recommendations arise for addressing the problems faced by university students who use computer Screen-reading software for learning at universities in Pakistan.

- 1) Policy development.** There is a need for policy development related to the provision of AT, specifically Screen-reading software, which can meet local needs and requirements. During the policy development phase, meaningful participation of people with vision impairment, especially advanced users of Screen-reading software, is needed to ensure the formulation of an effective policy pertaining to the availability of free or affordable Screen-reading software for university students with vision impairments in Pakistan.
- 2) Research and development.** It is recommended that the government establish a specific research and development (R&D) centre focussed on accessible Screen-reading software that is context-specific, because R&D activities can provide insights and deeper knowledge about the latest developments and innovation in the realm of AT. The R&D centre would aim to develop context specific AT products, improvise the existing free and open-source products and technologies, develop context specific

localised Screen-reading software and other products, improve existing free and open-source screen reading solutions and technologies, and troubleshoot any issues that end-users report.

The R&D centre should aim to improve the functionality of free and open-source Screen-reading software and further develop the capacity of eSpeak (open source and free text to speech engine) to read and correctly pronounce text in Urdu language.

Additionally, the R&D centre should work in close coordination with WHO Global Cooperation on AT (GATE) initiative, major producers of AT, humanitarian agencies, and other states to leverage learnings from comparable projects already launched in other countries with similar conditions.

- 3) Inclusive education policy.** The higher education commission (HEC) Pakistan and its affiliated universities and other institutions of higher education need to develop specific inclusive education policies about ensuring the provision of AT for the facilitation and grievance redressal mechanisms for the students with vision impairments.

The HEC should develop accessibility guidelines for the universities in the country of origin, to ensure accessibility compliance with the standards set by W3C and provide alternative text with graphics and images.

The HEC in consultation and partnership with organisations of PWDs, varsities, department of social welfare and special education need to develop steering committees for the effective and meaningful implementation of the inclusive education policies for the facilitation of students with vision impairment and other disabilities in the country of origin.

The HEC should make it mandatory for universities to implement the inclusive education and AT policies by the establishment of appropriate and dedicated AT centres within universities.

- 4) Technology centres.** AT centres at each university should be equipped with adequate technology and sufficient and capable human resources to convert inaccessible learning content, online learning portals and other relevant material into an accessible format for students with vision impairments.

The HEC should establish an online repository of relevant resources including downloadable copies of Screen-reading software, tutorials about the use of computer by individuals with vision impairments, online user's forums for posting questions, and sharing important useful tips and workarounds related to the use of Screen-reading software and other services. Locally developed Screen-reading software and any related tutorials and training content or help topics should be preinstalled on computers provided to university students with vision impairments under the government schemes.

4.5 Limitations of the Study

Although the findings of the research may be valid for the broader group of people with vision impairments who use screen readers as their AT, these findings may not be representative of the overall population of individuals with a vision impairment across Pakistan. Furthermore, the barriers and attitudes encountered by the respondents in this study may not be assumed or applied to other contexts where circumstances may differ.

It is well known that researchers tend to research topics they are interested in, or they may choose to study an issue they have been affected by. Researcher bias is an important limitation to recognise because, as individuals, our own experiences can colour how we interpret data (Gerhard, 2008). For example, the researcher's own experiences of inequity during university studies, in accessing screen readers, and in society generally have left an indelible impression that requires careful consideration to maintain objectivity and minimise personal bias during the study. Therefore, in this study, the potential for bias in the primary researcher was managed and avoided through the involvement of two other members of the research team, consisting of the two study supervisors, who each undertook secondary analysis of the survey results and interview analyses. Thus, the findings and conclusions of the study reflect their independent and impartial confirmation that researcher bias was not a significant factor in the outcome.

CHAPTER FIVE - CONCLUSION

This research aimed to identify the barriers to the use of Screen-reading software encountered by university students with vision impairment in Pakistan while learning at the university level. It aimed to explore and understand the perspectives of university students with vision impairment and identify if respondents were aware of the existing legal and policy frameworks to support the provision of Screen-reading software to university students with vision impairments.

