

# **Experiences of blind high-school learners regarding computer use**

**Gert Hendrik Grobler**

# **Experiences of blind high-school learners regarding computer use**

by

**Gert Hendrik Grobler**

Submitted in partial fulfilment of the requirements for the degree

**MAGISTER EDUCATIONIS  
(EDUCATIONAL PSYCHOLOGY)**

at the

**Department of Educational Psychology  
Faculty of Education  
UNIVERSITY OF PRETORIA**

Supervisors:

**Dr T. Loots**

**Prof C. Lubbe-De Beer**

**PRETORIA**

**2014**

*Hierdie dissertasie word opgedra aan  
my liewe vrou,  
Olive,  
dankie vir jou onwrikbare geloof, geduld, liefde en ondersteuning.*

## Acknowledgements

I owe a debt of gratitude to the following people whose guidance and support was instrumental to my successful authorship:

My wife, Olive for your love and support through difficult times. Your calm sense of purpose and empathy is my pillar of strength. Thank you for helping me create the time necessary to complete this work.

My Parents, Daan and Susan for your patronage, inspiration and love. Your parenting and guidance have fostered a creative, inquisitive mind with a thirst for knowledge. I strive to propagate the wisdom of your teachings in my private and professional life.

Dr Tilda Loots, without your selfless sustained professional guidance, motivation, patience and understanding, I would not have been able to complete this dissertation. Thank you for always being there and supportive.

Prof Carien Lubbe-De Beer, thank you for giving me the same expert guidance and support you've given to so many others. May you continue to find joy in your work and inspire passion and professionalism in your students and colleagues.

All the lecturers who had a hand in my education, thank you for your time and knowledge.

The Creator, Thank you for the people, time and talents granted me, may my life be pleasing.

# **ABSTRACT**

## **Experiences of blind high-school learners regarding computer use**

**By**

**Gert Hendrik Grobler**

Supervisor : Dr T. Loots  
Co-Supervisor: Prof C. Lubbe-De Beer  
University : University of Pretoria  
Department : Educational Psychology  
Degree : MEd (Educational Psychology)

The visually impaired community forms a small but integral part of South Africa with the potential to contribute meaningfully to its infrastructure and society, yet blind learners still seem to struggle with computer use. There are various barriers that stand between blind learners and computer access. In this study, I explore the experiences of blind high-school learners (n=4) with regards to computer use. A qualitative case study was applied as research design at a high-school for the visually impaired. Data sources included semi-structured interviews and focus-group discussions, which were audio-recorded and transcribed. Observation-in-the-context was documented in research diaries and field notes. Following thematic analysis, the following themes emerged: value of computer use for blind users; barriers related to blind computer use; and future solutions and possibilities of blind computer use. Insights may inform future conceptualisation and implementation of computer use amongst blind high school learners.

## **KEYWORDS**

- **Blind high-school learners**
- **Visually impaired**
- **Blind computer use**
- **Information and computer technology**
- **Assistive/adaptive technologies**
- **AAC or alternative and augmentative communication**
- **Screen reader**
- **Disability**
- **Impairment**
- **Barriers**



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Experiences of blind high school learners regarding computer use

Gert Hendrik Grobler

Educational Psychology

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# CHAPTER 1: INTRODUCING THE STUDY

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## 1.1 INTRODUCTION

The visually impaired community forms a small but integral part of South Africa (Mokiwa & Phasha, 2012), with the potential to contribute meaningfully to its infrastructure and society. However, blind learners still seem to struggle with computer access (Fraser & Maguvhe, 2008) and use (van der Geest, van der Meij, & van Puffelen, 2013; Gerber, 2003), which is both a skill and service which many will later rely on to support themselves. Following the shift to a more humanistic society, Britain and the United States have embraced the practice of inclusive information technology (Brophy & Craven, 2007; Devins, Darlow, Petrie, & Burden, 2003), which entails the adoption of accessible services in government and educational institutions. In an attempt to further inclusion (Department of Education, 2001) in South Africa, it would seem only fair that we attempt to adopt similar equal access strategies to the blind community, as it might enhance our practices as education and support professionals.

The current study aimed to investigate the experiences of blind high-school learners regarding computer use. By listening to the voice of blind high-school learners, the researcher<sup>1</sup> attempted to gain an insider perspective on the phenomenon of computer use. In addition, making the users' voice heard could aid in development and support strategies that are focused on what users say they want as opposed to what we think they need.

## 1.2 PURPOSE OF THE STUDY

The purpose of the research study was to obtain an in-depth understanding of the experiences that blind South African high-school learners have regarding computer use. Through an in-depth analysis of the accounts of four blind learners, the researcher aimed to derive to a deeper

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<sup>1</sup> Though customarily referred to in the first person (I) in an interpretivistic inquiry, it was felt that a third person narrative would aid in amplifying the voices of participants in the current study.



understanding of the potential value of computer use, specific barriers and possible solutions in the computer communication process as well as their awareness of additional assistive programs and hardware. The researcher is aware of the fact that other assistive technology (AT) is available to bridge the proposed barriers in communication. Because resources are generally limited, the researcher is of the opinion that the perceptions of blind South African high-school learners could contribute insights in choosing and implementing the correct assistive technologies. The study may provide valuable insights for possible interventions in terms of curriculum development and future research leading to the selection of assistive technologies that are appropriate to the unique requirements of the South African context. Finally, it can raise awareness among educators, learners and parents regarding blind computer use and assistive technology.

### **1.3. BACKGROUND AND RATIONALE OF THE STUDY**

Following a preliminary literature review, the researcher noticed a significant gap in literature regarding blind computer use. Multiple studies have been conducted on visually impaired computer users and other computer users with a combination of various disabilities (Douglas, Pavey, Corcoran, & Clements, 2012; Gerber, 2003; McNaughton, Bryen, Blackstone, Williams, & Kennedy, 2012; Whitburn, 2014; Zhou, Ajuwon, Smith, Griffin-Shirley, Parker, & Okungu, 2012). However, the literature on computer use (Shinohara & Tenenberg, 2009; Wentz, Hochheiser, & Lazar, 2012) among blind high-school learners was found to be limited. The researcher attributes this gap to a lack in differentiation and deeper understanding pertaining to the unique experiences of blind computer users in high schools.

The learners at the school where the researcher used to teach (and where the research was conducted) were all either blind or had low vision. This means that they often found it difficult to use non-verbal means of communication such as writing or typing. Blind learners usually make use of a screen-reading program such as JAWS<sup>2</sup> to navigate around the desktop or various

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<sup>2</sup> JAWS is an acronym for Job Access With Speech. It is a screen-reading program that reads the contents of a screen out loud by using text analysis and speech synthesisers to produce audible text/speech ("Freedom Scientific - BLINDNESS SOLUTIONS: JAWS," n.d.). Participants in the current study were using Windows 7 and older versions of JAWS at school though two participants did have home access to version 12. JAWS version 15 include touch and Windows 8 support : Standard and professional versions of JAWS version 15 are available for a cost of \$895 or \$1,095, respectively" ("Screen Reading," n.d.)

other programs. One of the disadvantages of JAWS is that a person has to sit and listen to an electronic voice, reading everything on one's desktop from top to bottom or left-to-right. However, more recent versions of JAWS have the option of skipping through different parts of the screen. Being able to skip through parts of the screen has greatly increased the navigational speed of visually impaired computer users, but it is still not as fast as sighted navigation. There is a delay in pressing the key and listening to a spoken response as opposed to visually taking in a whole page at a glance.

The school for visually impaired learners chosen for the study is one of three of its kind in South Africa (a resource centre for visually impaired education). It has a variety of departments catering for approximately 350 learners with visual impairments of whom roughly 180 are boarders. Half of this school's population is comprised of learners hailing from previously disadvantaged backgrounds and the school prides itself on its diverse multi-cultural population. Tuition caters for grade R, primary school and secondary school learners. Additional respective Special Education sections, focussed on skills training and learners with multiple handicaps, comprise additional sections of the school. The normal curriculum is taught in primary- and secondary phases providing further education and training (FET) opportunities to grade 12 graduates. The average amount of learners per class vary between 9 (small class) and 18 (large class), with an average of around 15 learners per class. At the time of investigation approximately 45 educators and 5 Auxiliary personnel were employed at the school.

The main assistive device utilised by learners at the setting is a Perkins Braille, which is used to "write" with. In most classes, two or three learners per class would also make use of dictaphones to help record and remember work discussed in classes. At the time of investigation, personal computers were not used by learners in the classroom and educators had to book the computer laboratory whenever learners were to conduct research during class time. This laboratory was also available to learners for an hour and a half, three afternoons per week. Depending on the subject, task and personal access, learners were often allowed to complete homework assignments on their home computers. At the time of investigation, the school had a CAT classroom and a computer lab housing twenty computers each. Educators had a separate laboratory with six computers, a scanner, printer and two Braille embossers, where they adapted and printed (or embossed) most of their class materials. The main assistive teaching resources included embossed Braille print resources, compiled by the educators. Many

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classes possessed electronic magnifiers linked to eight television sets around the classroom. Supplementary tactile media such as embossed pictures, three-dimensional models and abacuses were also utilised at times. At the time of investigation, only the school computer technician was actively engaged in the search for computer independence for the visually impaired through assistive technology. Although most of the staff members were well-trained educators, they only utilised the programs that were necessary to prepare Braille and enlarge or otherwise adapt sighted work for their learners. In classes which are mixed or that have only blind learners, teaching strategies have to be adapted and the emphasis in key content shifts from visual to auditory. Although screen magnifiers in combination with television screens were used effectively with visually impaired sighted children, the blind did not benefit directly from this technology.

It was believed that the most effective way to investigate possible advancement strategies for computer inclusion and equal access would be to explore the experiences of the community in need, paying special attention to empowering and disempowering factors in combination with the overall conceptualisations of blind community members. Asking their opinions regarding future solutions could also encourage them to take ownership of their situations and possibly foster new insights.

The researcher realised that very few blind learners in the school where he had taught had computer application technology (CAT)<sup>3</sup> as a subject in Grade 12. This raised considerable concern, since we are living in a technological and information age. On the occasions that the researcher had taken his classes to the information technology laboratories to conduct subject research, he found that blind learners found it extremely difficult to find the necessary information. Most of them were only able to read a small part of the web page before the period ended. The researcher is well aware of the difficulties experienced by the sighted visually impaired community. His observations during the four years of teaching at the school for the visually impaired indicated that visually impaired learners are able to help themselves to a far greater extent than blind learners. The researcher was thus convinced of the necessity to conduct an in-depth investigation into the experiences of blind computer users in their school.

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<sup>3</sup> Computer Application Technology (CAT) is an elective school subject dealing with the study and application of computer hardware and software as a means of overcoming everyday challenges.

## 1.4 RESEARCH QUESTIONS

This research investigation was guided by the following research question: *What are the experiences of blind high-school learners regarding computer use?*

To aid the researcher in answering the primary research question, the following three secondary research questions were posed:

- *What is the value of computer use for blind high-school learners?*
- *What are the barriers that blind high-school learners experience related to computer use?*
- *What are the future solutions and possibilities of blind computer use for blind high-school learners?*

The secondary research questions formed the basis of three differentiated subthemes during data analysis and interpretation.

## 1.5 WORKING ASSUMPTIONS

The following working assumptions informed the study:

- Blind and visually impaired high-school learners experience difficulties with computer use and assistive technology.
- Blind high-school learners experience more severe difficulties with computer use and assistive technology.
- Blind high-school learners experience value related to computer use and assistive technology.
- Blind high-school computer users could possibly provide more insight in potential solutions for future application of computer use for the blind.
- The blind high-school population of South Africa is a relatively small group.
- Very few South African educators of the visually impaired received formal training in assistive computer programs.

## 1.6 CLARIFICATION OF KEY CONCEPTS

Since the main focus of the study is on the functioning of the visually impaired community, the researcher considered it appropriate to use the World Health Organization's International Classification of Functioning, Disability and Health (ICF) to define the following key concepts: disability, impairment, barriers, participation, environmental factors and assistive/adaptive technologies.

*“Disability* is an umbrella term for impairments, activity limitations and participation restrictions. It denotes the negative aspects of interaction between an individual (with a health condition), and that individual’s contextual factors (environmental and personal factors)” (World Health Organisation, 2001:213).

*“Impairment* is a loss or abnormality in body structure or physiological function (including mental functions). Abnormality here is used strictly to refer to a significant variation from established statistical norms (i.e. as a deviation from the population mean within measured standard norms) and should be used only in this sense” (World Health Organisation, 2001,p. 213).

*“Barriers* are factors in a person's environment that, through their absence or presence, limit functioning and create disability. These include aspects such as a physical environment that is inaccessible, lack of relevant assistive technology, and negative attitudes of people towards disability, as well as services, systems and policies that are either non-existent or that hinder the involvement of all people with a health condition in all areas of life” (World Health Organisation, 2001,p. 214).

*“Participation restrictions* are problems an individual may experience in involvement in life situations. The presence of a participation restriction is determined by comparing an individual's participation to that which is expected of an individual without disability in that culture or society” (World Health Organisation, 2001,p. 213).

*“Environmental factors* constitute a component of ICF, and refer to all aspects of the external or extrinsic world that form the context of an individual's life and, as such, have an impact on a person's functioning” (World Health Organisation, 2001,p. 213).

"*Assistive/adaptive technologies* can provide the means for a blind or partially sighted person to overcome barriers such as the need to read print, use a computer, take notes and communicate both on paper and electronically" (Brophy & Craven, 2007, p. 954).

"*AAC or alternative and augmentative communication* refers to any system of communication that is used either alongside speech or instead of it to help people with oral communication impairments to communicate. It covers a range of systems, from those which involve no equipment, such as eye-pointing and signing, through low technology systems such as communication boards and books to a variety of high tech voice output communication aids (VOCAs)" (Hodge, 2007, pp. 457-458).

*Blind high-school learners*, in the current study, are learners who are in high school, or secondary school, between Grade 10 and 12 (16–18 years of age), and fall under the category blind. The latter means that learners had a visual acuity of less than 3/60 or a loss of visual field to less than 10° in their better eye – with correction (World Health Organization, 2007).

*Computer use* is regarded in the current study as any interaction or interfacing with a high-technology electronic device. This would include, but not be limited to, using a keyboard, mouse, screen and speakers or headphones to interact with digital content on the computer or any network.

## **1.7 POSSIBLE CONTRIBUTIONS OF THE STUDY**

The study aims to contribute to the existing body of academic knowledge in the disciplines of education, blind learners and information technology. Voices from participants in the current study could promote awareness of the blind community and their experiences regarding computers, with lecturers and students in the education field. Educators and subject specialists working with the visually impaired may also draw benefit from the study through awareness of the specific needs of blind high-school computer users.

The findings of the study could add value for developers and those concerned with the distribution and implementation of assistive technology for blind learners. This investigation

could also lead curriculum developers in tertiary education institutions to consider the establishment of an AAC and/or Inclusive Education course for education students. Insights into the experiences of blind high-school learners can provide a unique perspective regarding the value that blind learners attribute to certain areas of computer use as well as the way in which they encounter barriers and propose solutions to them.

The study could aid education policy-makers in constructing the framework for future curriculum development in the area of computer training, with the aim of growing independent business-competent graduates. Policy-makers could also use this study to aid the structuring of intervention projects in education. Finally, it may serve as a pilot for other researchers or might be approached critically.

## **1.8 SUMMARY OF THE FRAMEWORK OF THE RESEARCH PROCESS**

The main chapters of this study are represented graphically in figures 1.1, 1.2 and 1.3. The circle diagram (Figure 1.1) depicts the main domains covered in the literature study, namely blind computer use; computer accessibility for blind users; assistive technology for blind users; blind computer use in school contexts; voices of the visually impaired; and future application of blind computer use. Secondly, Figure 1.2 is a summary of the research methodology and research strategies described in Chapter 3. Figure 1.3 is a basic Venn diagram illustrating the results and findings, presented in chapters 4 and 5.



Figure 1.1: Circle diagram of literature review



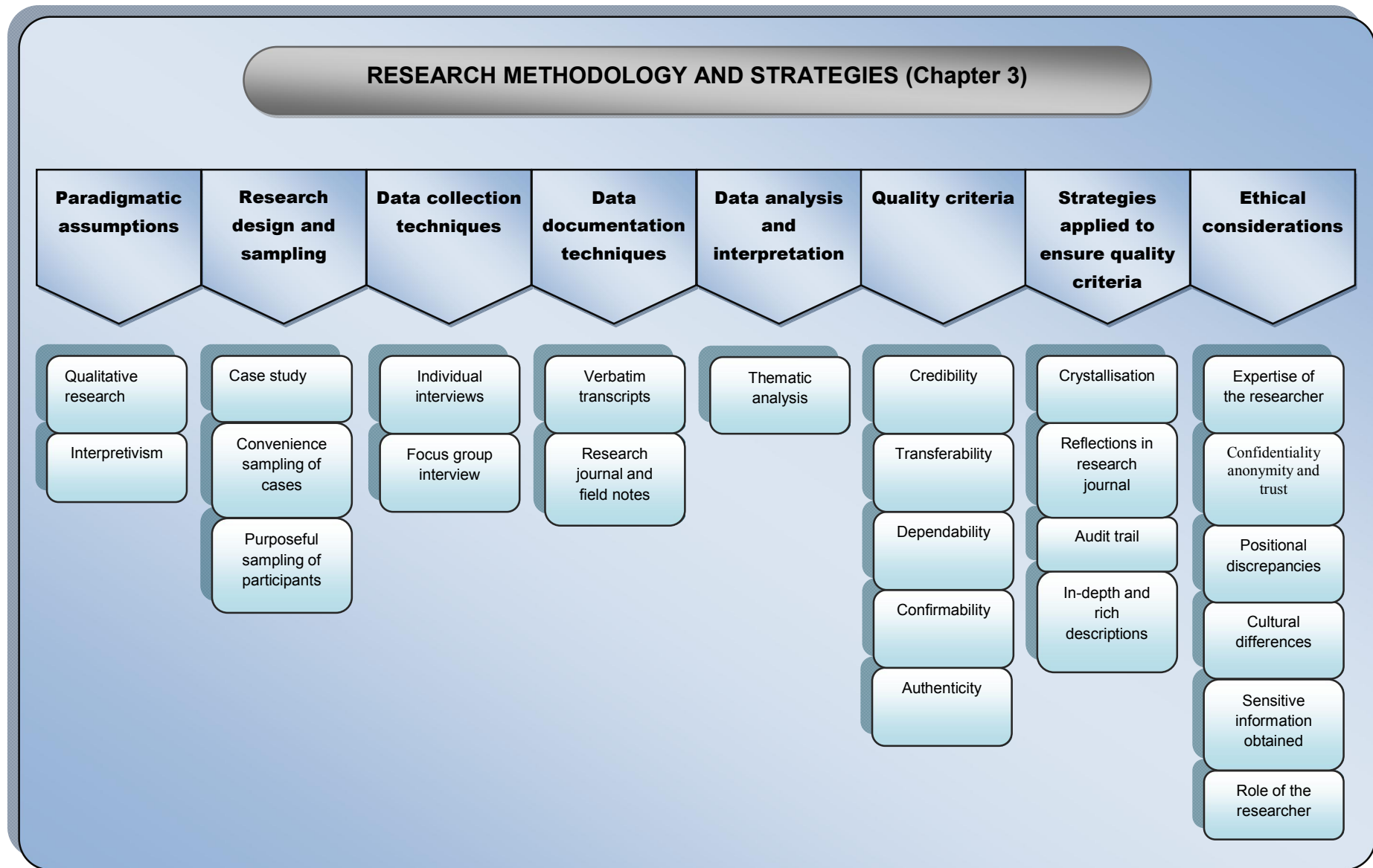


Figure 1.2: Research methodology and strategies

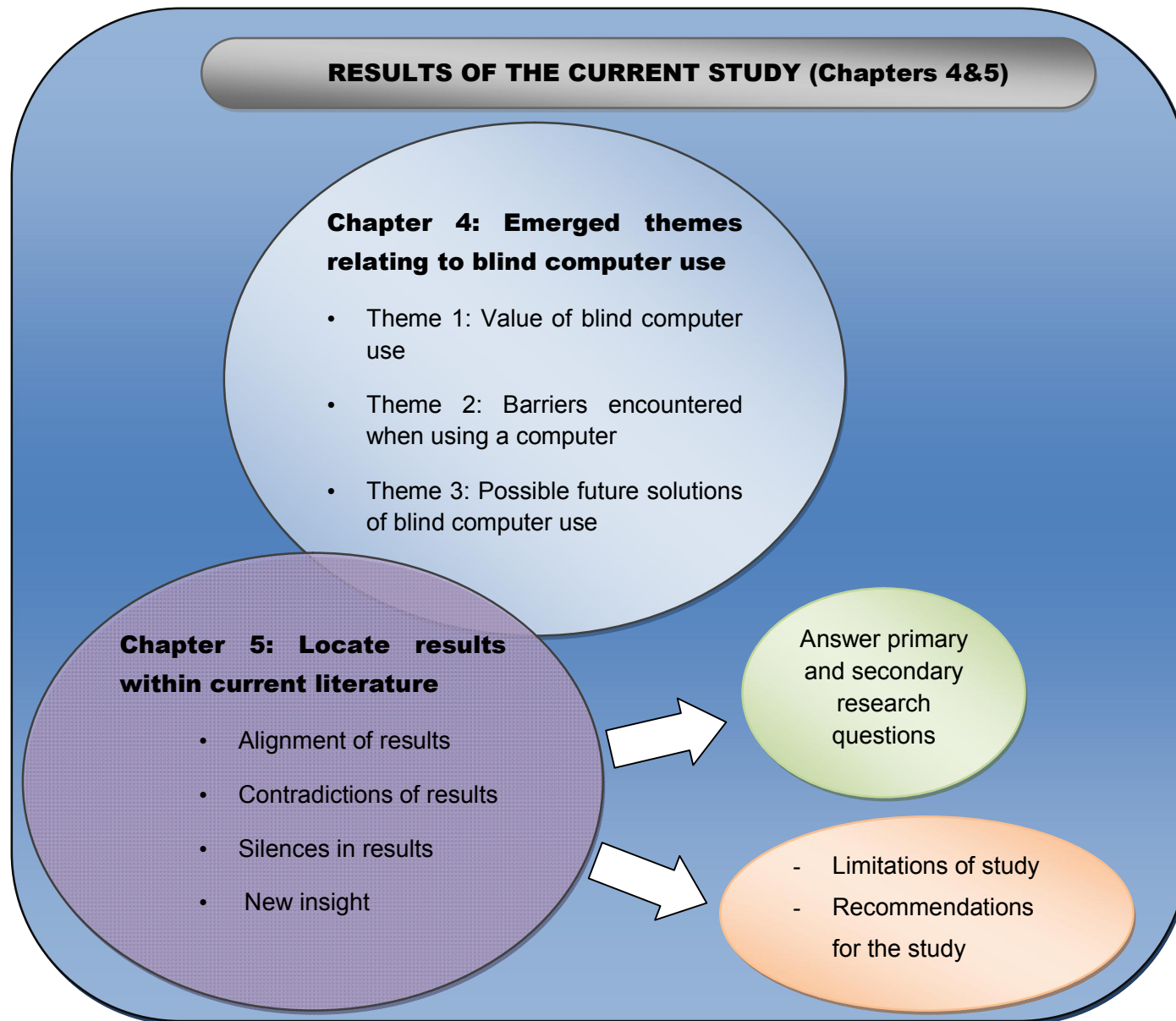


Figure 1.3: Results and findings of current study

## 1.9 OUTLINE OF CHAPTERS

### **Chapter 1: Introducing the study**

Chapter 1 introduces the study by providing the background, rationale and purpose of the reported research study. Working assumptions are presented and key concepts clarified. In conclusion, a graphical representation of the structuring of this investigation provides the reader with an overview of the dissertation.

### **Chapter 2: Literature review locating the study**

Chapter 2 provides insight into current trends in literature pertaining to blindness, education for the blind, computer accessibility, assistive technology, barriers related to blind computer use and the voice of blind computer users. The chapter concludes with possible future applications regarding blind computer use.

### **Chapter 3: Research methodology and strategies**

Chapter 3 describes and delineates the research methodology by arguing the suitability of employed strategies. Interpretivism is discussed as meta-theory and qualitative research as methodological paradigm. The researcher argues the chosen research design and elaborates on the selection of participants and the methods of data collection and documentation employed. The data analysis strategy is also discussed. This chapter is concluded by an overview of the ethical considerations and quality criteria deemed necessary for a sound study.

### **Chapter 4: Results of the study**

In Chapter 4, the researcher presents the results of the study by indicating the themes, subthemes and categories that emerged from thematic analysis. He also stipulates the inclusion and exclusion criteria for each theme that assisted with the categorisation of data into themes and subthemes. Verbatim transcripts from interviews and focus groups as well as extracts from the researcher's journal are used to present the themes.

## **Chapter 5: Findings, conclusions and recommendations**

Chapter 5 concludes the investigation with an in-depth discussion of findings. The findings are juxtaposed with current literature during the literature control and new insights obtained from the study are discussed, followed by the answering of the primary and secondary research questions. The limitations of the study are discussed and recommendations are made regarding practice, training and possible future research opportunities on the subject of blind computer use. Finally, the study is drawn to a conclusion.