Prior to conducting the research, it was important to understand how PWDs have been perceived in society and to identify some of the challenges they have faced. The construct of disability has been a complex phenomenon often characterised by stereotypical attitudes and discriminatory practices. To develop a better understanding of the issues PWDs face, the study sought to gain a fundamental understanding of the background of disability and how it has been defined. Therefore, a historical overview of the paradigm shift in the construction of disability over time was discussed. Historically, individuals with disabilities were viewed as objects of pity and regarded as the unfortunate victims of fate. This medical or charity model of disability was based on the individual characteristics of individuals and their physical or sensory impairments. Consequently, PWDs were stigmatised and often kept in isolation and neglected. They were merely the recipients of medical services and institutional-based care services with limited opportunities for inclusion in the mainstream of society.

The medical model of disability was replaced in more recent times with the social model of how disability is perceived. The social model of disability proposed a more rights-based approach and considered disability to be caused by external factors, such as an inaccessible built environment and negative attitudes. The international disability rights campaign led by organisations of PWDs, human rights groups, and the UN has reconceptualised the notions of disability. Thus, it is now better understood that disability is not caused by a person's impairment, rather it is the result of the external physical and discriminatory policy environments that create disabling conditions and disadvantage for PWDs. Following the enactment of the UNCRPD, disability has become a human rights issue that must be addressed by the creation of an inclusive and accessible environment. In Pakistan, PWDs have been experiencing stigma and exclusion. In 1980, legislation guaranteeing the provision of opportunities for PWDs was introduced, which was followed by the National Policy for PWDs (2002) and the National Plan of Action (2006). With the

adoption of the CRPD in 2006, the definition of disability was changed on a global scale. In 2011, Pakistan ratified the CRPD and efforts to amend the existing laws and policies in line with CRPD were expedited in the country. In recent years, laws at federal and provincial levels have been formulated to promote inclusion of PWDs by ensuring an enabling environment. In addition, PWDs are able to use modern technology if it is designed with accessibility considerations and additional functions to assist the needs of these users. The specialised technology or services that enable users with disabilities to use modern technology is referred to as assistive or adaptive technology, most often abbreviated to AT. The provision of person-centred and affordable AT is instrumental for ensuring the inclusion of 10 to 15% of the population with disabilities who would otherwise find the information accessible through computers to be out of their reach.

To meet the individual, specific needs of people with different disabilities, various AT models, devices, and frameworks have been developed and are available, depending in some cases on cost and suitability in the context of application. The usability of these frameworks is imperative for ensuring the maximum utilisation of the technology. Individuals with vision impairments can use a computer with the help of a computer program or smartphone application called a screen reader, which delivers text-to-speech output and access to the functionalities through keyboard commands and touch gestures. In developing countries, individuals with vision impairment are often reliant on their families or limited government financial support to acquire computers and any associated AT to overcome the disadvantage of their vision impairment. Due to the high cost of commercially available Screen-reading software, students with vision impairments in developing countries, including Pakistan, have been reported to use pirated versions of Screen-reading software or free screen reading programs. Although the free and open-source Screen-reading software offers a reasonable level of functionality, training and support to enable and promote the use of free Screen-reading software is lacking. Other limitations of free screen readers, including language use and reliability, have been reported, yet few studies have been conducted in the context of Pakistan to help reveal the perspectives of university students with vision impairment who rely on Screen-reading software to overcome learning disadvantages in their studies.

This study was based on a mixed-method research approach, where both quantitative survey and qualitative interview data were collected and analysed. The online survey enabled the researcher to develop a better understanding of the problem and aided in formulation of the questions for the semi-structured interviews for collection of qualitative

data. The survey, which was the first phase of the project, was followed by in-depth, semi-structured interviews that showed awareness and preference among the participants of the use of Screen-reading software for university studies. Most of the participants relied on computer-based Screen-reading software for their university studies and a few of them used smart phones with Screen-reading software. Although the respondents appreciated the enabling facility of Screen-reading software to use a computer, they mentioned difficulties and an absence of support systems in the use of the Screen-reading software for learning. In Pakistan, people with vision impairments experience a diverse range of challenges in the acquisition, use, and customisation of Screen-reading software.

Access to Screen-reading software is imperative in ensuring optimum learning at the university level for students with vision impairments. However, this research has revealed that in Pakistan, various contributing factors hinder the availability of Screen-reading software for university students with vision impairments. This is a serious situation that is compounding the effect of multiple barriers, disadvantage, and discrimination these students are confronted with in attempting to gain a tertiary qualification.

A summary of the key findings, their interpretations, and implications was provided in the third and fourth chapters. These findings culminated in Chapter Four with a series of key recommendations for the provision of AT to the students with vision impairments, and for the resolution of barriers they face. These recommendations form the basis for significant improvements in the way Pakistan's universities accommodate the needs of PWDs and, in particular, show how universities can help provide equitable access to education for students with vision impairments. In addition, the recommendations illuminate a pathway that would enable universities to meet their obligations under national legislation and international conventions on the prevention of discrimination against persons with disabilities.

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APPENDIX 1 HUMAN RESEARCH ETHICS COMMITTEE APPROVAL

3 December 2020



HUMAN ETHICS LOW RISK PANEL APPROVAL NOTICE

Dear Associate Professor Belinda Lange,

The below proposed project has been **approved** on the basis of the information contained in the application and its attachments.

Project No: 2952
Project Title: Understanding the uptake, barriers and challenges to using screen reading software for learning experienced by university students with vision impairments in Pakistan
Primary Researcher: Associate Professor Belinda Lange
Approval Date: 03/12/2020
Expiry Date: 20/12/2021

Please note: Due to the current COVID-19 situation, researchers are strongly advised to develop a research design that aligns with the University's COVID-19 research protocol involving human studies. Where possible, avoid face-to-face testing and consider rescheduling face-to-face testing or undertaking alternative distance/online data or interview collection means. For further information, please go to <https://staff.flinders.edu.au/coronavirus-information/research-updates>.

RESPONSIBILITIES OF RESEARCHERS AND SUPERVISORS

1. Participant Documentation

Please note that it is the responsibility of researchers and supervisors, in the case of student projects, to ensure that:

- all participant documents are checked for spelling, grammatical, numbering and formatting errors. The Committee does not accept any responsibility for the above mentioned errors.
- the Flinders University logo is included on all participant documentation (e.g., letters of Introduction, information Sheets, consent forms, debriefing information and questionnaires – with the exception of purchased research tools) and the current Flinders University letterhead is included in the header of all letters of introduction. The Flinders University international logo/letterhead should be used and documentation should contain international dialing codes for all telephone and fax numbers listed for all research to be conducted overseas.

2. Annual Progress / Final Reports

In order to comply with the monitoring requirements of the *National Statement on Ethical Conduct in Human Research 2007 (updated 2018)* an annual progress report must be submitted each year on the approval anniversary date for the duration of the ethics approval using the HREC Annual/Final Report Form available online via the ResearchNow Ethics & Biosafety system.

Please note that no data collection can be undertaken after the ethics approval expiry date listed at the top of this notice. If data is collected after expiry, it will not be covered in terms of ethics. It is the responsibility of the researcher to ensure that annual progress reports are submitted on time; and that no data is collected after ethics has expired.

If the project is completed *before* ethics approval has expired please ensure a final report is submitted immediately. If ethics approval for your project expires please either submit (1) a final report; or (2) an extension of time request (using the HREC Modification Form).

For student projects, the Low Risk Panel recommends that current ethics approval is maintained until a student's thesis has been submitted, assessed and finalised. This is to protect the student in the event that reviewers recommend that additional data be collected from participants.