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## CHAPTER 2: LITERATURE REVIEW

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### 2.1 INTRODUCTION

While various studies have been conducted in the field of visually impaired computer use in First World countries (Brophy & Craven, 2007; Alves, Monteiro, Rabello, Gasparetto, de Carvalho, 2009; Zhou *et al.*, 2012; Nam, Bahn, & Lee, 2013), there are definite gaps in the current literature with regards to blind computer use, even more so in the South African context. Most studies take place in First World countries and cover visual impairment as an umbrella concept, which complicates differentiation between the blind and partially sighted when reviewing literature. Blindness itself can be subcategorised into legal and total blindness. Current developments in mobile computing and cell phone design have blurred and in some aspects surpassed the traditional concept of a computer (Shane, Blackstone, Vanderheiden, Williams, & DeRuyter, 2012).

With the recent shift towards inclusion in South Africa (Department of Education, 2001), the use of computers and assistive technology to provide independence and accessibility to visually impaired learners is becoming inevitable (Kajee, 2010). Assistive devices and technology have improved drastically over the past decade (Shane *et al.*, 2012), yet it still appears that both educators and learners share a limited awareness of the function and availability of new assistive computer technology (Safhi, Zhou, Smith, & Kelley, 2009).

In my study, I aimed to address gaps in literature regarding computer use by blind South African high school learners. I also aimed to draw attention to this marginalised population and possibly spark future conversations and investigations which could aid the promotion of computer accessibility and competence in blind and visually impaired South African youth.

### 2.2 CONCEPTUAL FRAMEWORK

My conceptual framework aims to utilise the same key concepts as described by the International Classification of Functioning (ICF) (World Health Organization, 2001), which covers both clinical and social aspects of disability and is ideally suited to provide qualitative guidelines when conducting investigations into the physical restrictions of impairment. These

terms also acknowledge the different barriers responsible for social exclusion. The focus of this study was narrowed to encompass only blind high school computer users from South Africa since they are perceived to be the most vulnerable (Gerber, 2003). However, the main guiding concepts remain the same, and include impairment, participation, participation restrictions, environmental factors and barriers (Douglas, *et al.*, 2007). These guiding concepts are defined and graphically presented in Figure 1.

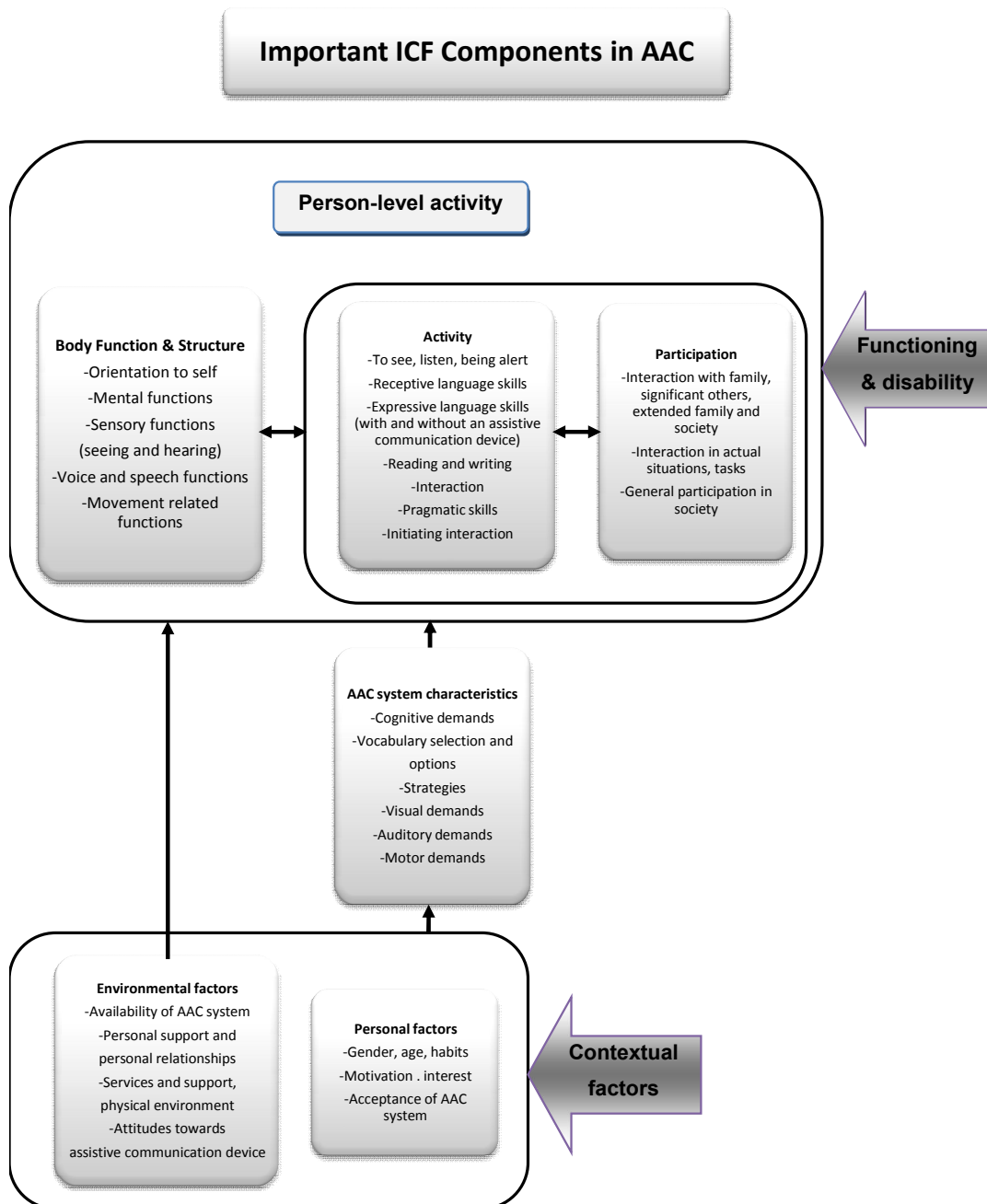


Figure 2.1: A reconceptualisation of important ICF components in AAC (Adapted from: Raghavendra, Bornman, Granlund, & Björck-Akesson, 2007, p. 353).

To utilise the ICF model effectively to elicit the voices of blind high school computer users, an additional dimension is needed that clarifies the relationship between the intrinsic and extrinsic factors linked to disablement in individuals. Ragavendra *et al.* (2007,p. 351) call this third dimension, used to describe personal behaviour and activity in accordance with their social or physical environment and individual traits, the “person-level activity”. Personal activity is thus described through behaviour applicability juxtaposed to a specific task and context, in this case computer use amongst blind high school learners. Personal activity can also be referred to as the psychological dimension of the ICF. According to Ragavendra *et al.* (2007,p. 351), “the biomedical, or body, dimension; the psychological, or activity, dimension; and the social, or participation, dimension; combined with contextual factors, are relevant for all human functioning.”

The ICF conceptualises functioning as a set of universal human experiences which is grouped in two sections according to functioning and disability (section 1), and contextual factors (section 2) (Ragavendra *et al.*, 2007). Functioning and disability are subdivided into body function and structure, and activity and participation. Environmental factors and personal factors combined make up the contextual factors. Environmental factors can then have either a restricting (for example barriers) or facilitating (for example values) role at the body function and structure, participation and/or activity levels. In short, this version of the ICF model depicts disability in terms of the multi-systemic interaction between the person-level activity and environmental and personal factors. The person-level activity interacts with AAC system facets and is influenced by personal and environmental factors to depict the functioning of an individual (Ragavendra *et al.*, 2007). The ICF as a conceptual framework for blindness provided the researcher with a globally accepted framework for structuring his investigation into the use of computers by blind high school learners.

### **2.3 BLIND COMPUTER USE**

Current computer interfaces rely primarily on sight for navigation. In the absence of a visual channel, blind users compensate by making use of their auditory and tactile channels (Sodnik, Jakus & Tomazic, 2012). Fortunately, sight is not a prerequisite for developing automatic activation of an externally defined spatial framework during tactile task engagement. The externally defined spatial framework of a child that was born blind does, however, develop more slowly in comparison with that of a sighted learner (Eardley & van Velzen, 2011). Due to a high cognitive workload and temporal demand, blind computer users find it more difficult to use spatial auditory interfaces for computer navigation. This is

primarily ascribed to the auditory channel's possible limitations regarding multiple simultaneous stimuli (Sodnik, *et al.*, 2011). The auditory working memory of the blind has also been found to be more important when manipulating numbers than in sighted populations, who are able to see what they are working with.

Blind people might also use spatial representations slightly differently than sighted people. They require a higher level of attention to complete mental navigation and manipulation tasks (Salillas, Graná, El-Yagoubi, & Semenza, 2009). Shinohara and Tenenber (2009) warn designers of assistive technology to heed blind people's unique mental representations of an environment as well as their often alternative approaches to task accomplishment. It was also discovered that the utilisation of assistive technology by blind users was strongly influenced by efficiency, flexibility, control, and socialisation (Shinohara & Tenenber, 2009). The internal values and desires of individual blind computer users also play a part in their preferences when choosing such technologies (Shinohara & Tenenber, 2009). How blind users find a way is a matter of personal preference; although there are limited paths leading to an objective, it was found that blind individuals use different strategies, yielding differing levels of success (Coughlan & Manduchi, 2009). Blind learners that become confused or lose their way in electronic navigation, often resolve to a linear search method which is very time-consuming (Shinohara & Tenenber, 2009). An investigation comparing blind computer users' self-assessed internet skills to their actual internet skills revealed very poor correct task completion and highlighted significant room for improvement or improved intervention (van der Geest, van der Meij, & van Puffelen, 2013).

I next discuss blind computer use by referring to computer accessibility for blind users and assistive technology for blind users.

### **2.3.1 Computer accessibility for blind users**

De Souza and de Freitas (2012) define non-specific accessibility as a combination of effectiveness, efficiency and satisfaction shared by all users. A significant element of computer application entails the use of the World Wide Web<sup>4</sup>. Implicit interaction, understanding and navigation of the greatest part of web content takes place in a visually organised system (Plessers *et al.*, 2005), which places blind users at a significant disadvantage.

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<sup>4</sup> The World Wide Web refers to the online web or network of navigable hyperlinked content (consisting of documents, multimedia or any other digitally accessible content).



Blind users rely on a screen reader to provide auditory feedback on screen objects, or read selected sections of text. The main challenge with this approach is a screen reader's limited ability to deduce the relevance of content, thus to align and unite the intentions of the user with the purpose of the author, due to barrier objects, poor layout or excessive amounts data in web pages (Plessers *et al.*, 2005). It was found that successful localised and cross-page navigation requires a significant amount of visual cognition (Kouroupetroglou, Salampasis, & Manitsaris, 2008). Just like sighted users, blind users also depend on scanning to grasp web content. Sighted internet users have the advantage of grasping a web page at a glance (Kouroupetroglou *et al.*, 2008). Hence it is vital to distinguish between blind users and visually impaired users due to the difference in their construction of mental maps (Harper, Goble, & Stevens, 2001).

The World Wide Web Consortium (W3C) is the global standards body for the World Wide Web. When the need for improved accessibility for users with special needs was identified, W3C launched the Web Accessibility Initiative (WAI) (Dardailler, 2009) to address inconsistencies in the annotation of web content and the structuring of web pages. WAI's Web Content Accessibility Guidelines or WCAG are considered the world standard for accessibility guidelines concerning web content ("Web Content Accessibility Guidelines (WCAG) 2.0," n.d.). Since the WAI's founding, there has been a significant increase in awareness in First World countries regarding web accessibility for visually impaired and blind users, resulting in more pages that are optimised for assistive software.

Over the past decade, dedicated individuals have attempted to improve and refine web accessibility for blind and visually impaired learners. A significant advancement in the development of web accessibility was the likening of movement to travel, i.e. regarding movement from the perspective of a traveller who encounters and interacts with travel objects in different travel scenarios or settings (Harper *et al.*, 2001). Harper *et al.* (2001) postulated a similarity between the core processes of both cyber and physical travel as an ontology to accessibility design, due to similarities in the mental processes of the "traveller". They propose that fragmentation of hypermedia resources (Harper, Stevens, & Goble, 1999) and the ability to preview information and receive knowledge feedback greatly enhance the mobility of blind computer users (Harper *et al.*, 2001). Building on the above, Yesilada, Stevens, and Goble (2003) have proposed a travel analysis framework for the semi-automatic identification, classification and annotation of so-called travel objects, which they define as "environmental elements supplied by the design of a web page and browser, as a basis for accessibility support" to improve mapping of a digital terrain. Kouroupetroglou *et al.*

(2008) found that the tendency of blind users to rely on a combination of random entry points, skimming and luck was significantly improved by the provision of a structuring mechanism (browsing shortcuts) which provided structured entry points (links) to different content types. Yang, Hwang, and Schenkman (2011) also propose that the abridgement of information for a screen reader reduces the time required to conduct advanced web searches and that simplifying unnecessary page content provides a smoother user experience.

Although significant efforts are made to research and improve upon web accessibility, a lack of research on the impact of such measures on blind users' browsing behaviours and their mental frameworks remains. It appears that the perspective from blind users remains limited or excluded in this regard (Kouroupetroglou *et al.*, 2008). Although an investigation of the effectiveness of the WCAG 2.0 web usability criteria to improve online task performance of visually impaired users yielded positive results regarding usability and efficiency (Leporini & Paternò, 2008), there is still significant room for improvement. Since the internet is a globally accessible network, we can deduce that there is a global need for improved accessibility, and that all blind users would benefit. Brajnik, Yesilada, and Harper (2011) have found that engaging expert blind users significantly improves web accessibility evaluation by decreasing the number of evaluators and increasing the reliability and validity of such evaluations. An investigation into the accessibility of 24 South African websites revealed that even though 80% of the companies regarded accessibility as a necessity, most companies were unaware of W3C and all of them failed to uphold WCAG. Their sites were found to be inaccessible to blind users (Venter, 2005). Thus it seems as if there is still significant room for implementation and improvement of web accessibility in South Africa. Although the need for implementation is evident, the current study attempts to align itself with blind users rather than existing policies, guidelines or software developers. The alignment intends to expose the needs, values and possible future solutions surrounding blind learners' categories of description, allowing different perspectives against which the weight of mainstream categories of description can be measured and the focus adapted to increase user efficiency and satisfaction among blind computer users.

### **2.3.2 Assistive technology for blind users**

Assistive technology devices can be grouped under two main categories, namely high technology (high-tech) and low technology (low-tech) devices (Safhi, 2009). An easy way of distinguishing between the above devices is the presence or absence of microcircuitry.

Smartphones and computers are two of the most common high-tech devices, both of which can be enriched through additional software and hardware options. It is of paramount importance that such assistive technologies cater specifically for the needs of blind people, so that they do not become an additional barrier (de Souza & de Freitas, 2012).

A phone survey in Turkey found that 46% of visually impaired participants identified computer screen readers as the assistive product most frequently used. Cell phone screen readers were desired by 25% of the visually impaired participants, but was not considered affordable enough (Bengisu, 2010). Though there are many screen readers, the majority are expensive commercial versions (de Souza & de Freitas, 2012) forming an access barrier to those without the means to purchase them (Brophy & Craven, 2007). JAWS has always been a popular commercial screen reader among blind users, with the most recent standard version, *JAWS 14*<sup>5</sup> (by Freedom Scientific®)<sup>6</sup>, selling for \$895<sup>7</sup>, and professional versions fetching \$1 095 (“JAWS Screen Reading Software by Freedom Scientific,” n.d.). Because assistive programs are so expensive, it is evident that a large percentage of visually impaired South African communities would not be able to afford it without external funding.

The fact that screen readers are most blind computer users' main interfacing device (Bengisu, 2010), merits the mention of certain current product features. JAWS 14 boasts the following added features:

- A highly customisable Flexible Web feature, able to selectively suppress excess web content according to user specification.
- Vocalizer Direct Synthesiser<sup>8</sup> utilising Nuance Communications' Vocalizer Direct<sup>9</sup> voices grants improved speech quality and reduces latency – South African English is a recent addition to the offered languages.
- Suppression of unwanted Flash<sup>10</sup> and frame announcements.
- ARIA (Accessible Rich Internet Applications)<sup>11</sup> support.

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<sup>5</sup> JAWS 14 is the fourteenth version of this screen reader and was the most recent version at the time of investigation. Readers should note that JAWS is updated regularly and version 15 is now available.

<sup>6</sup> Freedom Scientific® is a corporation that develops assistive technology for visually impaired and learning-disabled users.

<sup>7</sup> The rand-dollar exchange rate at the time of investigation was R1 : \$0.101596

<sup>8</sup> Vocalizer Direct Synthesiser is a speech synthesizer program capable of utilising different dialects and languages.

<sup>9</sup> Nuance Communications' Vocalizer Direct is a collection of 36 different text to speech voices that supports 43 different languages and dialects.

<sup>10</sup> Adobe Flash is a software and multimedia platform for the creation of animation, vector graphics, games and other rich internet applications. All the latter have to be viewed in Adobe Flash player, complicating web pages for assistive programs.

<sup>11</sup> ARIA is a technical specification from W3C aimed at improving dynamic web content and user interfaces.

- The ability to change the amount of punctuation that JAWS speaks.
- Text analyser enhancements to aid with identification of inconsistencies in documents such as white space, formatting discrepancies and incorrect punctuation.
- Windows 8<sup>12</sup> support as well as numerous other features not listed (“JAWS Screen Reading Software by Freedom Scientific,” n.d.).

Further investigation into the full potential of JAWS and how it is received by different levels of users merits a separate study, yet this brief overview hints at a formidably powerful tool in trained hands. The current study focused on blind learners’ experience of computer use, including their perception of JAWS.

Even with fairly recent versions of JAWS, students tend to find it difficult to browse through large documents such as e-books, and they express difficulty in effectively organising these documents or sections for future use (Ahmed, Candan, Han, & Qi, 2009). Visually impaired students also experience greater difficulty when requested to complete online tests, quizzes and CD-ROM tutorials (Fichten, Asuncion, Barile, Ferraro, & Wolforth, 2009). Blind American email users, though competent and independent, still experience problems navigating complex email interfaces and ineffective HTML<sup>13</sup> heading tags (Wentz, Hochheiser, & Lazar, 2012). Users also report difficulty using visual CAPTCHAs<sup>14</sup>. In addition, the fact that the majority of blind users do not make use of the calendar functionality in email clients merits further investigation (Wentz *et al.*, 2012). Lazar, Allen, Kleinman and Malarkey (2007) investigated problems that frustrated blind screen reader users and reported the top causes of frustration to be: poor page layout that results in confusing screen reading; screen reader and software conflicts; forms that were not designed or adapted for screen readers; pictures without alternative text; confusing links; inaccessible PDFs and screen reader crashes. Another interesting finding was that blind users were reluctant to restart computers to solve a problem, tending to seek alternative solutions to problems. Another significant observation was the fact that nearly a third of blind users’ time was spent troubleshooting while browsing the internet (Lazar *et al.*, 2007).

Fortunately, assistive technology also offers many benefits. North American focus group studies found that 85% of the visually impaired participants regarded assistive technology as essential to their occupation and responsible for greater work independence. Growing

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<sup>12</sup> Windows 8 the current Microsoft® operating system at the time of investigation.

<sup>13</sup> HTML or HyperText Markup Language is the primary language used to create web pages and other information displayed in web browsers.

<sup>14</sup> CAPTCHA is the term given to text distortion for human verification as a security measure against automated attacks.

access to information also contributes to the empowerment of individuals with a visual impairment. The ability to engage with peers through social and community networks has added an aspect of social development previously unattainable to isolated individuals (Gerber, 2003). Armstrong and Murray (2010) found that converted learning materials and methods enabled them to provide visually impaired Australian students in information technology with a level of learning that was equal to that for sighted students. However, the process was more labour-intensive and time-consuming when it came to blind students (Armstrong, 2010). Within the context of assistive technology for blind computer users, my study also investigated barriers (for example the time factor) experienced.

If we are to brave future challenges, we need to adapt our mindset to include combined or layered technologies. As previously indicated, JAWS is a powerful text to speech engine, used to vocalise computer text so that visually impaired users can read without the need for additional devices. Dragon NaturallySpeaking by Nuance<sup>®15</sup> is a powerful speech to text engine granting users voice control of their computers ("Accessibility - Dragon NaturallySpeaking for Accessibility – Enable hands-free use of PC applications with voice control - Nuance," n.d.). Theoretically the combination of the two software products should respectively eliminate the need for both screen and keyboard in order to effectively use a computer. Due to past compatibility issues, the merging of the software proved ineffective ("J-Say," n.d.). A third program, Jsay-Pro<sup>16</sup> (by T&T Consultancy Ltd<sup>®</sup>), was recently developed to serve as an integrating platform for JAWS and Dragon NaturallySpeaking, effectively transforming all the JAWS commands to voice commands and granting blind users hands-free access to their computers ("J-Say," n.d.). Unfortunately J-Say only works with professional versions of JAWS and Dragon, leaving prospective users with an approximate initial investment of \$2 444,99,<sup>17</sup> limiting access to the wealthy.

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<sup>15</sup> Dragon NaturallySpeaking is a program that transfers dictated speech to word processors and most other areas where a keyboard would normally be used to type. It enables users to literally type at the speed of speech, which greatly reduces time spent typing. Additionally, it has the capability to create voice macros with which advanced users can accomplish a series of complex pre-recorded procedures with a single voice command. Commands such as "send an email to: 'email contact's name'" for instance automatically opens up Outlook and starts an email to the mentioned contact.

<sup>16</sup> J-say Pro combines JAWS and Dragon NaturallySpeaking to effectively replace typing and reading with speaking and listening. These programs are very expensive. Professional versions have to be bought separately and are somewhat scarce.

<sup>17</sup> \$2 444,99 was roughly equivalent to R24 461 (at the time of investigation).

## 2.4 BLIND COMPUTER USE IN SCHOOL CONTEXTS

Alves, Monteiro, Rabello, Gasparetto and Carvalho (2009) found that 98,3% of educators in Brazil highlighted the importance of specific programs for education for visually impaired learners. Despite being aware of the need for specific programs for visually impaired learners, and an awareness of the importance of additional resources, the majority of educators (94,8%) in Brazil responsible for educating the visually impaired still failed to use information technology in the tuition of visually impaired learners (Alves *et al.*, 2009). North American studies found that educators of learners with visual impairments still employed human readers, instead of technology, more frequently during assessments (Johnstone, Thurlow, Altman, Timmons, & Kato, 2009). The educators explained that they avoided using information technology because information technology facilities and the correct software were not available, adding the absence of planned courses (identified as main barrier), as well as a perception that visually impaired learners were unable to use computers. Educators reported a need for advisers, and learners expressed a need for sufficient numbers of computers to provide equal computer access (Alves *et al.*, 2009). The use of assistive technology in schools was found to be largely reliant on educators' perceived usefulness of the assistive technology (Nam *et al.*, 2013). During a study of educators' self-reported competency in assistive technology, Zhou *et al.*, (2012) found that 39,05% of the educators expressed some confidence and 18,81% limited confidence in assistive technology. There was also a positive correlation between an increase in the age of educators and their self-reported limited competency with assistive technology. It would appear that educators who want to effectively employ the necessary assistive technology for visually impaired learners require intensive training (Kamei-Hannan, Howe, Herrera, & Erin, 2012).

Freeland, Emerson, Curtis and Fogarty (2010) found that assistive technology for the blind in the United States was not as effective as previously assumed and that assistive technology did not provide visually impaired learners with an equal opportunity to acquire educational information. Although various explanations could be deduced from the findings of Freeland, *et al.* (2010), an in-depth investigation is clearly needed. An enquiry into the computer capabilities of post-secondary education students revealed that learners' computer needs were more effectively satisfied at home than at school (Gerber, 2003). In this regard, it was found that the software used by these learners was significantly more up-to-date at their homes than at schools (Asuncion, Barile, Ferraro, Fichten, & Wolforth, 2010). An earlier phenomenographic study concerning the interpretation of externalised images of British learners' conceptions of information and computer technology identified a significant latent

asset in the integration and implementation of learners' own personal devices for tuition by making use of networked technology (Mavers, Somekh, & Restorick, 2002).

In sub-Saharan countries such as Zambia and South Africa, a large number of learners do not have access to a home or school computer, not even to mention the appropriate assistive programs (Akakandelwa & Munsanje, 2012). Shane *et al.*, (2012) refers to this barrier as the "digital divide", indicative of the variance of access across localities and socioeconomic levels. The digital divide is also experienced through an inability to effectively control alternative augmentative communication technology, restricted online information access and services, and not being born into a technologically aware family (Shane *et al.*, 2012).

Chigonaa, Pollocka, and Roode (2009, p. 3) define "techno-centric approaches" as "political and technological attempts that focus almost exclusively on providing access to digital communication technologies", and "socio-centric approaches" as "the focus on people and their developmental needs". They further define the gap between these approaches as the "socio-techno divide" and propose a shift of focus from the "digital divide" to the "socio-techno divide" in order for Third and Fourth World countries to successfully employ information and computer technology in their development (Chigonaa *et al.*, 2009). The pitfall of possible techno-centric and/or socio-centric polarisation could pose a potential threat to South African inclusive education policy and practice, and possibly delay the progress of assistive technology adoption in the education system. Education White Paper 6 (2001, p. 25) identifies challenges related to curriculum adaptation, human resources and financial support regarding specialised inclusion. Further differentiation of technology adoption and implementation practices could potentially streamline transitions.

Lack of access does not mean that South Africa should neglect the development of inclusive practice. Schools for visually impaired learners in South Africa have now become government-funded resource centres, tasked with the responsibility to provide expert advice and support to their learners and educators from other schools (Department of Education, 2001). It is therefore important that educators should not only be aware of the existence of assistive technology, but familiar with the use and application of such technology (Alves *et al.*, 2009). Although the reported case study could be regarded as a technologically advanced facility in South Africa, very few of the educators in this school have received formal training in assistive computer use and the majority were not familiar with the current or even previous generation of assistive technology.