3. Modifications to Project

Modifications to the project must not proceed until approval has been obtained from the Ethics Committee. Such proposed changes / modifications include:

Appendix 2 Survey Questionnaire

Understanding the support mechanisms or factors that impede the acquisition and use of screen readers by people with visual impairment in Pakistan

Chief Investigator **Mr. Muhammad Babar Shahzad**

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My name is Muhammad Babar Shahzad and I am a Flinders University Masters student. I am undertaking this research as part of my degree. For further information, you are more than welcome to contact my supervisors via their details listed above.

Description of the study

This project will investigate the challenges faced by university students with vision impairments living in Pakistan with respect to accessing computer Screen-reading software for educational purposes. This project is supported by Flinders University, College of Nursing and Health Sciences and the College of Science and Engineering.

Purpose of the study

The purpose of the proposed study is to investigate the uptake, barriers and challenges experienced by university students with vision impairments in Pakistan with respect to using computer Screen-reading software for learning. The study will examine existing legal and policy frameworks to assess if they sufficiently meet the needs for the provision of screen readers as an Assistive Technology in Pakistan.

Benefits of the study

The sharing of your experiences will help us understand the views of the users of computer Screen-reading software and its effectiveness within an educational setting. It will also help in understanding the challenges experienced by users and the possible strategies of overcoming them in learning environments.

Participant involvement and potential risks

If you agree to participate in this research study, you will be asked to complete a questionnaire that will take approximately 15 minutes to complete. Completion of the survey is voluntary. Your comments will not be linked to your name. We do not anticipate the questions causing you distress, however, if you experience feelings of distress as a result of participation in this study, please let the research team know immediately. You can also contact UMANG via a toll-free 24-hour mental health helpline at (92) 0311 7786264.

At the end of this survey, you will be invited to provide your details or contact the research team if you are interested in taking part in the next stage of this research, which will involve an interview to find out more details on this topic. Participation in the next stage of the study is voluntary. You can complete the survey and decide not to take part in the interview.

Withdrawal Rights

You may, without any penalty, decline to take part in this research study. If you decide to take part in the survey and later change your mind, you may, without any penalty, refuse to answer specific questions or withdraw at any time without providing an explanation. To withdraw, please close the internet browser and leave the online survey. Please note that any data collected up to the point of withdrawal will be used in the study.

Confidentiality and Privacy

Only researchers listed on this form have access to the information that you provide. Privacy and confidentiality will be assured at all times. The research outcomes may be presented at conferences, written up for publication, or used for other research purposes as described in this information sheet. However, the privacy and confidentiality of individuals will be protected at all times. You will not be named, and your individual information will not be identifiable in any research products without your explicit consent.

No data, including identifiable, non-identifiable and de-identified datasets, will be shared or used in future research projects without your explicit consent.

Data Storage

The information collected may be stored securely on a password protected computer and/or Flinders University server throughout the study. You will be invited to provide your details or contact the research team if you are interested in taking part in the next stage of this research, which will involve an interview to find out more details on this topic. Any identifiable data will be de-identified for data storage purposes unless indicated otherwise. All data will be securely transferred to and stored at Flinders University for at least five years after publication of the results. Following the required data storage period, all data will be securely destroyed according to university protocols.

How will I receive feedback?

On project completion, a short summary of the outcomes will be provided to all participants via email or published on Flinders University's website.

Ethics Committee Approval

The project has been approved by Flinders University's Human Research Ethics Committee (Project ID 2952).

Queries and Concerns

Queries or concerns regarding the research can be directed to the research team. If you have any complaints or reservations about the ethical conduct of this study, you may contact the Flinders University's Research Ethics & Compliance Office team via telephone +618 8201 3116 or email human.researchethics@flinders.edu.au.

Declaration by Participant

I have read the Participant Information Sheet.

I am 18 years of age or older.

I understand the purposes, procedures and risks of the research described in the project.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time during the completion of the survey.

- Yes - I agree to take part in this study and begin the survey
- No - I do not agree to take part in this study – I do not wish to participate in this survey

PART A: We would like to find out some information about you and which screen readers, if any, you use. This information will help us to describe the group of people that complete the survey and help us to explore and evaluate the information provided. This information will not be used to specifically identify you.