## 2.5 VOICES OF THE VISUALLY IMPAIRED

The use of computer technology could benefit the blind community in terms of information access, employment, recreation and socialisation (Shane *et al.*, 2012). Unfortunately, many individuals who are visually impaired either fail to recognise the usefulness of assistive technology or are hampered by individually and socially perceived barriers (Douglas, Corcoran, & Pavey, 2007). Access remains a major barrier to effective computer use. Most visually impaired learners also express a need for independence (Khadka, Ryan, Margrain, Woodhouse, & Davies, 2012). The implementation of alternative and augmentative communication technologies is limited by context (locality) and function (intended use) (Shane *et al.*, 2012). Without access to the appropriate assistive technology in the right place, visually impaired learners would not be able to attain the level of independence they desire.

The use of the ICF as a framework for understanding disability could serve as a useful aid when regarding visually impaired participants' views, perceptions and experiences of computer use. Douglas *et al.* (2007) conducted an investigation of visually impaired individuals' views and experiences of personal computers and found that many visually impaired individuals did not want to use a computer due to a lack of knowledge about the benefits of computers. It was established that computer use was linked to age groups and that the elderly visually impaired were significantly less inclined to make use of computers. Another finding was the influence of psychological constructs such as a lack in confidence as a perceived barrier to computer access. Those without the financial means to secure equipment or training also had to forgo access (Douglas *et al.*, 2007). Abstaining from computer use excludes access to benefits such as online shopping, online socialisation and information access. Non-users forgo an array of assistive benefits offered by assistive software (Douglas *et al.*, 2007).

A key aspect of design is the subjectivity of an intended user's needs and experiences (Manduchi & Coughlan, 2012). Assuming an empathic perspective by listening to the voices of the blind (Andreou & McCall, 2010) might yield a better foundation for user understanding (Douglas *et al.*, 2007). An understanding of the difference in mental frameworks, positioning relevant to education and self-construction, between sighted and blind South African learners, might also lead to better assistance and empowerment (Kajee, 2010). The reported study focused on the views and perceptions of blind participating learners in their capacity as computer users in an attempt to gain insight to their individually constructed and shared realities.



## 2.6 FUTURE APPLICATION OF BLIND COMPUTER USE

The most obvious critique against the implementation of accessibility measures for blind computer users is rooted in the possibility for the synthesis of a cure for blindness. Whether artificial (Dramas, Thorpe, & Jouffrais, 2010), biological (Schwartz *et al.*, 2012) or combined, such a cure would be to the benefit of all who are marginalised and render the need for accessibility obsolete. A second, more viable alternative might involve the development of a compact, dynamic, layered assistive technology, capable of mimicking and in some areas surpassing human assistance. Examples of the latter include virtual assistants such as EVA<sup>18</sup> (“EVA - (Siri for Android) - Android Apps on Google Play,” n.d., p. -) and Nina<sup>19</sup> (“Nina – the intelligent multichannel virtual assistant,” n.d.), or cloud computers<sup>20</sup> such as the Google application platform. It can also be argued that individuals perform according to their potential in their constructed framework of reality. Intervention by foreign elements place a question mark on social justice.

It becomes clear that further investigation of the different aspects of computer use, however large or small, could be beneficial to blind South African high school learners and educators. Such benefits might include improved web accessibility (Brophy & Craven, 2007; Brajnik *et al.*, 2011), improved information technology reading and writing skills and improved world communication (Alves *et al.*, 2009). My study aimed at eliciting the views, perceptions and experiences of blind computer users in a dynamic society while creating awareness and piloting future possibilities.

## 2.7 CONCLUSION

The current definition of a computer (stated earlier) appears to be a dynamic concept which, even by present-day society, can be regarded as virtually any device capable of data processing and interfacing. There are already trends in e-learning promoting the use of personal devices, which hint that the level of computer development will most likely advance to a point where a shift in focus from the device, and its peripherals, to the processes is likely to result (Shane *et al.*, 2012).

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<sup>18</sup> EVA or Electronic Virtual Assistant claims to be the top virtual assistant on Android. Some of its features include sending and reading emails, scheduling meetings and conducting internet searches.

<sup>19</sup> Nina another paid-for virtual assistant by Nuance.

<sup>20</sup> Cloud computing involves the utilisation of a group or network of computers to solve a problem that is too large for a single computer or smart phone to handle individually. In essence, the personal device becomes the interfacing device and the linked computers (cloud) becomes the processor. Google voice recognition is an excellent example.

There are definite global gaps in the literature regarding blind computer use, most studies broaden their focus to include partially sighted participants. The literature on blind computer use in South Africa is even more sparse. Though small, the South African blind community deserves to be empowered, accommodated where necessary and included in the general society. Due to the nature of their disability, they are largely reliant on computer technology for integrated social, and to an extent physical independence (Shane *et al.*, 2012). Any investigation of blind computer use should therefore be considered as contributing to the search for complete computer independence.

The findings of American, African, Australian and European studies (Nam *et al.*, 2013; Armstrong, 2010; Kajee, 2010; Safhi, 2009; Alves *et al.*, 2009) are in agreement that computerised education is needed for visually impaired learners – yet context and socio-economic circumstances remain a differentiating factor. It would appear that policies are in need of revision or refinement and educators are in need of awareness and expert training (Nam *et al.*, 2013), in order to be effective proponents of assistive technology in the modern classroom.

Though perceived by many as a medically oriented system, it is felt that the ICF adequately serves to illustrate the physical, emotional and environmental factors of visual impairment, more specifically blindness, and could aid in substantiating a section of a realistic frame of reference for approaching blindness (Douglas *et al.*, 2012). In order to understand the whole, it is paramount that the human factor be incorporated in one's conceptualisation by listening to the voices of blind computer users (Douglas *et al.*, 2007). The previously mentioned voices received preference in this particular investigation. As stated earlier, it would appear that the greatest barriers to effective computer use are linked to a lack of access (Douglas *et al.*, 2007). In assuming the polar opposite, the greatest benefits of computer use would then simply be access similar to that of society in general. For this to become a reality to the collective dynamic evolutionary intellect of the blind, we need to start listening to their views and experiences and adapt our intervention strategies to their collective categories of description.

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## CHAPTER 3: RESEARCH METHODOLOGY AND STRATEGIES

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### 3.1 INTRODUCTION

In Chapter 2, the researcher investigated current trends in literature and attempted to locate the inquiry accordingly. Chapter 3 describes the research methodology by arguing the suitability of employed strategies. Interpretivism is discussed as meta-theory and qualitative research as methodological paradigm. The researcher then discusses his chosen research design, elaborating on the selection of participants and the methods of data collection and documentation used. The data analysis strategy is also discussed. The researcher concludes the chapter with an overview of the ethical considerations and quality criteria. Table 3.1 provides an outline of the research methodology and strategy.

*Table 3.1: An overview of the research methodology and strategy*

|  |                               |
|--|-------------------------------|
| <b>PARADIGMATIC ASSUMPTIONS</b>  |                               |
| Methodological paradigm  | Qualitative research          |
| Meta-theoretical paradigm  | Interpretivism                |
| <b>RESEARCH DESIGN</b>   |                               |
| Case study   |                               |
| <b>SAMPLING OF CASE AND PARTICIPANTS</b>   |                               |
| Selection of case  | Convenience sampling          |
| Selection of participants  | Purposive sampling            |
| <b>DATA GENERATION</b>   |                               |
| Data gathering techniques  | Data documentation techniques |
| Individual semi-structured interviews  | Verbatim transcripts          |
| Focus group discussion   | Verbatim transcripts          |
| Observation  | Research journal              |
| <b>DATA ANALYSIS AND INTERPRETATION</b>  |                               |
| Thematic analysis and interpretation   |                               |
| <b>QUALITY CRITERIA OF THE STUDY</b>   |                               |
| Credibility, transferability, dependability, conformability and authenticity   |                               |
| <b>ETHICAL CONSIDERATIONS</b>  |                               |
| Expertise of the researcher; confidentiality, anonymity and trust; role of the researcher; cultural and language differences; sensitive information obtained |                               |

## 3.2 PARADIGMATIC PERSPECTIVE

This section comprises a description of the guiding methodological paradigm, and provides justification of the chosen meta-theoretical paradigm.

### 3.2.1 Methodological paradigm

For this investigation, the researcher adopted a qualitative approach, since every person's reality, though partially shared, is viewed as uniquely experienced and to a varying extent constructed (Merriam, 2002). Opting for a qualitative approach made flexibility and deeper probing possible (Henning, 2005). It also allowed for a fluid, two-sided interaction as opposed to a static questionnaire. Due to the personal nature of a qualitative investigation, the researcher is more attuned to the emotional disposition of the participants and, to a certain extent, shares it (Granek, 2013). Hence, it was considered vital to approach participants openly and empathically so as to be less threatening to a vulnerable population.

Although the researcher found a number of quantitative and mixed method reports (Cairns, Herriotts, Douglas, Corcoran, & Pavey, 2009; Khadka *et al.*, 2012) on similar topics, he decided to make use of a qualitative methodological approach in order to obtain an in-depth understanding of blind computer use among high-school learners. As is customary in a qualitative line of inquiry, the researcher also ventured to gain the insider perspective on this social technological phenomenon in its naturally occurring environment (Merriam, 2002).

The study therefore aimed to discover, structure, thicken and document the realities of blind South African high-school learners regarding computer use in such a way that it created a meaningful new reality which is congruent with and possibly complementary to the original individual perceptions. The researcher attempted to use his voice as a facilitation tool for data collection, analysis and structuring of the voices of the participants (Bogdan & Biklen, 2003).

By exploring the world of blind high-school computer users, an attempt was made to gain an in-depth understanding of their experiences concerning computer use and assistive technology. The researcher also aimed to elicit possible solutions from the participants themselves, which could help them to reconstruct their own narratives as a first step toward resolving the barriers they experienced.

Conducting qualitative research is not without its drawbacks. Critics often question the trustworthiness of a qualitative investigation (Shenton, 2004). The researcher has attempted to address this concern by comparing and contrasting the findings of this study with findings in current literature. To address issues pertaining to bias, the researcher took care to remain self-aware and considering of his own values and assumptions. He tried to maintain an open attitude toward alternative interpretations and acknowledged the subjectivity of his research (Given, 2008). The researcher also followed the guiding principles of Spencer, Ritchie, Lewis, & Dillon, (2003) and attempted to conduct research that was contributory, defensible and indicative of rigorous practice.

### **3.2.2 Meta-theoretical paradigm**

This investigation was approached from an interpretivist perspective. Knowledge is considered to be dynamically constructed by the descriptions, intentions, values, conceptualisations and beliefs of participants (van Rensburg, 2005). The researcher interprets phenomena based on multiple interactions across varied social contexts. Interpretations are also influenced by community-specific discourses (van Rensburg, 2005). The objective of interpretivism is to unravel the meaning-making techniques applied by participants in order to gain a deep understanding of their conceptualisations of reality regarding the phenomena concerned. This study investigated the experiences of blind computer users between grades 10 and 12 in a particular timeframe (Merriam, 2002). The context of the participants was also taken into account and investigations therefore took place in their natural school environment (van Rensburg, 2005).

Interpretivism was utilised to investigate the general views and experiences of blind high-school learners on computer use. Although some argue that blindness is not a culture (Weisleder, 2012), the blind community does have their own world view and unique way of exploring and perceiving reality – certain commonalities, as it were. Schwandt (2000) argues that it is important to understand the social meanings attributed to occurrences by the community one is investigating, hence it was also an objective of this study.

Moreover, this study depicts an interpretation of the social realities and meaning-making of blind high-school computer users as experienced and informed by the values, intuitions and subjective beliefs of the researcher (Nieuwenhuis, 2007b). The following extract from the research journal represents an example of the researcher's voice:

*Every time I hear participants use the words "see" and "read" I'm reminded of the fact that I am a "sighted person" (in their words) and that I would never be able to truly "see" the world as they do. I do believe however that if I listen carefully, then training, experience and empathy will allow me to understand their voices to a significant extent (Research Journal 22/08/2012).*

### 3.3 RESEARCH DESIGN

A case study research design (Delport & Fouche, 2002) was used to obtain an in-depth understanding of experiences of computer use from the perspective of blind high-school users. According to Henning (2005, p. 41), "a case study as a format for research design is characterised by the focus on a phenomenon that has identifiable boundaries." In this case, it refers to computer use by blind learners (phenomenon) in a high school for the visually impaired (boundary). The researcher focused on the experiences of high-school learners in a particular situation (Henning, 2005). The focus is therefore on pluralism and relative truth, according to the perspective of the researcher. Although a semblance of objectivity is present, the method cannot be classified as truly objective. A boon of such methods is the close proximity between researcher and participant which allows shared meaning making and deeper understanding (Baxter & Jack, 2008). In this instance, a sense of systemic interaction between the researcher, participants, context and process was evident. The researcher attempted to construct answers for *how*, *when where* and *why* events occurred in collaboration with the participants (Henning, 2005). This type of design allowed focused yet dynamic interactions between the researcher and participants to give voice to the experienced phenomena of blind computer use from the perspective of the users (Gerber, 2003).

One of the challenges faced when conducting an in-depth case study is that it takes a significant amount of time. This challenge was addressed by using semi-structured interview questions and effective interviewing strategies. Only four high-school learners were selected. The sample size was therefore decreased to increase the level of interaction and probing. Due to the small sample size and the fact that participants were chosen using convenience sampling strategies, generalising to a larger population would be difficult (Mouton, 2001). However, the goal of this investigation was not to elicit a statistical analysis of blind computer use, but rather to explore in detail the way in which the four blind learners experienced computer use. The study was therefore aimed at understanding the challenges and

frustrations encountered by normal blind learners, as well as the empowerment and joy experienced during blind computer use at a school for visually impaired learners.

Since the results of this study cannot be generalised to a wider population, the researcher has provided in-depth, rich descriptions as sufficient material for comparison to similar cases (Lincoln & Guba, 2002). In addition, the study aimed to explore creative problem-solving and possible future solutions and applications for blind computer users. The results obtained from the study could be used as a description for the phenomena in a single case, to create awareness of the emotional experiences linked to computer use or, if deemed worthy by the reader, to pilot additional investigations to improve user experience.

### **3.3.1 Selection of research case**

The researcher used convenience sampling to select the research case. This form of sampling is employed when choosing a case which is easily available to the researcher. Motives for convenience sampling include, ease of access, familiarity and willingness to participate in the study (Given, 2008).

In order to investigate blind computer use, a school for visually impaired and blind learners was the primary criterion for choosing a setting. It was further deemed preferable that such a setting be an established institution to curb possible elements of inexperience on the side of the educators. This choice coincidentally resulted in the geographical homogeneity (Robinson, 2013) of the sample, since there are very few schools that are also considered resource centres for visually impaired learners in Gauteng.

The researcher's main reasons for choosing this setting hence centred around accessibility and familiarity. The fact that he used to be employed at the school diminished access barriers and ensured embeddedness and an enriched historical background, which simplified rapport building with key role-players while saving time and money. This school was one of the established schools for the blind in South Africa. It would frequently be contacted by the Department of Education and other institutions to provide guidance and assistance pertaining to visually impaired education and access and mobility. Two additional motivating factors behind the choice of setting was the limited number of schools for blind learners and geographic separation, i.e. the time and financial expenditure that would be necessary to expand the study. In order to conduct face-to-face interviews and focus groups, the selected school was the most convenient to access in terms of location.

The main drawback to convenience sampling, where a single setting is chosen, is the fact that a statistically representative sample is not possible and findings can therefore not be generalised to a larger population. Denscombe (2003) confirms this, stating that it is difficult to equate convenience sampling with rigorous research practices. However, he adds that a good researcher samples in alignment with the subject matter and the requirements for conducting a proper investigation. The chosen setting satisfies both prerequisites. Lack of generalisability was taken into consideration and it was decided that a more focused and personal approach would yield a unique perspective on the experiences of blind computer users in a specific school. The limited number of existing resource centres for visually impaired learners nevertheless increases the significance of the sample, although the focus was not on choosing a representative sample, but rather on exploring in detail the experiences of the four blind individual learners regarding computer use.

### **3.3.2 Selection of participants**

According to Nieuwenhuis (2007c), sampling in qualitative research should be done in such a way that the richest possible information source is gained in order to properly answer the research question. The researcher opted for purposive sampling to ensure that the participants met the criteria relevant to the research question (Patton, 2002).

"Purposive sampling is used in special situations where the sampling is done with a specific purpose in mind" (Maree, 2007b, p. 178). The purpose of this study was to investigate blind computer use in high school and participants were therefore sampled based on physical homogeneity (being blind) as well as psychological homogeneity (being computer users) (Robinson, 2013).

A potential challenge to the method of purposive sampling was the fact that it excluded the larger population and also limited the pool of participants in this instance (Nieuwenhuis, 2007c). It was nevertheless considered to be a practical method because it enabled the researcher to choose suitable participants, specifically aimed at the focus of the specific reported study.

In this case the participants were blind high-school learners between grades 10 and 12. As stated, the sample was drawn from a single service centre for the visually impaired in South Africa. Due to the vast amounts of raw data acquired from in-depth interviews and the constraints of time and funding, it was decided to choose four participants at the



convenience of the researcher. The following inclusion criteria were considered during sampling: firstly, learners were chosen from each consecutive grade, starting at Grade 10. Grade 8 and 9 learners were excluded due to their unfamiliarity with a new school and their limited experiences regarding academic computer use in the school. Hence the researcher decided to use older high-school learners because they would be more experienced and mature in their expressions than younger learners. They would also have had more contact time and experience with computers. Secondly, learners had to be academic computer users i.e. have CAT as a subject. Thirdly, the participants had to be fluent in English. It was paramount to the researcher that all of the selected learners had to be able to express themselves fluently and the conversation to take place as naturally as possible. Finally, to add a multicultural filter, 50% of the participants sampled were African and 50% Caucasian. Although most of the learners in the school were familiar to the researcher, it was decided that two key informants (Patton, 2002), the senior head of the Department of English in collaboration with the CAT educator, would be able to provide the researcher with favourable candidates who were well suited to the inclusion criteria. Table 3.2 provides a summary of the biographical information of the participating blind learners.

*Table 3.2: Summary of biographical information of learners who participated in study*

| Participant | Grade | Verbal expression and communication skills | CAT as a subject | Culture   | Gender |
|-------------|-------|--|------------------|-----------|--------|
| 1           | 10    | Good                                       | Yes              | Caucasian | Male   |
| 2           | 10    |  | Yes              | African   | Male   |
| 3           | 11    |  | Yes              | Caucasian | Female |
| 4           | 12    |  | Yes              | African   | Male   |

### 3.4 DATA COLLECTION AND DOCUMENTATION

This section delineates the data collection and documentation strategies employed during the current research study. The researcher discusses how semi-structured individual interviews and focus group interviews were conducted as well as the necessity of a research journal and supplementary observations to attain data saturation.

### 3.4.1 Research process

The purpose of this investigation was to gain more insight into the experiences of blind high-school learners regarding computer use. The researcher attempted to capture the joys (values), hardships (barriers) and future dreams (possible solutions) of blind high-school computer users. In addition, he was also interested in discovering a blind user's road to computer competence.

The main components of the process comprised individual semi-structured interviews with participants, followed up with a focus group discussion to gain possible additional insights. Observations were recorded as supplementary data. The researcher conducted two interviews per day. Participant 1 and Participant 2 were both interviewed on the first day, followed by Participant 3 and 4 the next day. The interviews were concluded with a focus group discussion on the third day. A classroom after school hours was used for the interviews and focus group. Initial transcriptions commenced the following week. Table 3.3 provides a summary of the data collection and documentation process that was followed.

*Table 3.3: Summary of data collection and documentation process*

| <b>Data collection technique</b>      | <b>Purpose</b>  | <b>Data documentation technique</b> | <b>Participating learners</b>                             |
|---------------------------------------|---|-------------------------------------|---|
| Semi-structured individual interviews | To obtain in-depth information on individual's experiences regarding computer use       | Audio digital verbatim recordings   | Four, blind, high-school computer learners – respectively |
| Semi-structured focus group interview | To obtain in-depth information on group's experiences regarding computer use            | Audio digital verbatim recordings   | Group of four blind high-school computer learners         |
| Observation                           | Documenting observations, thought processes and experiences during the research process | Research journal and field notes    | Researcher  |

### 3.4.2 Semi-structured individual interviews

The researcher utilised semi-structured interviews to gather rich contextual data from blind participants in order to provide a detailed description of their experiences as computer users. Interviewing is regarded by many as the main mode of qualitative data collection (Delpont & Fouche, 2002; Potter & Hepburn, 2005). A qualitative interview employs the researcher as a dynamic instrument of data collection (Merriam, 2002) to make meaning of the participants' reality perceptions regarding a specific social phenomena. Although these interviews took place in the participants' natural environment, any overt probe into a community is bound to alter the natural state of such a community to a greater or lesser extent. The interviews should therefore be regarded as naturalistic as opposed to natural (Potter & Hepburn, 2005).

The interviews were designed to be non-threatening. Participants in fact did not seem to be afraid to open up and actually shared deep and personal information. On his part, the researcher was empathic and made sure that he validated shared emotions and experiences (refer to Appendix D to view the interview schedule). Participants were willing to share their views and perceptions openly. The interviews each lasted between thirty minutes and an hour. They allowed the researcher to probe learners and clarify their answers.

One of the pitfalls of semi-structured interviews is that a researcher might get sidetracked by the conversation (Nieuwenhuis, 2007c). However, a clear set of guiding questions and researcher attentiveness aided the researcher in addressing this challenge. An adaptation of a set of questions used by Douglas *et al.*, (2007), due to their relevance, served as guidelines for this research investigation. Douglas *et al.*, (2007) constructed their interview questions to elicit participants' experiences of accessibility, frequency of use, intended use and experienced barriers to access related to blind computer use. The researcher of this study attempted to supplement it with an affective element, by starting the line of inquiry at participants' earliest recollections as well as probing the meaning generated by computers to a blind user. Participants' views on possible improvements to computers were investigated as well as their opinions regarding JAWS as a screen reader.

To increase the accuracy of data capturing and to streamline recording, the researcher used a digital dictaphone (Nieuwenhuis, 2007c). The researcher requested permission from the participants to use the dictaphone to promote the fluidity of the interview (Henning, 2005). In order to help build rapport and maintain transparency, participants were also allowed to touch ("see") the dictaphone, though the majority were quite accustomed to such devices, as dictaphones are employed regularly as study aids.

The high-quality digital recordings of the interviews aided verbatim transcriptions. The researcher opted to do his own transcriptions (see Appendix F) in order to limit misunderstanding and errors and to maintain the level of privacy and confidentiality guaranteed to participants (Henning, 2005). A separate document was created for each individual interview, lines were numbered and each speaking turn was transcribed on a new line. Clear distinction was also made by labelling the speaker as "researcher " or "participant (n)" in the preceding margin (Potter & Hepburn, 2005).

### **3.4.3 Focus group interviews**

Focus group interviews are generally defined as group interviews aimed at understanding how participants think or feel about the topic of investigation (Krueger & Casey, 2000). In theory, this data gathering technique allows participants the opportunity of collaborative feedback and brainstorming, which ideally results in richer data being gathered (Delport & Fouche, 2002). In this instance, a focus group discussion served as a data source to extract rich data from the group of blind participants.

Creswell (2009) and Nieuwenhuis (2007c) both caution against bias which may arise as a result of mediation of the discussion during focus groups. The researcher was able to limit and manage events that could create bias by drawing on his training in conducting educational psychological interviews as well as his experience as a language educator. The researcher employed mediation and coordination skills to ensure that the discussion was not dominated by certain participants (Greef, 2002). Control of the line of questioning was assumed and the researcher was able to steer the conversation in such a way that it created equal opportunities for participation. The need to employ a co-facilitator (Greef, 2002) was deemed unnecessary due to the group size.

Semi-structured interview questions were employed to prevent deviation from the topic (Nieuwenhuis, 2007c). The questions for the focus group interview were similar to the individual interview questions and allowed brainstorming and sharing of experiences in a group context. Prompting differed slightly as other members were often asked to voice their opinions as well. Supplementary to the data, participants as a group provided historical information about their past experiences and what it meant to be blind in different social settings, which aided in data enrichment (Creswell, 2009). The discussion helped to release prior reservations and inhibitions and participants were reminded of previously forgotten memories. The participants displayed a high level of maturity and insight, and it was

interesting to note the level of empathy and respect with which they treated other participants and the researcher. The collaborative discussion yielded rich supplementary data which would not have been attainable otherwise (De Vos, 2002).

A digital audio recording of the conversation was again made on a dictaphone and the transcription made in a similar fashion to the individual interviews. For convenience, anonymity and conformity, participants were again referred to as Participant 1, Participant 2 ... etc. (Potter & Hepburn, 2005).

#### **3.4.4 Observation**

Nieuwenhuis (2007c, pp. 83–84) defines observation as "the systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them". The main advantage of observation in the blind community is that, when practised correctly, it is non-intrusive. That said, covert observation of any group of people, especially a vulnerable population, raises significant ethical issues surrounding their rights to privacy, informed consent and voluntary participation (Maree, 2007a). The researcher made use of informal incidental observations recorded during both individual interviews and the focus group. Anecdotal records (Nieuwenhuis, 2007c) were made to serve as supplementary data. All observations were recorded in the researcher's field notes as part of his research journal.

#### **3.4.5. Research journal**

During the planning phase, the researcher realised that if he wanted to attain inter-subjectivity with participants (Granek, 2013) and maintain transparency, he would also have to include his own thoughts and feelings about the research process. He therefore organised and kept track of his thoughts in the form of a reflective research journal (Henning, 2005). This qualitative document served the secondary purpose of supplementing data by illuminating the thought processes and experiences of the researcher (Creswell, 2009). Although subjectivity was thus acknowledged, the researcher endeavoured to use his reflections as supporting evidence sparingly so that the voices of participants were dominant and clearly audible. The main purpose of this research journal was therefore to identify and monitor researcher subjectivity via the process of reflection (Merriam, 2002).

The research journal (see appendix E) is divided into two sections. Section 1 comprises the thoughts, feelings and intuitions of the researcher prior to and during the data collection process, whereas section 2 covers reflections pertaining to data analysis and meaning making. Orthographic information includes the date and activity reflected on.

### **3.5 DATA ANALYSIS AND INTERPRETATION**

The data gained from a qualitative investigation is usually multilayered, value-laden and thematically rich (Merriam, 2002). Making sense of vast amounts of qualitative data requires perseverance and organisational skills. There is a continued dynamic interaction with raw and refined data as the researcher discovers and tests new themes and conceptions (Nieuwenhuis, 2007a). Although formal analysis generally ensues after transcription, preconceptualisations of possible themes also unfolded during data collection as participants shared their beliefs (Henning, 2005). The researcher attempted to obtain an in-depth understanding of blind high-school learners' perceptions of computer use in order to structure and assign meaning to the user experience.

Thematic content analysis was used as a model for data analysis and interpretation (Henning, 2005). As an initial step to analysing the data, the researcher immersed himself in the data in an attempt to become more familiar with it. During the transcription phase, he listened repeatedly to the audio recordings while creating and viewing the physical manifestation of data in the form of written transcriptions.

While rereading the transcribed individual and focus group interviews, observational anecdotes and journal entries in succession, preconceptions for different codes and recurring themes were identified (Nieuwenhuis, 2007a).

It was then decided that a systematic hierarchical organising strategy would be beneficial, since data appeared to clearly depict either positive or negative views and experiences which provided stable reference points for differentiation. Code memoing was also employed at this stage of the investigation (Henning, 2005). Insights were then shared with the research supervisor, weighed and accepted or discarded.

Next, the researcher proceeded to code fragments of data so that the content related to specific keywords was clustered together (Maree & Van der Westhuizen, 2009). Attempts were made to locate codes and themes that corresponded or contrasted with existing

literature, and codes that were unique and unusual (Creswell, 2009). The next step in the process was to categorise the code clusters. A table of meaning was constructed (see Appendix G) in which categories were arranged in columns and quotes were copied and arranged according to weight. The researcher collaborated with his supervisor throughout the analysis and interpretation of the data as a form of verification (Creswell, 2009).

### **3.6 QUALITY CRITERIA**

In order to produce a study of quality and soundness, the researcher paid careful attention to the following quality criteria for qualitative research: credibility, transferability, dependability, conformability and authenticity (Given, 2008). The researcher opted to answer Guba's quality criteria with selected strategies as recommended by Shenton (2004, p. 73).

#### **3.6.1 Credibility**

Credibility depicts the level of congruency between research findings and the original intent (Kennedy-Clark, 2012). It is considered cardinal to the establishment of trustworthiness. Precision and accuracy combines to form trustworthiness. Nieuwenhuis (2007) stresses the importance of trustworthiness during data analysis, findings and conclusions. In accordance with Nieuwenhuis' (2007c) recommendations to ensure trustworthiness, multiple data sources were employed. Recognised and proven research methods were used. A combination of individual interviews, focus group interviews, observations and personal reflections were employed to gain thick descriptions of the social phenomena. A reflective research journal and two supervisors helped the researcher to steer clear of bias. During the coding process, intra-coding reliability was improved by reading and rereading the transcriptions until both researcher and supervisor were satisfied with the results. The researcher took steps to govern bias by journaling to promote reflective engagement, as well as documenting instances of bias in order to provide a fair account of events and perceptions of participants. He has also taken care in reporting negative findings and silences (Creswell, 2009).

The researcher was thoroughly familiar with the "culture" and communal language of participants, having previously worked at the setting for nearly half a decade (see 3.7.1). Debriefing sessions took place between the researcher and supervisor during guidance meetings. Reflective commentary was recorded in a research journal (Shenton, 2004).

### **3.6.2 Transferability**

Transferability or applicability focuses on the probability of applying findings to other studies or situations (Nieuwenhuis, 2007c). Richly descriptive background data of the setting and participants is provided and validated by similar predispositions in the literature study. The phenomenon of blind computer use is also richly described from the viewpoints of the participants and the researcher and sources in the literature.

It was acknowledged that it was unlikely that a study with a small number of participants would be generalisable to a larger population. According to Henning's (2005) understanding of Kvale's (2002) interpretation of validity in a neo-postmodern world, validity is situated between interpretation and action. The validity of a qualitative research design is often determined by the meaning it brings to the discourse community in combination with the accuracy of procedures, and the value of the research to the researched community (Henning, 2005). The onus of transferability therefore rests on the readers and the context they face (Shenton, 2004).

### **3.6.3 Dependability**

Dependability describes the extent to which the study is reliably replicable under similar circumstances due to the rigor in method (Shenton, 2004). There are unavoidable discrepancies between planned and conducted research, brought about by a multitude of unforeseen or unfamiliar nuances, of which time is the most obvious. A researcher therefore has to have a research infrastructure and adequate methodological information for increased chances of replicability (Given, 2008).

The researcher is aware of the changing reality in qualitative research; the possibility of identifying exactly the same results in a different setting is therefore very limited. In qualitative research, it is more important to ensure that the results obtained are consistent with the collected data. Although a clear delineation of the research methodology is provided to streamline attempts to replicate the investigation, the researcher ensured that the collected data was aligned with the results. The researcher made use of a focus group discussion to ensure that the voices of the participants were accurately presented in the findings (Halcomb, Gholizadeh, DiGiacomo, Phillips, & Davidson, 2007). Additionally, research practices were kept as transparent, organised and accessible as possible.



### 3.6.4 Confirmability

Confirmability is established when the research findings can be attributed to the views and perceptions of participants rather than the personality and agenda of the researcher (Shenton, 2004). Triangulation makes the assumption that credibility and confirmability increases when more than one researcher arrives at the same conclusion or reality perception. This method results in a single perspective or conceptualisation of the investigated phenomena. Crystallisation transcends triangulation and is achieved by including multiple data collection techniques and multiple perspectives to the researched phenomenon resulting in a multi-faceted (Richardson, 2000), crystallised image with the potential of multiple interpretations and conclusions (Tracy, 2010). The researcher aligns himself with the concept of crystallisation and has strived to create a lattice that is multifaceted yet transparent.

In light of the above, the views of the participants were emphasised and sufficient time, opportunity and prompting was used to hear, understand and record their views. In addition, validating discussions were held with the supervisor to limit researcher bias (Spencer *et al.*, 2003). Shortcomings and bias linked to the methods employed were highlighted, discussed and addressed or supplemented. Diagrams, tables of meaning and memos were used to create a clear audit trail (Given, 2008).

### 3.6.5 Authenticity

The main goal of qualitative research is to provide rich in-depth descriptions of a phenomenon investigated. Authenticity concerns the fair, balanced representation of differing viewpoints within a study and the wider social and political community (Given, 2008; Spencer *et al.*, 2003). It weighs the usefulness of an investigation to the researched community.

The researcher strengthens his claims to authenticity according to Lincoln and Guba's criteria as portrayed in Given *et al.* (2008, p. 44), as follows: *Fairness* was achieved by conducting individual interviews of the same length and by providing participants with an opportunity to engage equally in a coordinated focus group discussion. During the focus group discussion, participants had the opportunity to listen to the insights and viewpoints of others, which allowed an opportunity for increased awareness and promoted both *ontological* and *educative authenticity*. Although *catalytic and tactical authenticity* is more

difficult to measure, the structure of the investigation did provide a safe environment for both sharing and learning. The questions were designed to reactivate initial memories and experiences, then focus on a timeline of computer engagement (to create opportunities for reflection) and finally, probe participants for additional ideas or newly gained insights that might have arisen during the process (Given *et al.*, 2008).

### **3.7 ETHICAL CONSIDERATIONS**

"Ethics are moral principles and values which guide action" (Thompson & Russo, 2012, p. 33). According to Brinkmann and Kvale (2008), qualitative research has a higher degree of interaction between researchers and participants which increases the pool of ethical issues. This subsection will focus on the ethical considerations and the steps taken before, during and after the research investigation.

#### **3.7.1 Expertise of the researcher**

The research setting was a school for visually impaired learners and the researcher's training and previous work experience as an educator at this school prepared him for the social interaction with key informants, parents and participants. An honours degree in Educational Psychology has improved the quality of his academic work and impressed upon him the need for professionalism. Although this was his first dissertation, he had conducted a mini-qualitative investigation as part of a group research project for his honours research elective.

The researcher has been interested in and working with vulnerable populations since he started studying education in 2004. He became formally immersed in teaching learners with special educational needs (LSEN) when he started teaching in 2007. He worked with visually impaired learners for four years and is currently employed as a remedial therapist at a facility for learners experiencing barriers to learning. The researcher's earlier experience as an educator of visually impaired learners allowed him to closely observe blind computer use over a period of four years. He also became familiar with the jargon used by the blind community and educators. Temporary reintegration was therefore not difficult.

Various community outreach programmes under monitored guidance from lecturers during his honours and master's years have impressed on the researcher the importance of social justice, cultural sensitivity and best practice. Finally, both his supervisor and co-supervisor are experienced researchers and their support and guidance has given the researcher the confidence to venture into the qualitative field.

### 3.7.2 Process of following ethical guidelines

According to Maree (2007a), one should highlight the ethical considerations of a research study. Maintaining confidentiality and anonymity are paramount in the protection of all role-players in an investigation. Creswell (2009) suggests that a cardinal step to ensure ethical practice is adherence to the research protocols of one's institution. The researcher therefore followed the ethical protocols of the Faculty of Education of the University of Pretoria (2012) to ensure the protection of participants, himself and his institution. The protocols' five key values illustrate the responsibilities of all UP researchers and are comprised of:

- *Social responsibility* – which covers the betterment of society.
- *Justice* – pertaining to the treatment of participants and organisations.
- *Benevolence* – as an added mantra to protection from harm, researchers also encouraged to promote the well-being of the researched.
- *Respect for the individual* – with the focus on dignity, humanity, autonomy and freedom.
- *Professionalism* – researchers should always conduct themselves in a professional manner with integrity by producing quality work and accepting accountability.

(University of Pretoria, 2012).

Creswell (2009) also emphasises that transparency concerning pre-entry ethical considerations and steps followed to gain access is paramount to best practice. Hence the researcher has provided a quick overview of the entry and exit protocols followed during this investigation. After the acceptance of his research proposal, he submitted a proposal to the departmental ethics committee, which he then tailored and adjusted according to their requirements until he was able to obtain provisional clearance. Due to the fact that the researcher had chosen a vulnerable population, additional requirements had to be met. He therefore also had to submit his proposal to the Gauteng Department of Education, who gave him a month's clearance in which to conduct the research.

A meeting was arranged with the school principal and the researcher gained permission from her to conduct his research outside of class time. Next, the researcher met with the head of the department of English and the school psychologist to help identify suitable candidates for the purpose of this study. The school psychologist made herself available to assist with deep briefing or possible therapeutic assistance during or after the research if the need should arise.

The researcher next approached the candidates and explained their rights, the purpose of the research, and the process and importance of voluntary participation and informed written consent. The researcher highlighted the fact that that they were minors and that he also needed their parents' informed written consent (refer to appendices A, B and C to view the informed consent forms for the principal, parents and participating learners respectively). The researcher asked the learners first because he did not want to make them feel that their parents forced them to participate and they were the quickest route of access to their parents. He also informed the participants of the intended focus group discussion and impressed upon them a need for respect and confidentiality towards other participants. Next, he informed the participants that the reason for his study was firstly to write a mini-dissertation as part of his master's degree qualification and secondly that participation in this research project might lead them to new insights regarding blind computer use, quite possibly allowing them to share a small part of their world with future readers. The researcher was very careful not to create any expectations of gain on their side and he told the participants that that the ethical steps researchers take result in a disassociation of reported participant persona or, put differently, anonymity. The researcher therefore attempted to maintain transparency and professionalism at all times.

### **3.7.3 Role of the researcher**

Glesne and Peshkin (1992) warn against ethical issues pertaining to disclosure and power which could arise when one conducts a backyard study<sup>21</sup>. Although the researcher does have four years' experience of working with visually impaired and blind children, he conducted his fieldwork nearly a year after transferring to a different LSEN school. This created some distance between himself and the population. Yet, to a certain extent the insider perspective (Nieuwenhuis, 2007b) was not altogether lost, which simplified the process of establishing rapport. However, the researcher acknowledged the possible pitfalls

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<sup>21</sup> Backyard research "involves studying the researchers own organisation, or friends, or immediate work setting" (Creswell, 2009, p. 117).

of unethical practice and therefore took the additional precautions discussed in the next section.

Having worked at the research setting as an educator before the research commenced, the researcher was mindful of the possible power relationship that could influence the dynamics of the relationship between the researcher and participating learners. He acknowledged the power he held as educator to enter into his role as researcher. He made it clear from the outset to the participants that he was no longer an educator, but a research student who was interested in learning their views on computer use. He further explained voluntary consent to the participating learners and that they were under no obligation to take part in the study and could opt out at any time during the research. He also explained to them that taking part in the research would in no way influence their academic marks or their relationship with the school.

This investigation was thus approached from the standpoint of an educational psychology master's student, former educator of the visually impaired and assistive technology hobbyist. The researcher realised that a degree of subjectivity would be present and that he would have to monitor it continuously (Merriam, 2002). He made use of a research journal to reflect on his experiences, possible bias and thoughts. The researcher accepted that in his reality as researcher, he could strive to glean a version of the truth from each of the participants, but that it would possibly be slightly different and segmented (inter-subjective) in comparison to the original reality experience (Granek, 2013).

#### **3.7.4 Cultural and language differences**

As stated previously, the samples were chosen in such a way that half of the participants were of African descent and the other half were Caucasian. The researcher was careful during focus group interactions to monitor the level of participation and emotional predisposition of all the participating blind users. Integration, assimilation and deculturation (Bhati, Hoyt, & Huffman, 2014) manifested similarly during interviews and, as a counter, probing was aimed at eliciting personal experiences and opinions of participants. A turn-based system of questioning was employed to validate the importance of each individual's contribution to the research and to prevent withdrawal. When any members interrupted other members, comments were briefly acknowledged and original speakers re-prompted to finish their thoughts. With differing cultures and social economic backgrounds, difficulties regarding language and vocabulary can easily arise.

Multicultural research has been well documented in the literature (Hole, 2007; Patton, 2002). The researcher was careful to heed challenges related to multicultural research and possible pitfalls during cross-language communication. During the interviews it became evident that participants thought of themselves as being blind first and foremost. All participants grew up in a Western academic environment and cultural predisposition did not play a large role in the study.

The researcher took precautions regarding language barriers during the sampling process (Spencer *et al.*, 2003). As stated, the head of the department of English aided the researcher in securing participants who were fluent English speakers. All learners listed English as their language of tuition. That said, the researcher remained vigilant for possible misunderstandings that mother-tongue speakers might encounter. Interview questions were rephrased if participants did not understand them. The researcher also took into account the uniqueness of the "blind community" and made attempts to use communal jargon obtained from participants to increase rapport (Kajee, 2010).

### **3.7.5 Sensitive information obtained**

In order to protect the rights of participants and preserve human dignity, a researcher has to be ethical (Aluwihare-Samaranayake, 2012). Mouton (2001) cautions against accidental violation of participants' right to privacy and anonymity. Nieuwenhuis (2007c) points out that confidentiality and anonymity is not simply maintained by the implementation of pseudonyms, but requires sensitivity and awareness from the researcher to completely mask parts of the paper trail that could lead to discovery and disclosure of privacy and sensitive information. I therefore refrained from mentioning anything to this effect.

Another aspect to be considered when dealing with sensitive information is the fact that participants often share emotionally sensitive information with a researcher, and that the researcher is not acquainted with the full emotional background of participants, creating an affect risk (Thompson & Russo, 2012). It was therefore considered vital that the researcher maintain a respectful and sensitive composure when dealing with the stories of participants at all times. Prearrangements were also made to have the school psychologist available to provide counselling, therapy or debriefing, should participants show signs of emotional distress or regression.

### **3.8 CONCLUSION**

In this chapter, the researcher discussed his research methodology and strategies, and provided reasons to support his choice of methodology. He shared his paradigmatic orientation and discussed the meta-theoretical and methodological paradigms adopted during the study. He then provided motivation for his choice of the research setting and participants and included justification for his sampling procedures. An exposition of his data analysis and interpretation strategies from a constructivist perspective was also included. Finally, he concluded the chapter with an explanation of quality criteria and ethical considerations. In Chapter 4, the researcher presents the results of the reported study.

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## CHAPTER 4: RESULTS OF THE STUDY

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### 4.1 INTRODUCTION

In Chapter 3, the researcher discussed his research methodology and the strategies he used to obtain and analyse his data. He used a qualitative approach in order to obtain rich data from the accounts and experiences that participants shared. He conducted semi-structured interviews to elicit authentic personal responses. This data was supplemented by accounts from his own research journal and focus group interviews.

In this chapter the researcher present the results of the study by indicating the themes, subthemes and categories that emerged from thematic analysis. He includes inclusion and exclusion criteria for each theme, which assisted him to categorise data into themes and subthemes. The verbatim transcripts from the interviews and a focus group discussion as well as extracts from his research journal illustrate the themes. In Chapter 5 the researcher positions his results in the framework of existing literature.

### 4.2 RESEARCH RESULTS

This chapter is divided into three sections that correspond with the three main themes that emerged during thematic analysis and interpretation. The first theme relates to the value and benefits of blind computer use. The second theme explores the barriers that blind learners associate with computer use and the third theme highlights possible future solutions related to blind computer use.

Figure 4.1 summarises the three themes that emerged from the data analysis. The figure indicates that blind users report computers to be a valuable resource, and that even though they experience certain barriers related to computer use as a minority, they are in the position to propose possible future solutions to address these barriers.

Awareness, or the actual experience of the value of computer use, appears to go hand in hand with the identification and experience of barriers related to computer use. The perceived value of using computers in turn brings to the fore possible future solutions for increasing proficiency and scope of computer application.



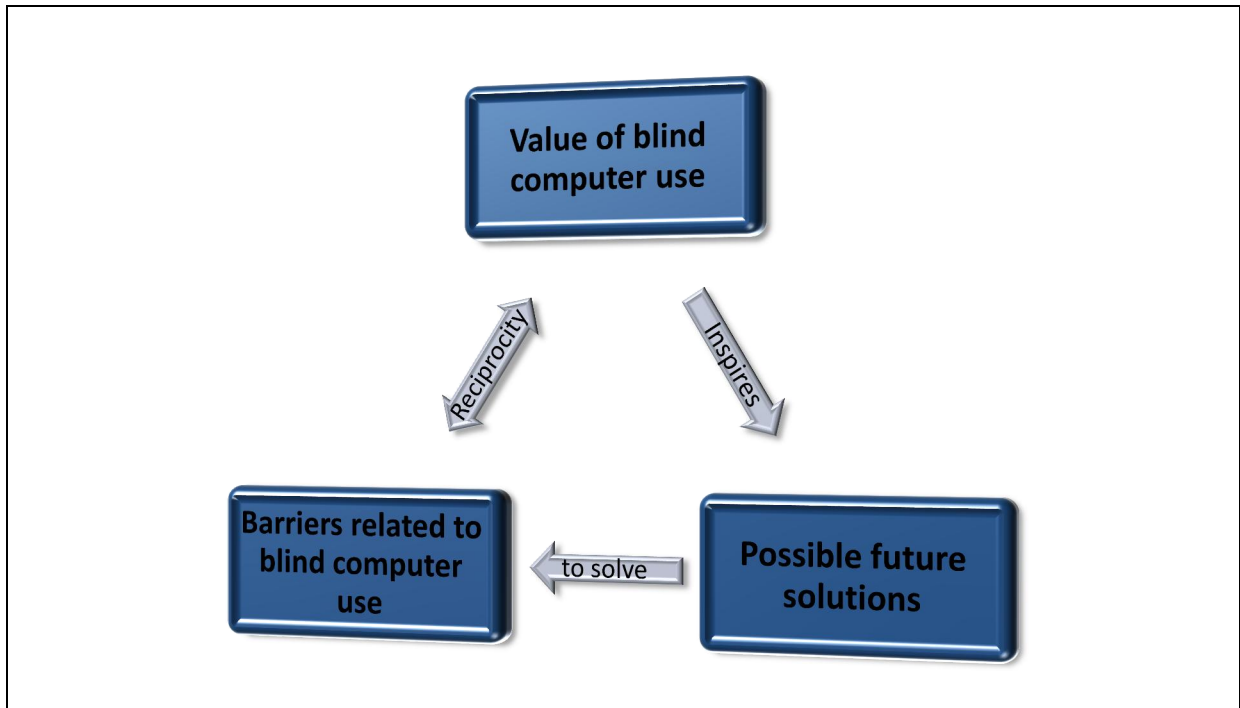


Figure 4.1: Schematic overview of the three themes emerged from data analysis

### 4.3 THEME 1: VALUE OF BLIND COMPUTER USE

The first theme focuses on addressing the first research question: *What is the value of computer use for blind learners?*

The data in this theme reflects the participants' accounts and views of the value that they gain through computer use. The researcher identified and grouped their accounts in an attempt to highlight the main benefits.

Table 4.1 is a summary of relating subthemes, each with its own inclusion and exclusion indicators.

Table 4.1: Inclusion and exclusion criteria for theme 1

| <b>4.3 Theme 1: Value of blind computer use</b>         |  |  |
|---|--|--|
| <b>Subthemes</b>  | <b>Inclusion indicators</b>  | <b>Exclusion indicators</b>  |
| 4.3.1 Connectedness to the "normal" <sup>22</sup> world | This subtheme includes data related to participating blind learners' ability to merge with the general population and fulfil unhindered societal roles and tasks through the use of computers. It includes data related to their ability to integrate, socialise and explore freely. | This subtheme excludes all references where participating blind learners are unable to merge with the general population and fulfil unhindered societal roles and tasks. It excludes all failed attempts to integrate, socialise and explore freely. |
| 4.3.2 Academic support                                  | This subtheme includes data related to participating learners' utilisation of computer assistive technology for academic purposes.   | This subtheme excludes references that are not directly related to participating learners' utilisation of computer assistive technology for academic purposes.   |
| 4.3.3 Recreational purposes                             | This subtheme includes data related to participating learners' ability to employ computers for recreational purposes.  | This subtheme excludes references that are not directly related to participating learners' utilisation of computers for recreational purposes.   |
| 4.3.4 Enablement and agency                             | This subtheme includes data related to participating learners' experienced feelings of enablement, competence and agency as a result of computer use.  | This subtheme excludes references that are not directly related to participating learners' feelings of enablement, competence and agency as a result of computer use.  |

<sup>22</sup> Though participants did not feel inferior, they were openly aware of their disability and the limitations it places on their functioning in society, in comparison with the larger population. Even though the blind do not regard themselves as a "culture", all participants made reference to the "outside-" or "normal world", meaning those who are unencumbered and not part of their primary social framework. To a large extent, participants' social and academic lives revolved around the school as a familiar micro-reality.

### 4.3.1 Subtheme 1.1: Connectedness to the "normal" world

Participating learners reported that computer access provided them with a bridge to the sighted world. It allowed them to take part in many activities that the sighted community tended to take for granted. Activities such as playing on the computer and being able to make discoveries on the computer are some of the experiences that participants shared:

*It was all new to me so it felt really good at the time and I was little, so of course I was excited* (Participant 1, Line 9–10).

*At that point I didn't really have many hopes and dreams, I just wanted to play on the computer* (Participant 1, Line 13–14).

*My first recollection of a computer was actually sitting in this cold computer room with the keyboard in front of me and learning the home row which is ASDFJKL and ... So um, I was really fascinated with JAWS the way it actually said things and um ... I guess my fascination was what, you know, led me to actually learn how to type. To actually duplicate what JAWS says when the teachers type* (Participant 1, Line 4–10).

*You just need to know outside your own world* (Participant 4, Line 161–163).

*Yes sir, I wanna be normal* (Participant 2, Line 190–195).

Just like in the sighted community, computers and cell phones play an important role when it comes to expanding a blind person's world. Participants reported cell phones to be particularly useful devices in communication and socialisation. Participants reported that they used Facebook<sup>23</sup> and BlackBerry Messaging (BBM) as tools to make friends and socialise in a relatively safe environment. This is supported by the following verbatim quotations:

*All my friends are on BBM* (Participant 2, Line 42–44).

*I usually use it for Facebook, yeah maybe Facebook* (Participant 4, Line 74).

*The thing with me is I can talk more easily and more freely when it comes to writing because although my vocabulary is good, socially I just, I'm more intellectually mature, you know. It's why sometimes I battle to converse with my classmates, because they are worrying about the weirdest things and we just don't fit* (Participant 3, Line 240–245).

Despite a variety of chat programs available to blind users, participating learners also preferred email as a more intimate means of communication:

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<sup>23</sup> Facebook is one of the largest online social networks. In this instance, Facebook allows blind learners with a small group of physical friends the opportunity to create and maintain an expanded virtual network of friends due to its ability to cut through the various barriers associated with expanded physical friendship networks.