1. What is your year of birth? _____

2. What gender do you identify with?

- Male
- Female
- Prefer not to say

3. What is your current relationship status?

- Single
- Married
- De facto
- Divorced
- Widowed
- Other
- Prefer not to say

4. What is your current living status?

- Living alone
- Couple with no children
- Couple with child/ren moved out of home
- Family with eldest child over 18 years living at home
- Family with eldest child under 18 living at home
- Share house
- Other – Please specify _____

Which University are you studying at?

5. Which broad field of study are you enrolled in presently?

- Humanities.
 - Arts.
 - Natural sciences and engineering.
 - Social sciences;
 - Health and related studies;
 - Administrative sciences and management studies;
 - Any Other, please specify)
-
- Are you a postgraduate or undergraduate student?
 - Undergraduate student;
 - Postgraduate student.

6. Which year of study are you now?

- First;
- Second;
- Third;
- Final;
- Other.

7. Which Screen-reading software are you aware of?

- Jaws;
- NVDA;
- Voiceover;
- Other (please specify)

8. Do you have a personal computer or laptop for supporting you during your university education?
- Yes
- No
9. Thinking about your experiences with screen readers. How much do you agree with each of these statements?

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
A screen reader can support students with vision impairments in university education	<input type="radio"/>				
Having access to a personal computer or laptop is important for meeting my learning needs					
It is important to have a Screen-reading software that can read Urdu					

PART B: We would like to find out more information about the supports provided by your university.

Statement	Yes	Sometimes	No	Not sure
My university provides access to computer for students with vision impairment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My university offers computer training for students with vision impairments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have received computer training and believe it meets the needs of students with vision impairments?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use a screen reader to support my university education	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My university has an online learning system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The online learning system is compatible with my screen reader	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
During COVID-19, my studies moved to online learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My screen reader has a sufficient level of functionality for me to attend online classes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My university provides textbooks in accessible formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My university provides readings in accessible formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My university provides other learning content in accessible formats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I prefer to use a screen reader for notetaking in class	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use a computer screen reader for completing the answer sheet during an examination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I complete university assignments using a computer screen reader	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10. How do you access computers for your University studies?

11. What additional training do you think is needed to support students with vision impairments?

12. Which organisations would be most appropriate to provide this training?

- University
- Department of Social welfare and Special Education
- Non-for-profit organisation
- Any other, please specify _____

13. How do you pay for your Screen-reading software?

- The software I use is free
- I pay for my Screen-reading software out of my personal funds
- The University provides my Screen-reading software
- Non-profit Organisation
- Department of Social Welfare and Special Education
- Other, please specify _____

14. How does the university communicate with students?

- Online learning system
- Social Media
- Email
- Other, please specify _____

15. How can the University support the use and accessibility of screen readers for online learning?

16. Are you aware of any screen reader available that can read Urdu?

- Yes. Please specify _____
- No
- Not Sure

17. If no, should such software be developed?

- Yes. _____
- No. _____

18. If yes, does it sufficiently meet the learning requirements of university students who need to use Urdu as a major?

- Yes. _____
- No. _____

19. If not, have there been any efforts to customise Screen-reading software for reading Urdu?

- Yes
- No
- Not Sure

PART C: We would like to find out more about the challenges that you have experienced when using Screen-reading software and how you have overcome these challenges.

20. Is your screen reader customizable for university studies?

- Yes
- No
- Not sure

21. Does your screen reader provide you the necessary pace to keep your learning tasks on time?

Yes

No

22. If yes, does the university provide you the learning content in an accessible format?

Yes

No

23. If no, how do you get access to the learning content that you need to access?

By using scanning software;

Requesting classmates to transcribe;

Family members extend support;

Download online;

A non-for-profit provides it.

24. Can the screen reader describe graphics, images and other visual content?

Yes

No

Not sure

25. If yes, what is the level of your screen reader's ability to report non-textual contents?

Feature not available;

Fair;

Excellent.

26. Does the extensive use of the synthetic speech of the screen cause discomfort to you?

Yes, how? _____

No.