*Friends ... My aunt, I always email my aunt. ... Yeah, she responds (Participant 2, Line 296–301).*

*Yeah, well on the phone, yeah, but I don't really have much patience for Facebook – you know. Emails is fine because it doesn't, like, what are you doing? You know? Which brand of toilet paper are you using? Just generally stupid things like that (Participant 3, Line 226–229).*

Participants also placed emphasis on the ability to conduct electronic research and discover the worlds by making use of the World Wide Web. Reasons for doing research ranged from satisfying curiosity to solving problems, as is evident in the following verbatim quotations:

*Other people, yes Sir because it's not like when you go out in the real world it's not gonna be the people that you know. You gonna meet new people and you're going to have to adapt to those types of people, with their own cultures and own stuff that they do. So it's better if you already know about it. Then, when you get there it's not as difficult (Participant 4, Line 167–172).*

*The fact that everything is there [on the World Wide Web], like everything (Participant 2, Line 289–290).*

*Wikipedia because they give like everything, almost everything (Participant 1, Line 88–90).*

*I think it's very valuable, cause the internet has pulled me out of the dump many times. If there's a problem, Google<sup>24</sup>. You've got a pesky critter on your tail, Google (Participant 3, Line 535–538).*

Portable software allows additional access and competency enabling a blind learner to use any computer. Blind learners can thus take part in computer activities with friends or fellow learners without having to take their whole computer with them. The following verbatim quotation serves as supportive evidence:

*I know you get Dolphins<sup>25</sup> that operate of flash drive dongles, Dolphin Dongles. They're quite nice I guess, if you feel the need for speed. ...Yeah, but you do get portable JAWS that you can set up on your own as well as portable NVDA<sup>26</sup>. If you wanna scoot off somewhere and use a mate's computer (Participant 3, Line 475–481).*

#### **4.3.2 Subtheme 1.2: Academic support**

Participating learners indicated that they preferred to use computers when conducting research to assist them with their academic projects:

*For a lot of things, for like, doing my school projects on and for doing research on the internet (Participant 1, Line 38–39).*

<sup>24</sup> Google (in this context) is a global online search engine/program that allows users to search for websites arranged according to topic and visitor preference.

<sup>25</sup> SuperNova, is a Dolphin product that allows the creation of portable assistive technology (screen reader and magnifier) on a flash disk/dongle called a Dolphin pen.

<sup>26</sup> NVDA (Non-visual Desktop Access) a free, Windows compatible, screen reader.

*I hate research. If I'm researching something for school, it's for school, you know, not for me. ... Well, I don't even brainstorm. I let the Google do that for me because it gives you a lot of search results and there is always another page and another page. And you eventually get what you're looking for. I mean, I really do sympathise for the people in the older days when there weren't no computers (Participant 3, Line 565–566 & 578–582).*

*Yes, on the internet you can do research and at the same time you can also do stuff, that you just ... But mainly, if not the communicating then the research (Participant 4, Line 147–150).*

After conducting research, participants also referred to the use of computers for typing their assignments and conducting the necessary language editing. According to the participants, the use of computers helped them to save time which would normally be spent rewriting draft assignments:

*If you do something wrong, to delete it or if the word count doesn't work out you can just edit it and it makes it easier. When it looks okay, then I write it out. ... Ja, but it's less work having to write it over than to rewrite it again (Participant 1, Line 302–311).*

*I type my assignments, my music assignments and CAT (Participant 2, Line 46–47).*

*I do all my assignments and projects like, my research projects for Life Science and Physics and LO and all those things are on the computer (Participant 1, Line 294–297).*

Participating learners all had Computer Application Technology (CAT) as a subject. Despite some difficulties they experienced in using computers, it seemed that their basic computer skills were of a good standard:

*Do you know when you have to draw a graph, you have to do it in Excel and import it to Word again? (Participant 2, Line 114–115).*

*The one that we are using now is actually quite good. ... No, it's easy because it's easy to navigate in those ribbons (Participant 4, Line 23–25).*

It appears that computers form an important part of participants' academic strategies and could be regarded as beneficial to their academic progress. Increased diversified application of computers in schools for the visually impaired may prove beneficial to academic achievement, as supported in the following quote from my research journal:

*I find it truly amazing that all blind participants with access to home computers, used them extensively to complete their homework. It would appear that they favoured computers above braille and that it was cumbersome and excessive to rewrite already completed assignments in Braille. With the shift towards more technological approaches to education and the increased adoption of e-learning strategies, blind learners who are computer competent should theoretically benefit from electronic subject material, in a sense streamlining access and learning (Research Journal, 2012-08-21).*

The following quote from one of the participating learners further supports the important role that computers play in the academic world of blind users:

*I'm more grammatically proficient when it comes to writing on a computer than it is to do Braille because writing on a computer is like a second skin (Participant 3, Line 213–215).*

### 4.3.3 Subtheme 1.3: Recreational purposes

The participating learners voiced the recreational value of computers, by referring to computer games, as indicated by the following quotes:

*... a lot of these "blindies" are obsessed with audio games (Participant 3, Line 147–148).*

*Ja, um, the most accessible ones ... Probably like strategy games, because you don't have to, you know, really have that fast reactions. Or react on things quickly. It's just like, like the medieval strategy games where you have your knights and archers and stuff. ... And then you do have first person shooters like, there is this one zombie game that's fun (Participant 1, Line 63–70).*

Blind learners also referred to the value of computers in viewing movies<sup>27</sup> as recreational activity, as reflected in the following verbatim quotations:

*... or watching movies, or like, anything (Participant 1, Line 36).*

*... .and watching movies (Participant 2, Line 24–25).*

Participating learners also made reference of using a computer to listen to music as a leisure activity:

*I mean, if you look at it from the music point of view, you don't have to get up and select CDs from the shelf. It's just a matter of space and enter and backspace and all that stuff (Participant 3, Line 21–24).*

*If you want something it's easier to download it than go to Musica, there are some snotty people behind the counter (Participant 3, Line 548–549).*

*I'm more into music, so I use it for music mostly ... (Participant 4, Line 104).*

Recreational socialisation also seemed to form a significant part of the participating learners' recreational computer use, as reflected in the following verbatim quotations:

*There's a group on Facebook that I joined called PC talk and if you wanna know anything, like any opinion on anything about anything about computers, you just ask them. Because most of them are blind or visually impaired. ... You do too, and if anyone's got a question, there's usually five or six people clamouring to answer you (Participant 3, Line 613–621).*

*Music, gossip, the latest news, celebrity news, fashion, movies (Participant 2, Line 292–293).*

<sup>27</sup> The majority of recent movies have the option to select an additional descriptive audio channel which narrates the action scenes in a fashion that allows blind viewers to follow the story.

All participants referred to the usefulness of computers or cell phones as a means of accessing electronic literature for recreational reading. As the following quotes suggest, most participants attested to reading electronic literature<sup>28</sup>:

*... Yeah, and reading as well* (Participant 3, Line 183–186).

*I use it as well for online reading or e-books or whatever* (Participant 3, Line 543–544).

*For a lot of things ... and for reading, just for fun ...* (Participant 1, Line 38–40).

In the verbatim quotations that follow, it is evident that some of the participants use a computer or cell phone to allow them a safe place for creative expression in the form of the written word, whether writing for escapism or diarising:

*I'm sort of becoming obsessed, okay, not really obsessed but like having a crack at writing Fanfic<sup>29</sup>. In the last three weeks I wrote 14 000 words on a prologue, and that's just a prologue* (Participant 3, Line 116–119).

*Yeah, and Harry Potter<sup>30</sup> is a way to express yourself that nothing else really offers because you can do anything* (Participant 3, Line 130–131).

*For Jobe<sup>31</sup> I've written about 17 000 words –which is kind of nothing if you really think about it* (Participant 3, Line 111–115).

*Because everything is there –my music, my pictures ... I can even diarise there* (Participant 2, Line 85–87).

#### 4.3.4 Subtheme 1.4: Enablement and agency

Throughout the participants' accounts of their experiences of computer use, they reflected a sense of empowerment, creative problem solving and an overtly positive attitude:

*Ai, not a lot. I don't get frustrated that easily. I'm not someone that's impatient. So, no, not a lot* (Participant 4, Line 239–240).

*I don't usually use help menus, I fiddle around until I get it right* (Focus Group 1, Participant 3, Line 502–503).

*I could, cause recently someone came into the class and the person is new so teacher asked me to show him some stuff. I think I would be able to teach someone* (Focus Group, Participant 4, Line 527–529).

<sup>28</sup> Electronic literature means any form of electronic writing.

<sup>29</sup> Fanfic or fan fiction refers to literary works (by fans of the original publication) in which certain aspects of the original publication is elaborated on, altered or employed in new or alternate narratives.

<sup>30</sup> Harry Potter is a popular teenage fantasy novel series.

<sup>31</sup> Jobe (pseudonym) name of the book that the participant is writing.

Not being able to see meant that participants had to memorise the keyboard. However, participants showed proficiency in using the keyboard in a confident manner:

*I don't think it's necessary because we memorised the keyboard, it's just like when someone has to type fast, you don't really look at all the keys (Participant 1, Line 179–182).*

*No, "A" "S" "D" "F" "J" "K" "L" and then asdfghjkl we learnt the asdf row first (Participant 2, Line 489–490).*

*I managed to type a 300-word something with that keyboard in about ten minutes (Participant 3, Line 358–359).*

Although participants reflected on the difficulty of sometimes being required to type with one hand and read with the other, it seems that they experienced proficiency in dealing with these demands:

*Because in Mrs X's class I have to type with one hand and read with other. So, that really slows me down (Focus Group, Participant 2, Line 279–280).*

*If we need to type over [retype] something that we are reading ... Otherwise we can use two (Focus Group, Participant 1, Line 291–292).*

*Like, you find "F" with that one and you find "J" with that one. Because those dots are mos on them. If you know that it's "F" then you just count from there (Focus Group, Participant 3, Line 307–310).*

Participating learners indicated that being able to type and navigate on a computer meant being able to communicate. Despite some challenges experienced in this regard, participants remained positive and displayed proficiency in communicating through the use of computers:

*Oh! I love Word. It's the easiest (Participant 2, Line 64–65).*

[So, if the other guys are speaking quickly, do you leave the chat room?] *No, not really (Participant 2, Line 105–107).*

*Well, like I said this is for reading, or when I need to chat. I'm just thinking where is the best place to type. Ah, I think notes will do [Quickly navigates to the notes]. What would you like me to type? "I", "N", "T", "E", "R", "E", "S", "T", "I", "N", "G" ... "INTERESTING"<sup>32</sup> (Participant 3, Line 293–300).*

Although participating learners voiced some difficulties with regards to screen reader application, they all seemed able to navigate functionally through most programs and the internet, as is evident in the quotes that follow:

*Yeah, I'm really good at it. Well, I'm good, relatively good at surfing the net with JAWS (Participant 3, Line 189–190).*

<sup>32</sup> The cell phone audibly spells out each letter, as it is typed, and then reads out the word after it is completed.



*Well, it's okay because it's easy. It's not really difficult. You just go on the internet and search for it. It depends more on the topic that I plan to do research about than the fact that I have to do research (Participant 1, Line 284–287).*

*Now we just press the Windows key, then we type in. Not even a full word. If we want to go to Word we press the Windows button "Wo" and then it's already there so you just enter. The first time when you learn it, you have to go through and read those other stuff and find it ... Yeah, and as you grow with it then you can find those shortcuts (Participant 4, Line 357–361).*

In Theme 1, the participating learners voiced their experiences with regard to the value of blind computer use, which included connectedness to the "normal world", academic support, recreational purposes, and enablement and agency. Despite the value of blind computer use, participants also referred to barriers related to blind computer use, which is discussed in Theme 2.

#### **4.4 THEME 2: BARRIERS RELATED TO BLIND COMPUTER USE**

The second theme focuses on answering the secondary research question: *What are the barriers that blind learners experience related to computer use?* The data in this theme reflects the participants' accounts and views of the different barriers that they associated with computer use.

Table 4.2 presents a summary of the second theme and related subthemes, each with its own inclusion and exclusion indicators.

Table 4.2: Inclusion and exclusion criteria for theme 2

| <b>Theme 2: Barriers related to blind computer use</b> |  |  |
|--|--|--|
| <b>Subtheme</b>  | <b>Inclusion indicators</b>  | <b>Exclusion indicators</b>  |
| 4.4.1 Financial implications                           | This subtheme includes data related to participating learners' challenges or inability to obtain computers, assistive technology or training due to limited available funds on the part of their parents or training institutions. | This subtheme excludes references that are not directly related to the influence of money or the lack thereof on the procurement of computers or assistive technology.   |
| 4.4.2 Technological access                             | This subtheme includes data related to participating learners' challenges or inability to gain access to technological devices (physical access), programs or the internet (virtual access).                                       | This subtheme excludes references that are not directly related to the learners' hampered ability or inability to gain access to technological devices (physical access), programs or the internet (virtual access). |
| 4.4.2.1 Category 1: Physical access                    | This category includes data related to participating learners' challenges or inability to gain access to a device (in this case a computer or cell phone),   | This subtheme excludes references that are not directly related to the learners' hampered ability or inability to gain access to <i>technological devices</i> .  |
| 4.4.2.2 Category 2: Virtual access                     | This category includes data related to participating learners' challenges or inability to gain access to the virtual domain (web content/program/onscreen area) reached via the device.  | This subtheme excludes references that are not directly related to the learners' hampered ability or inability to gain access to the virtual domain (web content/program/onscreen area) reached via the device.      |
| 4.4.3 Time-consuming process                           | This subtheme includes data related to excessive amount of time required to complete objectives related to computer use, as a result of being blind.   | This subtheme excludes references that are not directly related to time constraints related to computer use, experienced by individuals as a result of being blind.  |

| <b>Theme 2: Barriers related to blind computer use</b>       |   |  |
|--|---|--|
| <b>Subtheme</b>  | <b>Inclusion indicators</b>   | <b>Exclusion indicators</b>  |
| 4.4.4 Society's ignorance of needs of blind users            | This subtheme includes data related to participating learners' experiences of being unintentionally excluded from everyday services or activities related to computer use, (which are available to the rest of society) as a result of society's ignorance of the needs of blind users. | This subtheme excludes references that are not directly related to participating learners' views related to society's ignorance and exclusion of blind users from everyday computer services or activities (which are available to the rest of society). |
| 4.4.5 Limited exposure and awareness of assistive technology | This subtheme includes data related to participating learners' and their caregivers' being unfamiliar or unaware of or not exposed to specific types of assistive technology related to blind computer use.   | This subtheme excludes references that are not directly related to participating learners' and their caregivers' lack of knowledge and unawareness concerning specific assistive technologies related to blind computer use.                             |

#### 4.4.1 Subtheme 2.1: Financial implications

The first subtheme relates to participating learners' expression of the challenges they face in obtaining computers, assistive technology or training due to limited available funds on the part of their parents or training institutions.

Participating blind learners indicated the financial constraints related to devices or programs which could enhance their experience in computer use, as indicated by the following verbatim quotations:

*You get Braille displays but they are like one line. But they're one line ... But they could work. But the problem is they are very-very expensive* (Participant 1, Line 154–156).

*My dad has got this real tied up thing about money now so we can't go searching for ... yeah ...* (Participant 3, Line 410–414).

*... because the programming is expensive* (Focus Group, Participant 2, Line 595).

*Money, money as an obstacle* (Focus Group, Participant 1, Line 596).

The general consensus among participants was that the better the assistive technology (computers, tablets, cell phones, software or hardware) is, the more expensive it would be and the fewer blind users able to gain access to it would be. The following verbatim quotations act as supportive evidence in this regard:

*Last time I saw one it was like R30 000 that was a while ago so it's probably a bit cheaper by now, but still ...* (Participant 1, Line 158–159).

*Well, I'm not sure because when I first started using computers I started using JAWS but then, because JAWS was such a rare commodity and because it was so expensive I then migrated to the narrator, which is a common feature of Windows XP accessibility whatever* (Participant 3, Line 484–488).

Two of the participating learners resorted to software piracy as a means to bridge their financial barriers, as indicated in the verbatim quotations below:

*That's why we all copy stuff illegally. We work with JAWS anyway, so we have to do it with JAWS. So then we can't really have a problem there, because everything else* (Focus Group, Participant 1, Line 598–601).

*Thirteen. Poor buggers still haven't found a crack for that hey ... Nah, I'm not bothered till I get a crack<sup>33</sup>* (Participant 3, Line 271–274).

<sup>33</sup> *Cracking* is a slang term used by software pirates to define the process of software manipulation necessary to illegally bypass or modify built in program security measures and activate stolen software.

One of the participants voiced frustration, as he is financially less capable of affording commercial assistive technology than his more fortunate peers:

*I mean, it's gonna make life harder for them if they waste 10 grand on a good program. I mean it's good, don't get me wrong, but 10 grand is a truckload of money, and you can use it for other things (Participant 3, Line 528–532).*

Participating learners also made use of "less powerful" freeware<sup>34</sup> and open source<sup>35</sup> programs as well as Windows' native accessibility options to gain access to documents, programs and the World Wide Web, as affirmed in the following quotes:

*I then migrated to the narrator, which is a common feature of Windows XP accessibility whatever. I became good at that, you know relatively ... And then I moved from narrator to Thunder<sup>36</sup> which, mmm, wasn't that much better – although it did read Microsoft Word which Narrator doesn't. And then I went into JAWS and even though it was "40 minute mode" it was still plenty better (Participant 3, Line 486–495).*

*Yes, NVDA. That's what I use most of the time, it's free and it's completely free but, it's limited ... (Participant 1, Line 211–214).*

*And there's also some antivirus programs that NVDA can't work with (Participant 1, Line 227–228).*

Due to high financial costs and a limited budget for computer development, the school where the research was conducted did not have the most up-to-date computer software, as indicated in the verbatim quotation below from the researcher's journal:

*The CAT teacher seemed to be knowledgeable of her subject area, yet I picked up that there was a limited amount of funds available to the school. They used older versions of JAWS and Windows, and no one, save for participant three, had ever heard of a program called J-Say (Research Journal 2012-08-21).*

Only one participant was aware of the potential that combination assistive platform software such as J-say Pro<sup>37</sup> could offer.

*Yeah, I do, but I can't really sit around and train the thing because I don't have J-Say (Participant 3, Line 440–443).*

For such specialised software to be used effectively, a fair amount of training is required. Training fees and the cost of mobility (getting to the training facility) also need to be taken

<sup>34</sup> Freeware software is available free of charge.

<sup>35</sup> Open-source software is available free of charge with the added option of modification rights under copyright of the original owner to other developers or the public.

<sup>36</sup> Thunder is a free screen reader.

<sup>37</sup> J-say Pro combines Jaws and Dragon NaturallySpeaking (a text to speech and speech to text engine) to effectively replace typing and reading with speaking and listening. These programs are very expensive. Professional versions have to be bought separately and are somewhat scarce.

into account since blind people are limited to public transport or the assistance of friends and family because, as the following verbatim quote suggests, they are unable to drive:

*I think something that would be a very great invention is if they invent a computer that could drive a car for you (Focus Group, Participant 1, Line 915–916).*

*Ja! Doesn't something like that exist? Right now there's no possible way for us to drive (Focus Group, Participant 1, Line 918).*

#### 4.4.2 Subtheme 2.2: Technological access

According to accounts from participants, technological access can be divided into two main categories, namely physical access and virtual access. Physical access implies a person's access to a device (in this case a computer or cell phone), and virtual access implies access to the virtual domain (web content/program/onscreen area) reached via the device. It is important to note that although physical access and virtual access are separate concepts, the lines between these two concepts were often blurred by participants' perceptions of reality and similarities in the nature of access difficulties. The following verbatim quotes attest to the enmeshed realities that participating learners' experience:

*It fulfils my "more getaway" side, cause a computer to me is the world away from this world, you know, it's the world away from reality. It's why I hold so much stock in what I do with it and, yeah, it's probably one of my most prized possessions (Participant 3, Line 165–168).*

*Umm, It means a lot, a computer ... If I had a laptop, personally, it would be my life. Just like my phone (Participant 2, Line 81–82).*

From a constructionist perspective, it was equally important to gauge both the physical abilities and identify the mental map according to which the blind learners constructed their perceptions of reality. This is important because computers create an additional "artificial reality", or level of abstraction, according to which new access parameters are gauged. Upon closer consideration of participants' perception of reality, it was evident that the general population's perception of their physical reality is situationally more expanded than that of the blind participants. This is partly due to the added perceptual range and continuous feedback that vision provides. The average sighted person's spatial awareness is drastically superior to that of a blind person. Participants find navigation (physical access) in an unfamiliar setting to be a daunting, sometimes frightening task, as the verbatim quotations below confirm:

*Crowded places make us uneasy because you, we feel comfortable in the school because we know it. We know where everything leads so we can move around in it. If you are at a new place and it's*

*crowded, it's just confusing. All the noise, and you have no idea what's going on (Focus Group, Participant 1, Line 890–894).*

*I mean, like the crushing pressing people – it's intimidating. But then you also got these, like real ... The tension, there's like real tension in there because it's thick in the air (Focus Group, Participant 3, Line 897–899).*

*You keep walking into people and knocking stuff over (Focus Group, Participant 1, Line 900).*

The following account also reminds us that the perceptions and conceptualisations of visually impaired learners are slightly different to that of a sighted person. This particular participant describes how his visualisation of Excel (a virtual environment) helped him overcome navigation barriers:

*Well, you know, to actually ... This is kind of a weird thing for me because, um ... I was working on Excel the one Friday and that was a weekend I actually had a fever. So um as a sort of hallucination this whole spreadsheet was running around my head. So, I get these blocks, ja, in my head, I can figure out what's going on (Participant 3, Line 79–84).*

#### **4.4.2.1 Category 1: Physical access**

This category refers to challenges experienced by participating learners regarding physical access to devices and programs. Logically, physical access forms the first accessibility barrier, as learners cannot use devices that they don't have access to.

The socio-economic circumstances of certain learners do not allow them the benefit of access to a personal computer at home. Not having physical access to a computer hinders their ability to do computer-related homework or engage in computer communication or recreational activities, as is evident in the following verbatim quotations:

*And there is no computer at home. So, if I want to use a computer, I have to go to those internet cafes, and you pay for the amount of time, and when the time is passed, you have to leave – no matter what you are busy with or something (Participant 4, Line 225–228).*

*If I had access to the computer at a young age, they'd given me just, say Grade 4. It would be much more easier. Or rather, it would have been much more faster. So, it would have been quicker learning it (Participant 4, Line 292–295).*

*Well, if you don't have one at home – that's probably one of the biggest problems (Focus Group, Participant 1, Line 591–592).*

From the following accounts by participants, having a computer at home without having the necessary assistive programs<sup>38</sup> also appear to result in denial of access or severely limited access:

*Okay, at home I don't have JAWS so I can't really use the computer (Participant 2, Line 151–152).*

*No, it's not, because the programming is expensive (Focus Group, Participant 2, Line 595).*

According to the participants' accounts, the complexity of a device appears to increase proportional to the level of abstraction and or the level of visual complexity. Learners who were less competent displayed more resistance to change as the following verbatim quotations attest:

*For me it's quite difficult because, the more they improve, they make it to be those touch screens and those stuff. So, I can't work with that. If I had to work with that it would take me like the whole day to do just a small thing (Participant 4, Line 256–259).*

*Um, they say it works fine it just apparently takes a bit of getting used to the touch screen and like, the touch typing with the keyboard. But it sounds further that it seems to work fine (Participant 1, Line 363–365).*

From the above accounts, it becomes evident that a basic computer setup without the proper software or internet access provides a limited user experience for blind users.

#### **4.4.2.2 Category 2: Virtual access**

This category refers to difficulties experienced by participants when accessing the abstractions of software developers' conceptualisations of physical reality on an interfacing device. Although computer and software developers have created devices of tremendous complexity, one should always bear in mind that, at the origin, the presence or absence of impulses are used to create binary code represented as 0 and 1. Even though modern computers are often said to have personalities or wills of their own, any persona ascribed is in fact only a combined, projected personification of their creators and users.

Accounts by participants highlighted the central role that keyboard shortcuts (e.g. "ctrl + c") play in proficient computer use and navigation. It also became evident that the users' virtual

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<sup>38</sup> Though computer programs are represented virtually on an interfacing device, such programmes also have a physical existence in our world, even if the data is stored as a series of electrical charges on a micro-chip. In this instance reference is made to gaining access to the physical program – often determined by financial capabilities or awareness of the intended user group.



access skills were greatly influenced by their repertoire of shortcuts, as shared in the following excerpt from a focus group discussion:

*There are a lot of shortcuts that you have to remember (Focus Group, Participant 1, Line 389).*

*And there's a lot of patience there as well (Focus Group, Participant 3, Line 390).*

*To start on a basic note, like in Excel. You can't just highlight the column. You have to press "ctrl-space", I always get confused, "ctrl space" and "shift-space". One selects the column and one selects the row (Focus Group, Participant 1, Line 394–397).*

Participants further shared their views on the Graphical User Interface<sup>39</sup> (GUI) as a link between program and user. As the following quotes suggest, participants felt that operating systems were not primarily developed with blind accessibility in mind – some even suggested a correlation between accessibility issues and technological advancements:

*The people who make the operating systems don't really take accessibility into consideration – they don't usually anyway, they make it a bit harder sometimes (Participant 1, Line 349–352).*

*Well, accessibility does sort of seem to decrease the more advanced the technology gets. Like with Windows. Windows XP was the most accessible while Vista was worse, and in Windows 7 it's a bit more difficult than Vista. And then, I don't know about Windows 8 but apparently it's very difficult to work (Participant 1, Line 316–320).*

Program user interfaces primarily appear to have a neat logical layout, yet cross-screen navigation in combination with multilevel navigation (e.g. the hierarchy of links in MS Office ribbons) provides a non-visual user with many challenges, as supported by the following verbatim account from a participant:

*It's just all these ribbon menus, trying to remember where everything is and then you have to do everything to the letter because if you got like a 11-step process, you know if you want to change something and you just miss one little detail and the whole thing comes crashing down and you really bugger up the document (Participant 3, Line 42–47).*

Participants also found that graphics that conform to mainstream perceptual organisation intended to be visually organised or pleasing, fell outside their scope of perceptual awareness. The following verbatim quotations illustrate the limitations of visual design to the blind community.

*It's just with Word, if you have to do things like fonts and word art and stuff. I can do it but I can't really see the result of it so I, don't know if it actually worked like it should (Participant 1, Line 127–129).*

<sup>39</sup> Interface making use of visual graphics in the form of icons, boxes or buttons for navigation and alterations in the operating system.

*... It can't really, you know, they've made like with OCR<sup>40</sup>, it's improving but it still can't really help you with pictures and, so visual stuff is still difficult ... (Participant 1, Line 207–209).*

These visual design barriers in combination with the software glitches and incompatibilities often experienced with a screen reader, could potentially result in an extremely difficult user experience for blind learners.

Blind computer users experience challenges whilst browsing the web, which are similar in nature to those linked to program accessibility. Software compatibility<sup>41</sup> is reliant on source code<sup>42</sup> and application software<sup>43</sup> in the web pages. The multitude of advertisements in combination with Flash media and the poly-embedded structure of a web page complicates non-visual navigation. This is reflected in the following verbatim quotes:

*Usually the teacher that teaches us computer tells us to go to and read IOL news or News 24 or something, some stuff you do get but some, aa, no ... Yes, it just reads the stuff. I don't know how does it choose it (Participant 4, Line 51–55).*

*Sometimes it just can't tell you some stuff. Like maybe, let's say you wanna read some stuff on Facebook, like on someone's wall or something. It's gonna tell you some other stuff that you don't want to hear (Participant 4, Line 91–94).*

*Yes, they have a mobile site, which is an HTML only site because the regular one is a bit difficult to work. Not impossible but difficult (Participant 1, Line 303–306).*

*Ja, viewer websites. Usually they have, they call it HTML-only website because it doesn't have all that extra flash and dynamic content all that stuff and that's the more accessible one (Participant 1, Line 354–356).*

Participating learners found complex mathematical equations impractically difficult to represent on a computer (e.g. "Insert + equation" found in the MS Word ribbon menu). The navigation inside the equation itself seems to prove difficult because they have no tactile (sighted) frame of reference from whence to approach the equation, as is evident in the following verbatim quotation:

*Ja. There are a few areas like maths and physics where it might not really work that well because you need to see the ... Like, if you have an equation you have to be able to see it. It wouldn't really work if you just hear it on a computer (Participant 1, Line 149–152).*

<sup>40</sup> Optical character recognition (OCR) refers to software designed to recognise images of text and digitise the content to produce manipulable digital text.

<sup>41</sup> Software compatibility is a term used to define the effective functioning of a program in combination with other programs.

<sup>42</sup> Source code is a term used to describe human readable computer language.

<sup>43</sup> Application software or programs purposed at helping users perform tasks or activities.

In some instances the text to speech engine fails or a program error occurs. If a learner does not wish to do a full reset and start over, their access is often dependent on the aid of a sighted person. This is also the case where the mouse has to be used for precision dragging and dropping or clicking. The following are corroborating accounts by participants:

*It does help if sometimes the computer just stops talking and then you need someone to tell you what's going on (Participant 1, Line 199–201).*

*Excel is okay, but there are some places where it just doesn't talk, like some icons that shows on the screen but JAWS just won't tell you (Participant 2, Line 71–73).*

*It just stops talking, in some programs and it doesn't tell you ... like in Excel, yesterday we were doing this thing in Excel. And then ... There's an icon, the "Fill" icon. We had to ask Mam to do it for us. We can't do it ourselves because JAWS doesn't ... (Participant 2, Line 121–124).*

It therefore seems that virtual access, in part due to its predominantly visually organised nature, provides blind users with an additional array of barriers that are similar in nature yet differing in magnitude in accordance with the individual and situation. In order for blind virtual computer access to be successful, it is paramount that an auditory (text to speech) or tactual (text to Braille screen) link be maintained.

#### **4.4.3 Sub theme 2.3: Time-consuming process**

The participating learners indicated that it was time-consuming to navigate to where they wanted to start working, as indicated by the following verbatim transcripts:

*A minute ... Or two ... No, it's not fast in responding (Participant 2, Line 276–284).*

*Sometimes it's just slow when it's on the internet. It takes time to open things like when ... I mean Google and everything (Participant 2, Line 309–310).*

Participating learners commented on the fact that a screen reader takes longer to read a section out loud, than a person reading silently, therefore reading takes up more of their time. In the accounts that follow, participants expressed difficulties about rereading longer pieces or reading across different documents:

*... and the time that we have here isn't enough for, if you use JAWS. Because you might end up not doing exactly what you went there to do (Participant 4, Line 95–97).*

*Let's say it's reading something really long to you. When there is something that you don't understand, it's hard for you to get back to that word or something. Because it's just reading through. If you wanna go back, it's gonna go to the top and read from there, till where you wanted to go*

(Participant 4, Line 205–211).

*The one thing that is annoying though is when you are doing something in Word and you must obviously open the paper in Word. So, they give you the instruction. Then you go into a dialogue box, but then you can't really remember, but when you are in the dialogue, you can't read the document. You can't read any of the documents (Focus Group, Participant 1, Line 369–374).*

Some of the participants, though declared legally blind<sup>44</sup>, still had a small amount of vision and would resort to using special magnifying glasses in an attempt to read from a screen. Unfortunately, due to their severely limited eye span (1–4 letters) it would take them much longer than a sighted person to read. The following quotes substantiate participating learners' feelings in this regard:

*How long does it take you to read with a magnifying glass? Tjoe! Very long (Participant 2, Line 95–96).*

*Here at school, I think it's the same thing, because it is just for an hour that you get to do the stuff. Mainly, I just ask some people to help me with the research because it's quite difficult doing research ... Time! (Participant 4, Line 228–233).*

*Maybe two or three. And just imagine, there's a lot of letters that you have to go through when doing research to find the one that you are looking for. So, it's difficult (Participant 4, Line 228–237).*

*No, I normally enlarge the print. I don't use JAWS with Facebook ... Yes Sir. It takes long (Participant 4, Line 85–89).*

According to participating learners, special needs educators are often strained or unable to attend to all their learners' needs. Classes are reliant on the aid of a single educator who sometimes has to re-explain work to blind learners in a combined class, resulting in a longer tuition time and decreased time to work in class. The following verbatim quotation acts as supportive evidence in this regard:

*Because, for example with the Braille. Like in maths, for example, Mr X shows the sighted people the diagrams on the screen and then afterwards he shows me them, and he explains it to me separately because I can't really see them ... Yeah, things like that –because we're also smaller classes. In a big class you're not really ... Then you're just a number (Focus Group, Participant 1, Line 850–858).*

Even though the school has computers, participants expressed a need for longer access to the computers, which, according to them, were not available long enough to accommodate

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<sup>44</sup>To be declared legally blind: There is a global agreement that a person with 6/60 or less than 20° field of vision, with correction, be declared blind as a guide for service provision and the allocation of additional benefits.

all the prospective users in the limited amount of time that the computer laboratory was open, as is expressed in the following verbatim quotations:

*Um ... every day, but I have to do what Mam tells me to do and I only have three days, or four days a week of IT. It's not enough (Participant 2, Line 153–156).*

*Here at the school it's mainly because some people want to do their homework and researching. So, if you don't get there immediately after school, if you miss like maybe, let me just say, ten minutes. When you go there it's already full (Participant 4, Line 116–122).*

#### 4.4.4 Subtheme 2.4: Society's ignorance of needs of blind users

In general, participating learners reported that the general public often treated blind learners differently and excluded them, because they were unaware of their needs and perceived them differently:

*When you stay with people, they get used to you. But the other ones who are far, nah ... They just treat you like ... different (Focus Group, Participant 4, Line 720–723).*

*Once we went to cut our hair, me and my brother. She, the person who cut my hair. She kept asking questions about me, but to my brother. She doesn't want to talk to me, she keeps asking him. Like, where does he go to school, what does he do. I'm sitting just there, why doesn't she ask me? (Focus Group, Participant 1, Line 724–729).*

Participating learners further indicated that parents or relatives often excluded them from activities which they deemed dangerous to their emotional or physical state. They were also excluded from situations where they could cause possible damage to possessions. The participants were of the opinion that as a result, they did not get similar learning opportunities as other children. The following verbatim accounts serve as evidence in this regard:

*Aaa, just let them be. Let them do whatever they want to do, because sometimes the people ... like, eish ... they don't allow you to do certain stuff. Like maybe making yourself some tea at home that's like, hai ... [rest of the group murmurs agreement]. They say you're gonna burn yourself and, ai, no–no–no (Focus Group, Participant 4, Line 753–760).*

*My parents don't let me do anything in the kitchen. ... I'm, I can go in there, I mean, they don't want me to make food or to do anything because they're either afraid I would hurt myself, or break things or waste food or, anything. They don't trust me with anything that costs money. ...It is annoying. It's annoying to not be able to do something when you want to do it. That's why I just drink water. It's so much easier. You just walk to the tap, take a glass and put water in it (Focus Group, Participant 1, Line 770–780).*

In accordance with the way in which participating learners voiced their experience of being excluded by society, they felt that the gaming and entertainment industries did not dedicate a

lot of time or effort to the development of audio games for blind users. The following quotes illustrate participating learners' experiences in this regard:

*They are a bit behind –they are a lot behind actually, because you don't really get like big audio game companies (Participant 1, Line 44–46).*

*No, no, no, you move with arrow keys and there are sounds coming, you press the "space", and you shoot the poor bugger. ... You know, it's fine for about two minutes and then it gets kind of stupid (Participant 3, Line 153–156).*

From the above accounts, it becomes clear that blind learners often face additional challenges regarding access and experiential learning due to public and familial ignorance of the needs of the blind.

#### **4.4.5 Subtheme 2.5: Limited exposure and awareness of assistive technology**

Participating learners reported very few, if any, awareness campaigns regarding the use and benefits of assistive computer technology for educators, parents or users in South Africa. They also remarked that ignorance is a possible reason for non-implementation, as is evident from the following verbatim quotations:

*Well, probably not everyone knows about all the programs you get to make things more accessible and not everybody is really interested in learning to figure it out, it's not really that ... As easy as looking at the screen. You can't, you know, you have to figure out how to do things (Participant 1, Line 220–224).*

*No, I don't think so. The reason why I don't, is because that's all they know. They are brought up inside the little shell that they know ... It's the way they are (Focus Group, Participant 3, Line 618–623).*

*Never learning about them. Never being, you know, being exposed to them (Focus Group, Participant 1, Line 624–625).*

*It's sort of enforced mental block (Focus Group, Participant 3, Line 647).*

The following extract from the researcher's research journal further supports this theme:

*I noticed that JAWS was one of the main underlying themes and it became apparent to me that almost all blind computer activities' success were to some extent related to JAWS (read screen reader) proficiency. It might be beneficial to shift the focus in computer application technology so as to allow half of the emphasis to fall on JAWS training and practice and the other half on business oriented training in Word, Excel and Outlook. Effective reading strategies lead to increased learning. To blind computer users, JAWS is reading (Research Journal, 2012-08-25).*

In Theme 2, the participating learners highlighted barriers associated with blind computer use. It seems that financial barriers related to blind computer use also influence technological access to computers. A reported increase in time necessary to use computers, experienced as a result of slower navigation and reading, also creates significant barriers to effective computer use. Lastly, due to the small size and limited physical presence of the blind community, participating learners experienced that society is often ignorant of the needs of blind users. In the next theme, the researcher discusses possible future solutions of blind computer use, as voiced by the participating learners.

#### **4.5 THEME 3: POSSIBLE FUTURE SOLUTIONS FOR BLIND COMPUTER USE**

While the previous section highlighted some of the many difficulties that the participating learners experienced in blind computer use, it is also important to realise the potential that computers and other assistive devices grant the blind community.

The third theme focuses on addressing the third research question: What are the future solutions and possibilities of blind computer use for blind high-school learners? This theme reflects the participants' accounts and views of possible future solutions related to the use of computers for blind users.

Table 4.3 provides an outline of the inclusion and exclusion indicators for each of the subthemes.

Table 4.3: Inclusion and exclusion criteria for theme 3

| <b>Theme 3: POSSIBLE FUTURE SOLUTIONS FOR BLIND COMPUTER USE</b> |  |   |
|--|--|---|
| <b>Subthemes</b>   | <b>Inclusion indicators</b>  | <b>Exclusion indicators</b>   |
| 4.5.1 Practice makes perfect                                     | This subtheme includes data related to participating learners' accounts of computer proficiency, attained through an inquisitive approach and repetitive practice in learning computer skills. | This subtheme excludes references that are not directly related to participating learners' accounts of computer proficiency, attained through a willingness to explore and repetitive practice. |
| 4.5.2 Awareness and access among the blind                       | This subtheme includes data related to participating learners' suggestions to promote awareness or access to computers and assistive technology for blind users.                               | This subtheme excludes references that are not directly related to participating learners' suggestions to promote awareness or access to computers and assistive technology for blind users.    |
| 4.5.3 Awareness among developers and public                      | This subtheme includes data related to participating learners' direct or indirect references to the need for public awareness regarding blind computer use.                                    | This subtheme excludes references that are not related to participating learners' direct or indirect references to the need for public awareness regarding blind computer use.                  |



#### 4.5.1 Subtheme 3.1: Practice makes perfect

A strong underlying theme in all participant accounts was learnt competence and the accompanying increase in computer independence. Learners often mentioned instances where they were required to memorise key positions, shortcut keys, program layouts or process steps. Though this is certainly required of sighted users as well, the blind are significantly more reliant on memory. The following account from the researcher's research journal summarises his experience of participants' computer practice:

*I came to the realisation that blind learners have to do a tremendous amount of practising in order to be proficient computer users. The hierarchy of practice appeared to start off at the concrete level (learning to master the keyboard and using a screen reader) and moved to progressively abstract competencies [memorising program layouts and navigating the unfamiliar cyberspace] (Research Journal, 2012-08-25).*

Participants expressed curiosity and a willingness to learn, supported by tenacity and persistence when faced with challenges, which could facilitate the learning process when it comes to computer use for the blind. They also indicated that they often learnt to solve problems related to computer use independently, which resulted in a sense of empowerment and accomplishment, as indicated by the following verbatim transcripts:

*I didn't really know what I could do at that point. I didn't know what I can and can't do yet (Participant 1, Line 16–17).*

*It's not, I don't think it's [curious personality] required but it makes it easier (Participant 1, Line 194–195).*

*No, you got to learn on the fly, like there, there is little ridge and um, that's key 2. That's the exit is above that ridge there. So you've got to know that, you feel for the ridge quickly and then you just tap it there (Participant 3, Line 313–318).*

*If you just learn about it in school it's not really enough. If you do a lot of the stuff at home, you figure most of the stuff out yourself (Focus Group, Participant 1, Line 158–160).*

*Well, trying to sneakily download programs and stuff when I had to do research at the farm I used to live on got me quite good, so yeah (Participant 3, Line 194–196).*

The participants ascribed great value to experiential learning and felt that proficiency was part of a process of exploration and experience gained over time spent in engagement, supported by the following quotes:

*You have to be a person who is willing to work. So, if you are just a person who wants the short way through, it's not gonna be a good thing. You just have to go along with the process. Then, as you develop, then you can find those shortcuts (Participant 4, Line 348–351).*

*The thing is you get to know your laptop, you get a sort of symbiotic relationship with it, it sounds weird but it's actually true because you get to learn your computer's manners and it responds to you, I guess ... you can train it (Participant 3, Line 170–173).*

Participating learners were overtly positive and referred to the limitless possibilities that a computer with internet access grants them. Learners reported their vision of a functioning future as one tied to the continued use of a computer in the areas of work, home and social environments, as indicated below:

*The fact that you can do basically anything with it ... Cause with the internet there is so much you can do (Participant 1, Line 31–32).*

*The fact that everything is there, like everything (Participant 2, Line 290).*

*One day you might have your own computer with unlimited time. Hai, It's gonna be fine (Participant 4, Line 241–242).*

When asked about proficiency, or the mastery of certain computer skills, all participants shared their experiences with regard to computer practice. It became obvious that participants invested a great deal of time and effort into becoming proficient users. The following verbatim quotations act as supportive evidence in this regard:

*From Grade 4. We started learning it in school. Like, the keyboard and all that stuff. I really can't remember but somewhere, like in from Grade 4 to 6, somewhere along the line ... Yeah, I started figuring it out (Participant 1, Line 23–28).*

*Not really, I believe that it needs a lot of practice. You need to practice a lot (Focus Group, Participant 2, Line 133–134).*

There was also consensus among participating learners that additional time should be spent learning to use JAWS if a person wanted to become a proficient or advanced user, as is evident in the following verbatim quotations:

*Yes, if you spend more time with it. Maybe if you do, just like they said, if you do have it at home. Then, ja, it's much more easier. Cause you're gonna to train more and, yeah (Focus Group, Participant 4, Line 248–250).*

*If you just learn about it in school it's not really enough. If you do a lot of the stuff at home, you figure most of the stuff out yourself (Focus Group, Participant 1, Line 158–160).*

Although the participating learners regarded themselves as computer literate, they indicated that there were still some additional computer skills they wanted to acquire or improve on in

order to make them even more competent blind computer users. The following quotes illustrate a few examples:

*Just probably also a few things in office ... Like PowerPoint especially. Just, because it's hard to learn it by yourself. But if someone shows you what to do in a ... then you can remember it (Focus Group, Participant 1, Line 473–476).*

*Um, I'd really like to learn, not how to write programs as a whole but at least to customise it. But an easier way to customise programs without tearing a lot of glitches. ... And then also um, I suppose as well, with the Microsoft products (Focus Group, Participant 3, Line 427–432).*

Contrary to the sighted population, who can use their eyes to deduce whether their actions in a program are yielding the desired results, participating learners reported that they are to a large extent "blind" to changes they make in programs. This, according to them, means that they have to actually memorise the steps necessary in order to achieve a certain action. The following accounts from participating learners affirm the necessity for practice:

*... so then you have to remember the instructions, basically. Like, set the margin to 3.1. Then you have to remember that (Focus Group, Participant 1, Line 377–379).*

*And it [referring to the mastery of Computer Application Technology] requires a lot of patience (Focus Group, Participant 3, Line 384).*

*And a lot of practice [referring to CAT] (Focus Group, Participant 2, Line 386).*

*But that's not the point, the point is there's a lot more that you got to remember because as well as Word, Excel you've got to be precise in what you wanna do, what action you wanna take (Participant 3, Line 53–56).*

*I'm getting used to it more, because, at first, yo. I just heard those, and there and there but some stuff they just. I heard it but it just doesn't go into the head cause it's too fast. Now it's getting better (Participant 4, Line 250–252).*

#### **4.5.2 Subtheme 3.2: Awareness and access among the blind**

Although there are various support groups on the internet for blind people, it appeared that the majority of participants did not contribute to, or make excessive use of this underutilised resource, as reflected in the following quotes:

*I think, like I said they should maybe join groups, websites, newsletters you know that kind of thing ... Awareness, that's right (Participant 3, Line 636–639).*

*I should actually contribute, you know to actually mean something to the whole blind community (Participant 3, Line 640–643).*

By comparing current resources to the participants' awareness of different assistive programmes and devices it became evident that they were only aware of a small percentage of the software technology designed to enable them in computer use. Only twelve examples were given (eight of which came from Participant 3) for all categories of assistive software<sup>45</sup>. Participating learners' focused more specifically on what they used in school or shared with friends, and awareness appeared to be need-related (they only knew about assistive technology that they thought necessary or beneficial to them), as evident in the following group attempt to name assistive programs:

NVDA (Focus Group, Participant 3, Line 19).

*Magic*<sup>46</sup> (Focus Group, Participant 1, Line 20).

*Zoomtext*<sup>47</sup> (Focus Group, Participant 2, Line 23).

*Yoh, there is no one left* (Focus Group, Participant 4, Line 24).

#### 4.5.3 Subtheme 3.3: Awareness among developers and public

Although few, if any, direct references were made to public awareness, the need surfaced when the participating learners shared their experiences of the "outside world" and dealings with strange people or places. However, quite a few references were made to a need for awareness among developers. Evidence of both instances became evident in the following verbatim quotations.

*Because blind people forms like, it's a small community – some people are generally not really aware of them* (blind people) (Focus Group, Participant 1, Line 872–873).

*I think, like I said they (developers) should maybe join groups, websites, newsletters you know that kind of thing* (Participant 3, Line 636–637).

During the focus group interview, the participants expressed their gratitude toward their educators' and friends' empathy and how this facilitated the necessary positive collaborative learning environment. From the verbatim quotes below, it appears that being in touch and aware of one's community is a very important type of awareness:

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<sup>45</sup> There are at least ten different commercial assistive software companies, each with various software products covering different categories or areas of assistance.

<sup>46</sup> Magic is a screen magnification software that facilitates the manipulation of colour, size and in some instances formatting of screen content. It also has limited screen reader capabilities and is mostly used by individuals with low vision.

<sup>47</sup> Similar to Magic.

*The bubble thing. Umm, I wouldn't say it's wrong, in school. I mean, we're surrounded by blind people and then after that we just go to the outside world. It's just so sudden (Focus Group, Participant 2, Line 824–826).*

*I think the best way to describe it is to call it a fortified school of blindness (Focus Group, Participant 3, Line 838–839).*

*The thing is, you sort of need it because if you're in a regular mainstream school you are not really going to be able to keep up (Focus Group, Participant 1, Line 842–844).*

*I'm so glad you guys are blind because you don't look at me weirdly when I talk about stuff like this (Focus Group, Participant 3, Line 877–878).*

*We listen to you weirdly (Focus Group, Participant 1, Line 879).*

Although the participants seemed appreciative of the current level of technology available to blind users, they offered suggestions to improve blind computer use and contribute to enablement of their community:

*I think something that would be a very great invention is if they invent a computer that could drive a car for you (Focus Group, Participant 1, Line 915–916).*

*It could. I suppose if you had like raised touch screen keys. Does that make sense? Like little raised beads that you touch, then I'm sure that'll work (Participant 3, Line 330–334).*

*You know what, one thing that will also be cool to operate the laptop or computer, is a remote (Participant 3, Line 430–431).*

*Um, OK I know JAWS has some, I don't know what they call it, oxy-something, where it explains the picture to you, but apparently if the pictures too colourful, with a lot of colours it can't really tell it properly (Participant 2, Line 504–509).*

*Well there is still, I guess there's a lot that can still be improved. Like screen readers need to keep being changed and updated to keep up with new computer operating systems (Participant 1, Line 347–349).*

Judging from accounts by participating learners, it seems that the majority were only aware of a small percentage of the software available. Participants reaffirmed that they regarded screen readers to be among the most important software necessary for their successful computer use.

In summary, Theme 3 highlighted participating learners' sense of hope and purpose towards being successful and independent blind computer users. They voiced steady growth in competence in computer use. However, they indicated that awareness and access among the blind and awareness among the general public and developers were potential future solutions for more effective blind computer use.

## 4.6 CONCLUSION

An overview of the experiences of participants under the three main themes suggests a balanced user experience. Participating learners described the value of computer use, the barriers experienced related to blind computer use as well as future possibilities for more effective computer use for the blind.

Participants' accounts suggest that they found the connectedness to the "normal" world and increased academic empowerment that computers afforded to be of great value. When in need of distraction or recreation, participants commended the versatility offered by the plethora of computer entertainment.

Participating learners also shared challenges they experienced due to financial implications or limited access to technological devices. The need for additional time due to the limiting reading capabilities of screen readers proved to be an additional challenge. Society's ignorance of the needs of blind users coupled with blind users' limited exposure and awareness of assistive technology further complicated computer use.

Participating learners were evidently hopeful of future solutions, diligent in practice, and patient regarding experiential learning. They were of the opinion that awareness campaigns among the blind and public could also prove beneficial to effective blind computer use.

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## **CHAPTER 5: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

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### **5.1 INTRODUCTION**

In Chapter 4, the researcher gave voice to blind high-school learners' experiences of computer use. Chapter 5 discusses the results outlined in the previous chapter. Findings are juxtaposed with current and past trends in literature and new theoretical postulations are made. The primary research question and secondary research questions are answered. Lastly, limitations are outlined and recommendations for practice, training and future research are made.

### **5.2 LITERATURE CONTROL: POSITIONING FINDINGS WITHIN EXISTING LITERATURE**

In the next section, the researcher positions the findings from the current study within existing literature. He highlights confirmation and contradictions of findings as well as silences in current literature. This section is structured according to the themes and subthemes presented in chapter 4.

#### **5.2.1 Theme 1: Value of blind computer use**

Aligned with the views of participants in the current study, various enquiries across the globe into blind computer use are in agreement regarding the beneficial aspects of computer use to both users and society (Alves *et al.*, 2009; Gerber, 2003). Consensus was reached regarding increased independence, autonomy and an empowered lifestyle (Shane *et al.*, 2012). Many participants who use computers reported them to be useful to a lesser or greater extent (Gerber, 2003; Kajee, 2010; Mokiwa & Phasha, 2012), and all participants in the current study placed great value on their use. The following is a discussion of the four subthemes that surfaced under the value of computer use (theme 1).