27. If yes, how do you address it?

- Take regular breaks;
- Change the speech synthesiser;
- Any Other, (Please specify)
- _____.

28. Is the voice of the screen reader clear enough in pronouncing words?

- Yes
- No.

29. If no, are you able to modify the speech dictionary?

- Yes
- No.

30. Do you face any specific issues in installing, using and customising your screen reader to meet your particular needs?

- Yes
- No.

31. If yes, how do you manage complex screen reader issues?

- Contacting the developer;
- Support from the university;
- Guidance from friends;
- Consulting the help topics and web search;
- Any other, please specify.

PART D: We would like to find out more about your thoughts on how the legal and policy frameworks in Pakistan have impacted the provision of user centred and appropriate screen readers.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
There are National policies to support the provision of screen readers for vision impaired students in Pakistan	<input type="radio"/>				
There are provincial policies to support the provision of screen readers for vision impaired students in Pakistan					
The existing policy frameworks in Pakistan sufficiently address the provision of computer Screen-reading software for people with vision impairments					
There are policies at the University that provide access to students with vision impairments to Screen-reading software					
The implementation of the policies about provision of Screen-reading software sufficiently meets the needs of the students					

32. If no, should the university formulate such policy?

- Yes
- No
- Not sure.

33. If yes, does the policy need review to improve it?

- Yes, please explain _____
- No
- Not sure.

34. If no, how could the implementation be ensured?

- Establishment of a monitoring committee;
- Establishment of student's representative association;
- Any other, please discuss:

Appendix 3 Interview Questions

Hello and Assalamualaikum (A greeting used in Pakistan meaning may peace be upon you), my name is Muhammad Babar Shahzad. Thank you for volunteering to participate in this project.

I am undertaking my master's research at Flinders University, and I am very interested in the experiences that you have had using screen readers as part of your university studies.

I believe we have much to learn from you and your experiences and I am grateful that you have provided us with the opportunity to do that.

I am particularly interested in understanding your perspective about the use of Screen-reading software during your university studies, any challenges you might have experienced and I hope to use this information to better understand the problems of university students with vision impairments from Pakistan in accessing learning content using screen readers.

Please know that anything you tell me is private. You will not be named and information you tell me will not be linked to you or shared specifically with other people. In order to enable me to transcribe the interview, the interview will be audio recorded. The recording of the interview will not be shared, will be securely stored on Flinders University Cloud and will be permanently deleted after the transcription.

If there are any questions that make you feel uncomfortable, please tell me. If at any time you need to rest or would like to take a break, please tell me and we can do that. Are you ready to start?

1. Tell me a little about yourself

a. (Age, background, studies.....)

2. Tell me about your experience as a student at university?

3. How does access to a computer support your university education?

4. What value does a computer bring to you as a student with a vision impairment?

5. Can you tell me about your experience with using screen readers for your university education?

6. Which screen reader do you currently use?

Does it support in reading Urdu?

7. What training have you received in the use of your screen reader?

8. How did you acquire your screen reader?

9. Have you used other screen readers during your university education? (Please explain why)

10. As an alternative to the commercial screen readers, have you used or considered free screen readers to be productive for university students with vision impairments?

If yes, please explain how?

If no, please explain why not?

11. What specific problems do you face while using computer for learning at the university level?

12. What are your thoughts on the capability of screen readers to describe non-textual content such as images and graphics?

13. How effective and reliable is the provided description to you?

14. How do you think having this feature can improve your access to learning content?

15. What specific support systems have been put in place for students who use a Screen-reading software with vision impairments in your university?

In case of no support, do you think it important to establish such supports?

16. In your view, what is the overall attitude of teachers and your fellow students about your use of computer Screen-reading software?

17. What (if any) legislative/policy frameworks are in place to address the needs of the university students with vision impairments in Pakistan?

18. Are these policies implemented and effective at your university?

I don't have any further questions for you but is there anything else on this topic that you would like to share with me that you have not had an opportunity to say?

Thank you very much for your time. I really enjoyed talking to you. I appreciate you sharing your thoughts and stories with me.