### 5.2.1.1 Subtheme 1.2: Connectedness to the "normal" world

Participants' accounts in the current study suggested that they found the connectedness to the "normal" world and increased academic empowerment that computers afford to be of great value. Participants reported that they were able to merge with the general population and freely fulfil societal roles and tasks through the use of computers.

In reviewing existing literature, it seems that being connected to one's peers, friends and family members and being socially included is paramount to the healthy development of blind high-school learners (Roe, 2008). In confirmation, a significant portion of the participants' recreational activities comprised communication with friends and family members. The two most popular forms of digital communication found in the literature was instant messaging on cell phones or social networking on either cell phones or computers (Shinohara & Tenenberg, 2009; Bengisu, 2010). Both participants in the current study and those reported in the literature agreed to the fact that computers and cell phones played (and still play) a paramount role in abolishing the social isolation that was previously experienced by visually impaired individuals (Gerber, 2003).

Though mention of portable assistive software was made by the participating blind learners in the current study, they did not mention successful or regular implementation of this software. The literature reviewed echoed this silence and the researcher has not yet found an example of a blind learner using portable accessibility software to independently access a computer other than their own. Investigators in most studies made arrangements for software to be installed (Kajee, 2010) or prepared laboratories to aid participants during their investigation (Armstrong, 2010). It appears that in the majority of cases, access remains limited to personal or preconfigured devices. Further investigation is necessary to determine whether awareness, compatibility issues, usability issues or some other factors could contribute to non-use of portable assistive software.

Participants in the current study were silent about the experience of social exclusion from play activities – quite likely because they were in a school for visually impaired learners. Khadka *et al.*, (2012) report that blind learners are often excluded from social activities because they encounter difficulties playing along with sighted children. Multiplayer online gaming and virtual worlds, such as Second Life<sup>48</sup>, merit additional investigation (Smith, 2011), as these game-related modalities spill over to the corporate and educational sectors. In accordance with the above, a contradiction is noted in the learning environment of participants in the current study

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<sup>48</sup> Second Life is a vast online three-dimensional virtual world where users are able to create avatars through which they then explore, interact with, socialise, and create and/or trade virtual merchandise, services or property with other users.



as opposed to participants at other tertiary institutions (Kajee, 2010; Kasiram & Subrayen, 2013). Kasiram and Subrayen (2013) also found that blind learners or students in mainstream institutions report feelings of isolation and social exclusion. On the other hand, participants in the current study reported feeling included and accepted. It therefore appears that the experiencing of peer discrimination and isolation could possibly be linked to "mainstreaming", limited access and awareness. It seems that the wider community could feel uncomfortable or uncertain when it comes to interacting with the blind as reported by participants from other studies (Kajee, 2010; Shinohara & Tenenberg, 2009).

### **5.2.1.2 Subtheme 2.2: Academic support**

It became apparent that participating learners in the current study found value in the use of computers for academic purposes, such as completing their homework projects and assignments, and used them whenever possible. Existing literature is in agreement with findings from the current study. Computers are generally considered to be a very valuable tool with which visually impaired users are able to independently complete their academic work (Kajee, 2010; Gerber, 2003; Shinohara & Tenenberg, 2009). Computers have significantly improved the younger generation's ability to access electronic literature for educational purposes (Rowland, 2008; Mokiwa & Phasha, 2012). The younger blind generation seems to show an increased ability and willingness to access such literature (Rowland, 2008). Visually impaired participants from another study (Gerber, 2003) also reported their appreciation of digital access by comparing the old system of written books and libraries to a vastly more accessible internet.

Participants in the current study were silent about educators' minimal use of assistive technology as part of their everyday educational arsenal. Studies show that assistive technology is used to a lesser extent by educators teaching visually impaired learners in the United States (Flanagan, Bouck & Richardson, 2013; *Johnstone et al.*, 2009) and Brazil (Alves *et al.*, 2009). Safhi (2009), after conducting a global survey on educator training in assistive technology for the visually impaired, found that training programs differed in content, focus and depth and recommended the incorporation of a framework inclusive of instruction in assistive technology. Reasons provided for lack of implementation of computer assistive technology for visually impaired learners included a lack of funding, limited training and support (Alves *et al.*, 2009; Flanagan *et al.*, 2013). A possible explanation for the silence could be related to the following of old educational practices such as chalk and talk approaches by educators as opposed to interactive lessons.

### **5.2.1.3 Subtheme 1.3: Recreational purposes**

When in need of distraction or relaxation, participants commended the versatility offered by a plethora of computer entertainment and their ability to independently employ computers for recreational activities. An investigation into current literature proves congruent with the reports of participants in the current study regarding their choice of recreational activities. It became evident that blind learners share common recreational activities such as listening to music, reading books, playing audio games or watching videos (Khadka *et al.*, 2012; Somekh & Mavers, 2003). Current trends in literature support reading for pleasure as one of the main recreational activities favoured by blind learners (Spacey, Creaser & Hicks, 2013). Participants in the current study reported increased access to digital literature in the form of both e-books and audio books.

The value of crowdsourcing, where problems are solved by an online community of expert advisers (Shane *et al.*, 2012) to the visually disabled community was affirmed by a participant in the current study who found solace and answers among a group of like-minded, like-sighted individuals on Facebook.

Another recreational activity which participants from the current study had in common with visually impaired participants from other studies was the adoption of recreational writing (Gerber, 2003). It seems as if both blind and sighted participants appear to enjoy similar recreational activities (Khadka *et al.*, 2012).

Participants in the current study were silent regarding any online paid-for recreational activities. It appears that participants in the current study did not make use of online shopping, gaming or paid for entertainment subscriptions. Possible reasons could be attributed to exclusion from services due to the visual nature of digital marketing. Spacey *et al.*, (2003) found that only 20 percent of recreational literature is chosen amongst both blind and visually impaired participants as a result of advertising. Other possible reasons for this silence could be ascribed to parental control, an older population's unawareness of online shopping trends, limited finances of participating learners (or their parents) in the current study, and a possible fear of exploitation or making wrong decisions.

### **5.2.1.4 Subtheme 1.4: Enablement and agency**

Being independent proved important to participants in the current study. The participating learners experienced feelings of enablement, competence and agency as a result of computer use. In confirmation with results of the current study, the existing literature frequently highlights

an improvement in the quality of living for visually impaired computer users (Biswas & Robinson, 2011). van der Geest, van der Meij, and van Puffelen (2013) report that it is the strategic skills of blind users that allow them to increase their quality of living.

Participants in the current study reported confidence in the utilisation of JAWS for basic computer navigation and the assumption was made that successful basic training and sufficient navigational experience (Brophy & Craven, 2007) have empowered participants to become fairly competent navigators. Corresponding with capabilities of participants in other studies (Lazar *et al.*, 2007) who had the keyboard memorised and knew how to use JAWS, all participants in the current study reported complete mastery of the keyboard as interfacing device, which learners are required to memorise at a young age.

Though evaluated repeatedly in the literature (Armstrong, 2010; Kajee, 2010; Kouroupetroglou, Salamasis *et al.*, 2008), blind and visually impaired participants themselves and participants in the current study refrained from comparing their computer capabilities with those of sighted users. This could be ascribed to limited exposure to the sighted computer community or non-competitiveness. The latter would be difficult because assistive technology does not grant blind users equal access in relation to sighted users, which automatically places them at a disadvantage (Freeland *et al.*, 2010).

Existing literature is also in agreement with the findings of blind participants in the current study with regards to the amount of troubleshooting and problem-solving they are faced with on a daily basis (Lazar *et al.*, 2007). The latter include finding one's way through difficult layouts, or troubleshooting screen reader conflicts. Participants in the current study expressed increased patience and confidence in their skill as creative problem solvers. Similarly, the participant in Kajee's (2010) study maintained a positive attitude despite laborious tasks.

## **5.2.2 Theme 2: Barriers related to blind computer use**

In the next section, the researcher aligns the five subthemes that surfaced under the theme of barriers related to computer use with current literature.

### **5.2.2.1 Subtheme 2.1: Financial implications**

Participants in the current study reported that financial implications posed a significant barrier regarding procurement of technology needed to function independently. Access to devices, software and the World Wide Web were the most frequently listed challenges. In reviewing the current literature, it was found that constraints related to financial expenditures necessary for

technology and service procurement, as well as maintenance, proved to be one of the most common barriers to successful computer use by blind individuals (Brophy & Craven, 2007; Pilling, Barrett, Floyd & Joseph Rowntree Foundation, 2004).

Financial capability for successful procurement of the necessary technology was considered to be important at home and school by participants in the current study who had access to technology, as well as participants who did not. It would appear that access to technology in this instance improved awareness of devices and software that would further promote access. Other investigations also mentioned the limiting impact that a lack of funding has on the implementation of proper assistive technology (Brophy & Craven, 2007; Nam *et al.*, 2013). Even education facilities reported that the high cost of commercial software limited implementation of assistive technology (de Souza & de Freitas, 2012).

### **5.2.2.2 Subtheme 2.2: Technological access**

Technological access was discussed based on participants in the current study's challenge or inability to gain access respectively to both technological devices (physical access), and programs or the internet (virtual access).

In the United Kingdom, the Wired Up Communities Initiative<sup>49</sup> reported that just shy of 75% of people in disadvantaged communities used ICT technology they had received to access the internet, and 80% of these users continued to use the technology (Devins *et al.*, 2003). Most people with limited economic means that are aware of the potential of ICT consider it an invaluable tool. These findings are aligned with the comments from participants in the current study who did not own such devices despite the monumental value that access to such devices might hold for them. Aligned with existing literature, participants in the current study also reported that advanced navigation in and between both programs (Doush & Pontelli, 2012) and web pages (Lazar *et al.*, 2007) proved daunting and that the information was sometimes inaccessible to them.

#### **5.2.2.2.1 Category 1: Physical access**

In accordance with existing literature (Alves *et al.*, 2009; Mokiwa & Phasha, 2012), participants in the current study also mentioned that pedagogical practices remained rigid and that the employment of assistive technology in everyday education leaves vast room for improvement.

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<sup>49</sup> UK Government funded initiative to provide technology and online access, as well as training to successfully use technology and internet.

Even with access to high-tech reading solutions during tests and examinations, low-tech solutions are still preferred by assessors (Johnstone *et al.*, 2009). Alves *et al.*, (2009) and Mokiwa and Phasha (2012) suggest that proper training and awareness campaigns for educators may yield significant advancements in this respect.

A possible reason for resistance to change could be attributed to perceived usefulness (Nam *et al.*, 2013) fostered in a familiarity with the more labour-intensive, past-generation technologies. It appears that most educators fail to realise the advantages of the monumental shift (Shane *et al.*, 2012) in technology. Cloud computing<sup>50</sup>, networking, BYOD<sup>51</sup> and even e-learning seems to be misconstrued as services best left to "the IT department". A significant amount of educators' self-reported competency in assistive technology was found to be limited (Zhou *et al.*, 2012), an aspect that can only be rectified by intensive training (Kamei-Hannan *et al.*, 2012). Chigonaa *et al.*, (2009) propose that a more sustainable solution could be fostered following a bottom-up translation of needs, creating a need and awareness at institutional level and petitioning departmental, then district, then provincial and finally national support.

Current literature confirms that graphic (visual) materials still pose significant challenges to access for visually impaired participants (Armstrong, 2010; Kajee, 2010; Mokiwa & Phasha, 2012). Participants in the current study echoed the sentiments of others by remarking that the development of software applications that are able to describe and accessibly map digital images would be a significant improvement to access. Such descriptive software is likely to evolve from a combination of other technologies such as descriptive video software (Gagnon *et al.*, 2009).

Despite the rapid increase in technological advancements (Shane *et al.*, 2012), the need for flexible access to these technological devices remains (Kajee, 2010). New technology can only be empowering to blind people if alternative accessibility is incorporated in designs. Failure to do so results in exclusion of blind learners from technological devices (McNaughton *et al.*, 2012). Participants in the current study have mirrored the above sentiments with regards to touch-screen devices and the increasing movement toward visual-tactile operating systems, pointing out that they were new and unfamiliar. For people with deteriorating eyesight, it is paramount that they receive timely referrals and proper support to foster access and functioning (Thetford, Robinson, Knox, Mehta & Wong, 2011).

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<sup>50</sup> Cloud computing describes a process during which a computer or other high-tech device utilises a data connection to access the processing power of a more powerful computer or network of computers to increase productivity.

<sup>51</sup> BYOD or "bring your own device" signifies a current trend in e-learning where educational content is digitally accessible, dynamic and automatically adaptable to different devices, allowing users the freedom of choice and personalised learning.

The role of an accessibility expert or the need for one at school did not factor into participants in the current study's conceptualisation of computer use. Such an individual could potentially be tasked with the selection of accessible learning materials, training educators to use assistive technology effectively and in turn provide support to their learners (Asuncion *et al.*, 2010).

#### **5.2.2.2.2 Category 2: Virtual access**

The challenges that Lazar *et al.*, (2007) identified with regards to screen reader use were verified by participants in the current study. The top reported causes of frustration for participants in both studies were: poor page layout that results in confusing screen reading; screen reader and software conflicts; pictures without alt text; confusing links; inaccessible PDFs and screen reader crashes, which left them feeling stranded and powerless (dependent on others).

Participants in the current study nonetheless proved to be tenacious troubleshooters who, just like others reported on in existing literature (Lazar *et al.*, 2007), were reluctant to restart their computers to solve a problem, and rather displayed a willingness to find alternative solutions to problems. The researcher could not confirm with certainty the specific amount of time spent troubleshooting save for the deductions made from participants' repeated references to errors encountered. The latter seemed to confirm what Lazar *et al.*, (2007) and Kajee (2010) have mentioned regarding time spent troubleshooting whilst using a computer.

Participants in the current study were in agreement with the participant in Kajee's (2010) study regarding their disgust about the dependency and helplessness following a screen reader crash (Gerber, 2003). All participants in the current study confirmed findings in existing literature that screen reader crashes are confusing to blind participants, who often have to elicit the help of a nearby sighted person. The latter experience is considered disempowering and is disliked by blind users (Shinohara & Tenenberg, 2009).

A large percentage of South African websites are not accessible to blind users (Venter, 2005). Current web pages are also becoming less static and increasingly dynamic and interactive, complicating the blind user's task of keeping track of updates and changes whilst interacting with the site (Brown, Jay, Chen & Harper, 2011). Similarly, participants in the current study voiced their frustrations when asked to interact with dynamic social or news sites.

Participants in the current study reported the necessity of having printed equations when dealing with more difficult mathematical and physics problems to aid them in seeing the whole equation. This indicates a possible lack of proper virtual representation of complex equations

and is affirmed in the literature by Mokiwa and Phasha (2012), whose participant confirmed an electronic inaccessibility to mathematical equations and the need for brailled equations in order to do her work.

Blind participants in the current study did not appear to regard computer access difficulties as a common problem shared by all blind users, but thought of their access difficulties as isolated and specific to the individual. Gerber (2003) affirmed the above when she found that her participants did not view technological access difficulties as a collective (shared by many) systemic problem. Participants in the current study refrained from acknowledging shared or similar difficulties during individual interviews.

Akakandelwa and Munsanje (2012) reported a lack of teaching and learning materials having a negative effect on the education of visually impaired participants in Zambia. In considering the findings of Akakandelwa and Munsanje (2012), the researcher noted the contradiction in the level of access between South Africa and Zambia, as participants in the current study reported having moderate access to ICT and assistive technology at school. This contradiction can quite likely be attributed to the economic standing of a country, because South Africa's infrastructure seems to be more advanced. It also appears that South African infrastructure, in turn, is inferior to that of First World countries like Australia that are able to readily acquire the necessary assistive technology and employ teaching aids (Armstrong, 2010). Further investigation regarding access differences in First, Second and Third World countries might prove interesting.

### **5.2.2.3 Subtheme 2.3: Time-consuming process**

Often, the use of technology is a difficult and time-consuming process for the blind user. In a world that is visually organised, finding one's way as a blind person can sometimes take a little longer. Participants in the current study remarked that simple actions sometimes took up large amounts of their time. In accordance with this, the participant in Kajee's (2010) study reported that transcription of a 90-minute class usually took her about three hours. On average, blind computer users report losing 30,4% of their time resolving frustrating situations (Lazar *et al.*, 2007). In accordance with the above, participants in the current study reported having the computer laboratory open for only a limited amount of time prevented them from concluding their homework or research.

Rereading of difficult or missed concepts proved difficult for participants in the current study, who reported that they struggled to find the specific words or phrases and sometimes ended up jumping back to the beginning of a piece. Lazar *et al.*, (2007)'s participants also referred to these difficulties.

Participants in the current study further reported that they often had to wait their turn in combined classes before educators could re-explain complicated graphs or equations. This finding validates the findings of Alves *et al.*, (2009) and Mokiwa and Phasha (2012) regarding a lack of implementation of assistive technology to solve problems in everyday class situations. It could also be attributed to the fact that mathematics and science educators have not thought about the advantages of having learners bring their own devices for school work (Shane *et al.* 2012) .

If one theoretically compares virtual navigation to physical travel (Harper *et al.*, 2001), it can be deduced that physical and virtual navigation share coinciding barriers. Participants in the current study accordingly referred to the unease and tension they experienced when having to physically navigate an unknown, obstacle-filled terrain. These shared experiences regarding physical navigational difficulties could also provide the reader with a conception of the stress encountered during virtual navigation. The identification of barrier objects and provision of effective navigation strategies by blind experts (Brajnik *et al.*, 2011) could be a positive step towards fostering competence. Following a website design method that is structured as opposed to random could also significantly improve accessibility (Plessers *et al.*, 2005).

#### **5.2.2.4 Subtheme 2.4: Society's ignorance on needs of blind users**

The blind community is a small community, unfamiliar to many members of the general South African public. The small size of this community in combination with limited public awareness often creates and maintains barriers for the blind. Participants in the current study experienced that they were often unintentionally excluded from everyday services or activities related to computer use, which are available to the rest of society, because of society's ignorance of the needs of blind users.

Current studies confirm that disability groups are more likely to experience barriers to access due to societal ignorance and the concurrent exclusions (Brophy & Craven, 2007). Despite increased vigilance regarding accessibility improvements ("Web Content Accessibility Guidelines (WCAG) 2.0," n.d.), individuals are still experiencing challenges when accessing electronic content. As previously stated, interactions and socialisation in the digital or virtual world still take place from a human perspective. Hearing participants' accounts of being excluded or treated differently in public (Kajee, 2010; Mokiwa & Phasha, 2012) leads one to ask what percentage of online social inclusion experiences is authentic and human as opposed to



artificial or virtual, and whether it matters if feelings of inclusion are experienced through the personification of a virtual avatar<sup>52</sup> (Smith, 2011).

Participants in other studies (Kajee, 2010; Mokiwa & Phasha, 2012; Khadka *et al.* 2012) made references to "we" or "us" and "them", meaning blind and sighted. Participants were very aware of their status and some were embarrassed and wanted to be independent as opposed to being a burden to others. Confirmation of different treatment and participants' dislike of being excluded were made clear in current literature (Kajee, 2010; Kasiram & Subrayen, 2013). Whether for protection (Bruce, Harrow & Obolenskaya, 2007) or due to unfamiliarity, it appears that there is still significant room for inclusion of blind people in the physical world as well (Kasiram & Subrayen, 2013).

It appeared as if the concept of mentoring by older, successful and socially integrated blind people had not been yet been conceived by participants in the current study. Though family members can be supportive, the sighted cannot fully understand the essence of being blind. Armstrong (2010) realised this shortcoming and employed the use of educators who were blind with significant success to provide knowledgeable instruction and support to blind participants in an accessible electronic environment.

#### **5.2.2.5 Subtheme 2.5: Limited exposure and awareness of assistive technology**

Participants in the current study did not report regular exposure to new assistive technology. It appeared that they were only familiar with a handful of devices and software with the potential to improve their lives. Active implementation of assistive software appeared to be limited to computer and cell phone screen readers. Literature confirms the reasons for the limited awareness of available technologies and the features of such technologies, voiced by participants in the current study. Both reasons, according to participants in the current study, revolved around the lack of exposure and the possible coincidental awareness created (Douglas *et al.*, 2007). Participants reported their blind community to be isolated (Nam *et al.* 2013) if their caregivers, educators or peers were not exposed to assistive technology to the extent that value was realised. Even after fostering awareness, Alves (2009) reports that awareness is not enough and that educators and learners need to receive training and become competent for sustainable technology adoption. This leads one to agree with the views of Chigonaa *et al.*, (2009) regarding the establishment of agency at a baseline level followed by a relay of needs to key role-players. It therefore seems that the willingness to become aware appears to be the first step necessary for blind users to become computer competent.

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<sup>52</sup> Virtual customisable digital representation of a person.

It should be noted that participants in the current study were of high-school age and thus part of the so-called social and technological generation. Studies have shown that an increase in age group is accompanied by a decrease in the use of assistive technology (Douglas *et al.* 2007). Therefore, it is important to bear in mind that young and working blind people are more likely to use a computer (Cairns *et al.*, 2009), and that if they report feelings of exclusion and isolation, it may possibly be even more the case for older age groups.

Participants in the current study were silent in mentioning a need to read advertisements, identified by Gerber (2003) whose participants expressed excitement over the possibility of product information and the ability to become aware of and compare different types of merchandise. A possible reason for this silence is that present-day advertisements do reach the blind population. Another possible reason could be that participating learners are not so interested in merchandise advertisements due to financial constraints.

Another silence identified was that participants in the current study did not mention continued training in assistive technology. After receiving their initial typing and computer training, learners who wanted to continue working with computers could take CAT as an elective subject but the focus was reported to be more on mainstream curriculum work than on improved usage skills. Educators of visually impaired learners possibly do not have the incentive or sufficient time in a school day to effectively train learners to use assistive technology (Zhou *et al.* 2012). Younger educators are reported to be more confident when it comes to teaching the use of assistive technology (Zhou *et al.* 2012).

### **5.2.3 Theme 3: Possible solutions of blind computer use**

The researcher next aligns the three subthemes that reflect the participants' accounts and views of possible future solutions related to the use of computers for blind users, with the existing literature.

#### **5.2.3.1 Theme 3.1: Practice makes perfect**

Blind learners in the current study expressed the need for practice to gain competence in computer use. Existing literature states that the frequency with which blind users employ screen reading software increases in direct proportion to their training (Goudiras, Papadopoulos, Koutsoklenis, Papageorgiou & Stergiou, 2009), an observation that was echoed by the participants in the current study. That said, the participants in the current study admitted that they initially found it difficult to learn how to use a screen reader.

Empowerment and user satisfaction is described in literature as being determined by the frequency of screen reader use (Goudiras *et al.*, 2009). In confirmation, participants in the current study who were allowed access to home computers, and were able to practise more, reported feeling more confident using the software, and participants who did not have home access felt that they would benefit from additional practice.

### **5.2.3.2 Subtheme 3.2: Awareness and access among the blind**

Participating learners suggested that the promotion of awareness and access to computers and assistive technology among blind users could improve their computer independence. In alignment with literature (Pilling *et al.*, 2004), participants in the current study reported that having internet access allowed them to broaden their world perspective and stay informed. Their conceptualisation of the learning potential of the internet is best described as infinite.

Armstrong (2010) found that when provided with access to competent instructors and the right assistive technology, adult students who are visually impaired and have a basic knowledge of computers can attain similar results to sighted students in an IT networking course by utilising accessible e-learning materials. Participants in the current study voiced that they too were successful in following and passing a mainstream curriculum CAT.

Armstrong (2010) reported a significant increase in study time, corroborated by Kajee (2010), but noted that blind students seemed to have a better understanding of concepts and their physical application. Participants in the current study affirmed both findings by highlighting the significance of time necessary to practice and become competent as well as describing their ability to remember and successfully execute complex multi-staged procedures.

### **5.2.3.3 Subtheme 3.3: Awareness among developers and public**

Participants in the current study shared their views regarding the improvement of awareness among both members of the public and developers alike. Participants in the current study reaffirmed the fact that there was significant scope for improvements in assistive software development practices. Current literature confirms that collaborative design could improve initial conceptualisations of software (de Souza & de Freitas, 2012). It therefore seems that designing "with blind users" as opposed to "for blind users" might save time and money.

Despite identification of a need for improved awareness, participants in the current study were silent about the possible contribution they could make to advancements in assistive technology by participating in user trials such as those conducted by Biswas and Robinson (2011) and

Sodnik *et al.*, (2011). Though simulations are used to limit the need for user trials in the development of assistive technology, the semi-final and final products still require human trials (Brajnik *et al.*, 2011). Participants' silence about contact or correspondence with designers could possibly be indicative of the communication barrier that dampens the voice of the user and limits valuable input. An additional need for awareness pertaining to active participation in product reviews and making suggestions could be mutually beneficial to both developers and users.

The touch screens of tablets proved difficult to use by visually impaired students, and researchers who considered implementation abandoned them for more familiar tools (Armstrong, 2010). Participants in the current study also reported reservations regarding the successful use of touch screens and suggested possible improvements by adding texture reference points.

Participants in the current study also confirmed the value of social support found by participants from Bruce *et al.* (2007) and cherished the level of accommodation received at an institution catering specifically for their needs. They were appreciative of the social opportunity and level of empathy, understanding and acceptance from their friends. This confirms the value of the four goals listed by McNaughton *et al.* (2012) necessary for successful transition into adulthood, namely safety and support; participation in activities that are meaningful; open access to services; and, establishing intimate relationships and having friends.

### **5.3 INSIGHTS INTO THE EXPERIENCES OF BLIND HIGH-SCHOOL LEARNERS REGARDING COMPUTER USE**

In the following section, the researcher provides insight into the experiences of blind high-school learners regarding computer use. The researcher answers the main research question and three secondary questions, by referring to the different themes and subthemes reported in the current study. Figure 5.1 provides an outline of the themes and related research questions.

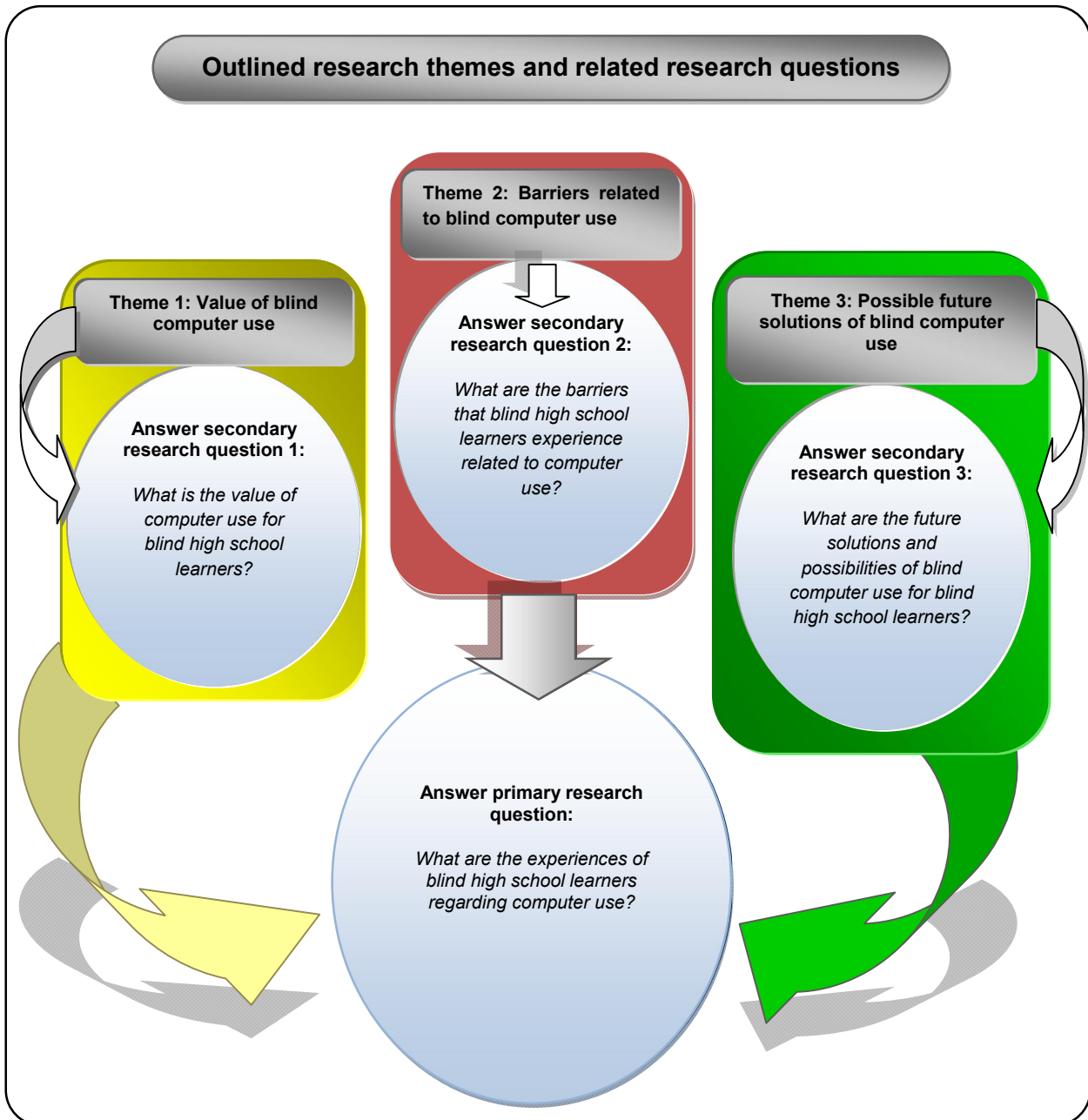


Figure 5.1: Outlined research themes and related research questions

### 5.3.1: Secondary research question 1: *What is the value of computer use for blind high-school learners?*

Blind high-school learners express the value of computer use as follows:

- Being connected means having the freedom to socialise at will and in doing so, breaking the barriers of isolation often associated with disability. Computers inspire a feeling of limitless potential.
- The ability to create and edit digital copies of homework or assignments in an environment which allows simultaneous access to the internet, and the capability to

send (or print) neat, legible copies of work, is held in high esteem. The ability to conduct both mandatory or personal research is highly valued.

- One has access to a centralised plethora of recreational activities such as socialising, reading, writing, gaming, watching movies or listening to music. Figure 5.2 illustrates the value that participants ascribed to different recreational activities.



Figure 5.2: Participants' reported recreational activities

- The value of blind computer use appears to increase in direct proportion to a rise in confidence and competence which originated in the initially introduced awareness, that was nurtured by practice, and appears to be maintained through sustained immersion.

### 5.3.2 Secondary research question 2: *What are the barriers that blind high-school learners experience related to computer use?*

Blind high-school learners describe barriers related to computer use as follows:

- The high cost of good computers, commercial software and internet services often proves to be a significant barrier at home, school and in the community.
- Not owning a computer or not being allowed access to a computer poses a significant physical barrier to blind computer use for high-school learners. Recent trends towards visual and tactual designs seem to be a barrier to blind computer use. The virtual digital environment is primarily designed for visual users and is often experienced by blind users as multi-layered and obstacle-ridden. Because most of this environment is

experienced through a screen reader, barriers are also experienced via the screen reader and sometimes erroneously ascribed to the screen reader. It therefore seems paramount to delineate that users experience virtual barriers as a result of three main categories, namely accessibility of the virtual environment, screen reader design and user competence. Without a means of accurate description, most images remain barriers to blind learners. Should a screen reader malfunction, users without Braille screens seem unable to interface with the computer.

- It takes longer to speed-read (listen) text with a screen reader than with the eyes. The latter, in combination with virtual barriers, make blind computer use more time-consuming for the average blind user.
- Societal exclusion of the blind, due to ignorance, is experienced by blind users in the digital and physical world.
- A limited exposure to and awareness of assistive technology forms a barrier between blind users and latent assets.

### **5.3.3 Secondary research question 3: *What are the future solutions and possibilities of blind computer use for blind high-school learners?***

Blind high-school learners propose the following future solutions and possibilities for blind computer use:

- Open access to a digital environment in combination with rigorous practice and a willingness to learn and explore appears to advance mastery and increase the perceived value of computers.
- A need for awareness of both the value of computer use and the different assistive technologies available to blind users respectively seems to be vital in improving blind computer use.
- A need for awareness of computer accessibility and inclusion of the blind among developers and the public seems to be vital in improving blind computer use.
- Transport automation, reference points on touch screens and image-to-speech software are possible ways to improve computer use amongst blind high-school learners.

### **5.3.4 Primary research question: *What are the experiences of blind high-school learners regarding computer use?***

Figure 5.3 provides a graphic presentation of the experiences of blind high-school learners regarding computer use. Blind high-school learners report feeling independent and empowered

with appropriate computer and assistive technology. They construct their social world according to insider and outsider groups, depicted in figure 5.3 as "us" and "them". They are aware that levels of accessibility differ among the sighted, visually impaired and blind. As stated previously, this difference in accessibility is also noticeable in most areas of blind computer use. Computers were found to be very valuable to blind users and, according to participants' accounts, not as valuable (latent asset) to blind non-users. Value in this instance appeared to be socially constructed, increasing with a rise in user confidence and competence.

Blind learners in the current study valued the ability that computers granted them to socialise freely, and be connected to their friends and family. All participants saw a limitless potential in ICT use. They also valued the flexibility and power that digital editing added to their homework and assignments. ICT has greatly simplified the task of conducting research for blind users. A single device grants access to a multitude of recreational activities such as socialising, reading, writing, gaming, watching movies or listening to music. Computers prove dynamically useful to blind users in a wide range of situations.

One of the greatest barriers to successful computer use among blind high-school learners seems to be limited financial resources, resulting in physical access barriers. Without a computer, there is no access to virtual, social or academic content. Even with a device and the correct assistive software, virtual barriers to accessibility such as complex and nonlinear program and web layouts, images without alt text and embedded content make computer use more difficult and time-consuming to blind users as opposed to sighted users. Using a screen reader takes longer than simply looking at a screen. Though regular updates are made to screen readers and other assistive software, the fluid digital environment challenges both software developers and users to stay current. A combination of perceived value, level of access and accessibility, determined by the financial status of users or benefactors, and user skills are responsible for the user experience. These three factors are influenced by barriers related to finances, access (both physical and virtual), time, societal ignorance on the needs of the blind, and lastly a limited exposure to and awareness of assistive technology.

Although barriers (read challenges) such as: finances, physical and virtual access and time, limit blind computer use, it appears that transcendence or bridging of these barriers increases a user's competence and appreciation of the experience. Empowerment and a feeling of accomplishment stems from such transcendence, which aids in fostering value and appreciation for ICT.

Experiences of empowerment and a realisation of the value and potential of ICT have the potential to inspire agency and curiosity. The latter, in turn, fosters a willingness to further



explore ICT and its benefits. Realisation of the necessity to develop skills leads to an increase in practice and an appreciation of personal achievement.

The proposition is made that ICT plays a significant role in bridging the divide between blind computer users and the general population. Creation of agency and awareness among the key role-players (educators, family, friends and developers) as well as the general society appears to be a good starting point. Participants' recommendations for improved computer use include improvement of their own computer skills through practice, expanding their awareness by joining groups and signing up for newsletters, and expanding the awareness of people in the world outside their school. Participants also mentioned that automated transport, image description software and raised reference points on touch screens might improve their lives.

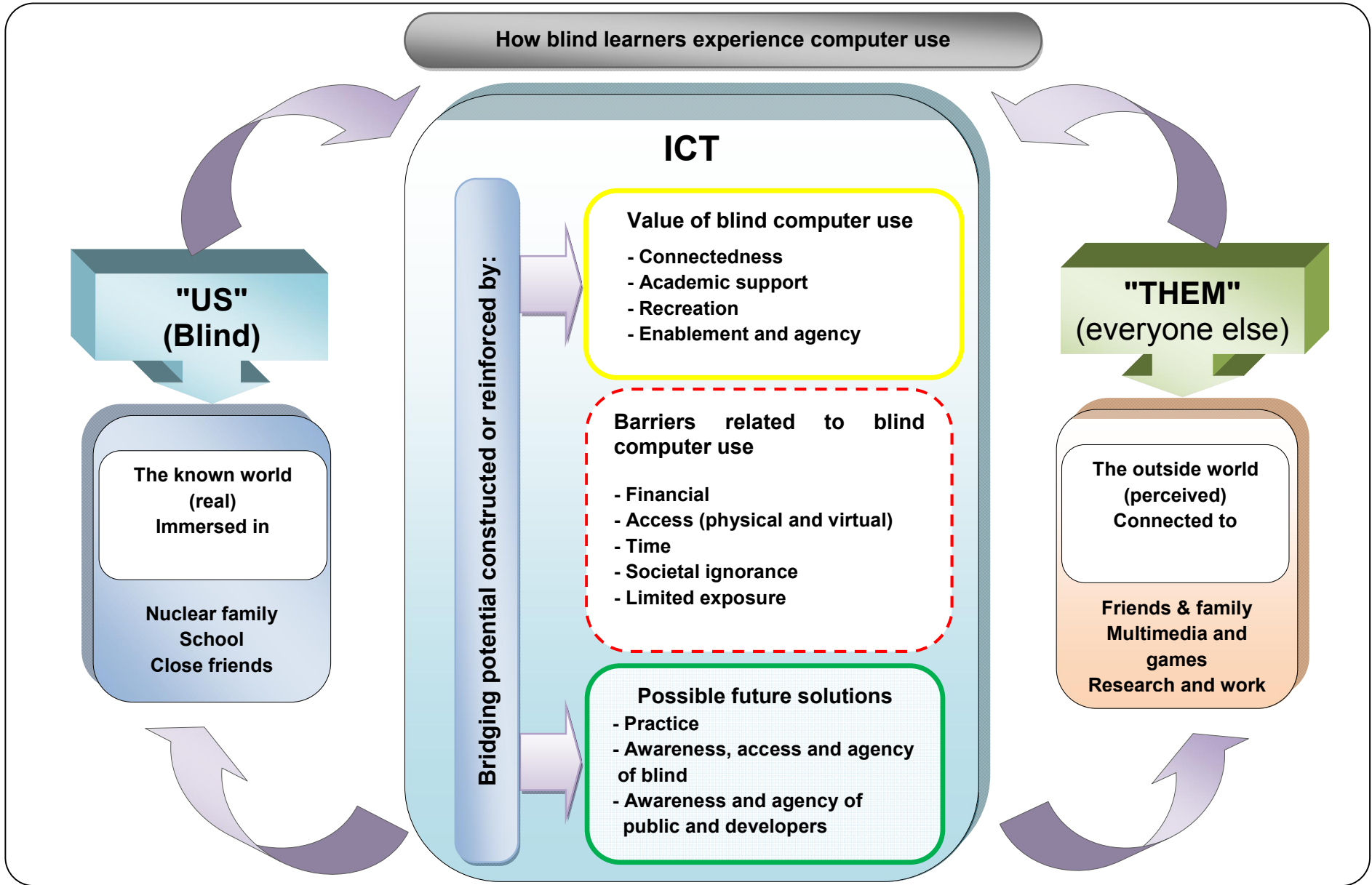


Figure 5.3: Blind high-school learners' experience of computer use and approach to their world

The cycle of blind computer use according to participants in the current study is illustrated in Figure 5.4. Funding and accessibility grant access to ICT. Education and training facilitate computer use, which then increases in frequency – partly due to an increase in awareness of potential as well as practice. An increase in competence and mastery, gained via use and practice, affirms the value of the mastered technology which reinforces exploration of additional assistive technology that could further improve access. The value of computer use appears to be the core driving force behind ICT use among blind learners. Reinforcement of any or all of these areas could potentially improve computer use among blind learners.

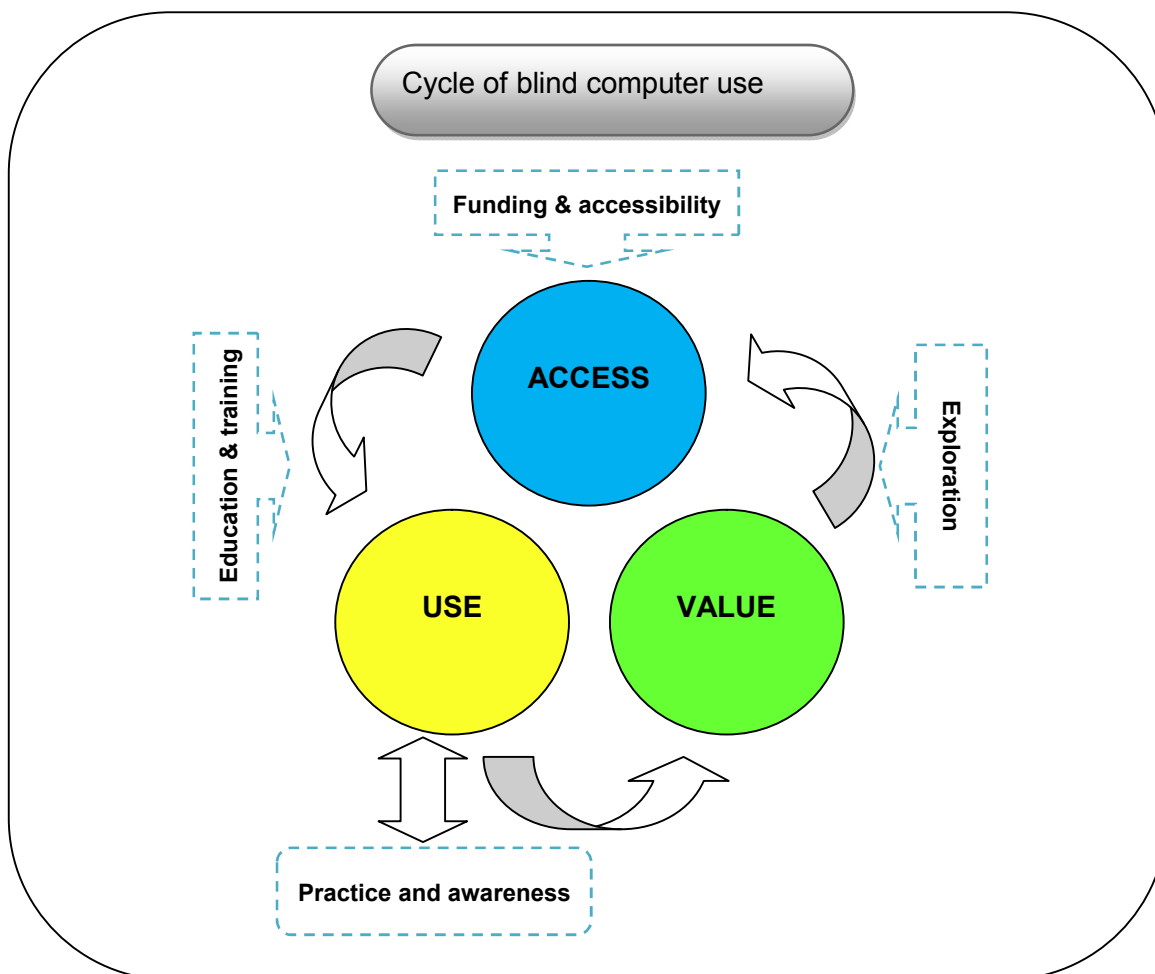


Figure 5.4: The cycle of blind computer use

#### 5.4 LIMITATIONS OF THE STUDY

The researcher next discusses the limitations of the current research study, namely the level of transferability of the study, the role of the researcher, sampling of participants and contextual factors.

#### **5.4.1 Level of transferability of the study**

Even though the participants in the study differed in gender, ethnicity, and social economic status, the sample size was too small to generalise the findings to the larger population. Although there are only a finite number of special resource centres for visually impaired learners in South Africa, the setting was localised to a single school. Again, generalisations cannot be made to the larger population. However, the focus of this study was not generalisation but rather an in-depth description of selected cases. Therefore, the onus of level of transferability lies with the reader. The researcher has taken care to provide a thick description of the case and the level of transferability would be proportional to the similarity in cases as perceived by the reader (Patton, 2002).

#### **5.4.2 Role of the researcher**

This research investigation was approached from the standpoint of an educational psychology master's student, previous educator of the visually impaired and assistive technology hobbyist. The role assumed was that of a researcher. Though it is acknowledged that role confusion can occur in situations similar to the current study, the researcher monitored and gauged himself throughout the process and pre-emptively informed and orientated participants with regards to his role. In clarifying the role of the researcher to participants, the researcher also clarified the role of participants as well as what they could expect and what was expected from them. Utilisation of a research journal and the reflective technique allowed the researcher to remain vigilant about his own feelings and perspectives regarding different roles. Continuous discussions with both supervisors and mentoring and guidance served to keep the researcher on track.

#### **5.4.3 Sampling of participants**

Computer competence was identified as important selection criterion for participants, since the study's central theme involves computer use. Due to the qualitative nature of this study, accurate measurement of participants' computer competency was not possible. To compensate, the researcher employed the aid of the school CAT educator during sampling. The CAT educator assisted the researcher in choosing fairly competent blind high-school computer users. The researcher also focused on the participants' computer vocabulary in combination with the level of difficulty of the description of task completions as a qualitative gauge for their competency.

#### **5.4.4 Contextual factors**

Finally, the views and experiences of participants are grounded in their interpretations of reality shaped by their life experiences and upbringing. The researcher did not bear any knowledge regarding the status of technological devices or internet connection speed save for answers from participants. It is important to remember that this account is seen through the eyes of four blind high-school computer users and should by no means be regarded as an empirical evaluation review of any of the mentioned assistive technologies. Because new updates and versions of assistive software and devices are released so fast, a reader of this report could well find that many of the reported difficulties have already been addressed at the time of reading.

### **5.5 RECOMMENDATIONS**

Next, the researcher makes some recommendations for practice, training and future research.

#### **5.5.1 Recommendations for practice**

This investigation may yield some educational value to those in AAC, ICT or special education. Educators and support specialists that find themselves in circumstances that are similar to the research setting, might gain deeper insight into the way in which blind learners view themselves and their world. The findings of this study may also supplement their mental map with the different concepts necessary to plan potential support and intervention strategies for blind learners. The need for expert trainers of assistive technology, for both educators and learners, reveals an exciting niche of new job opportunities for blind computer users.

Findings of the current study may inspire developers to further increase efforts to humanise, automate and simplify software and technology. Such a shift in design principles needs to become common practice so that computers can enable blind users to an extent that is equal or superior to that of the average sighted computer user. This will quite possibly only occur with networking between companies and a layering of technologies. Improved communication and collaboration between designers and users combined with a healthy attitude towards critique could also prove beneficial to progress in design. Fostering of proper awareness campaigns akin to product marketing has the potential to dually empower the blind and promote the sale of new products.

Policymakers could potentially gain additional insights into the key needs of educators and blind high-school computer users. Combining techno-centric and socio-centric approaches in the establishment of inclusive technological environments could aid the fostering, structuring and sustainability of support structures and entities.

### **5.5.2 Recommendations for training**

Mandatory, continuous computer and assistive technology training among blind learners seems very important. Adopting a differentiated formal scaling of competence levels for JAWS or other screen readers could potentially aid future structuring of curricula and provide a universal assessment scale for competence to both educators and developers.

It is proposed that collaboration be established and increased between schools-, tertiary institutions catering for the visually impaired, and assistive software developers. This could facilitate basic user competence in learners, students and educators via training from the source.

Continuous development and training of educators at schools catering for visually impaired learners could enforce awareness and boost educator competence and confidence, which might in time promote the use of assistive technology in schools. A collaborative effort by the Department of Education and South African Council of Educators (SACE) to tailor and monitor alternative continuous professional development (CPD) activities for LSEN educators could expand educator skill sets.

Tertiary facilities could endeavour to differentiate inclusive education modules to include introductory training in assistive technology, basic Braille and Sign language as part of its curriculum. This may pre-empt and promote postgraduate specialisation in Alternative and Augmentative Communication and contribute to both tertiary and scholastic domains.

Family awareness campaigns and parental training in assistive technology might prove useful to blind learners who need help, understanding and support.

### **5.5.3 Recommendations for future research**

The study could serve as a pilot for future investigations. Possible future research studies include:

- Blind learners' self-image and the elements responsible for causing agency and independence in blind learners could supplement conceptualisations of the blind population.
- Educators' experiences of technology implementation in schools and classrooms for visually impaired learners.
- Adoption of descriptors for virtual activities and functioning (i.e. classification of virtual function in the ICF) as a supplement to the ICF.
- JAWS developers could investigate the employment of an adaptive artificial intelligence which learns and aligns itself with the needs and deeds of a blind user.

## **5.6 CONCLUSION**

This chapter concludes the interpretation of the research findings by juxtaposition to current and past findings in literature. Findings were confirmed, contradictions and silences stated, and possible explanations and hypotheses for participants' reports were provided. The primary and secondary research questions were answered, recommendations were made and limitations were stated.

Continuous investigations and developments in the field of blind computer use are paramount to the success of inclusive practice in South Africa. It has become the firm belief of this researcher that the greatest change necessary for the establishment and maintenance of such inclusivity lies in the minds and hearts of key role-players, as well as the blind community itself.

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**Appendix A: Letter of permission from Principal**



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

**Faculty of Education**

**Department of Educational Psychology**

June 2012

Dear Mrs. XXXX

**REQUEST TO CONDUCT A RESEARCH STUDY AT XXX SCHOOL**

In order to complete my masters degree in educational psychology, I am required to conduct a research study in the form of a dissertation.

The objective of my envisaged study is to gain a better understanding of blind high school learners' experiences of computer use. The results of the study could be useful to other researchers, policymakers, educators, the blind community and computer programmers.

I will adhere to the ethical guidelines set by the University of Pretoria. Every necessary care and precaution will be taken to protect the rights of the school and participating learners. Special care is taken with regard to the fact that the visually impaired community is a vulnerable population and the protection of privacy of both the school and its learners take priority.

The fieldwork for the study will take place during the period following the 2012 June-July holidays once the schools have re-opened. Data for the study will be collected through semi-structured individual interviews and a single focus group discussion. I plan to use four learners as participants, one each from grades 9 to 12.

**Time:** The interviews and discussions will take place at a time convenient for you. It is therefore anticipated that the interviews will take place after the school day, in order to prevent this research project from interfering with your timetables and learners' academic work.

**Place:** The interviews will take place at a place suitable for you.

**Duration:** It is anticipated that each interview will be approximately 60-90 minutes long, concluded by a focus group discussion of 45 minutes with all participants. However, the exact duration will depend on the amount of information the learners disclose and the extent to which discussions become detailed.

I have made the appropriate arrangements to protect the identity of both the school and the learners involved and I can assure you that the investigation will be guided by strict ethical rules and the requirements of the University of Pretoria and the Gauteng Department of Education. My research proposal has been approved and I have already applied for ethical clearance from both the University of Pretoria and the Gauteng Department of Education.

The school's participation in this research project is voluntary and confidential. Should you require any additional information please contact either myself or my supervisor, Dr Tilda Loots.

Principal's signature: .....

Date: .....

Kind regards

\_\_\_\_\_

Mr Gert Grobler

Tel: 082 570 5645

\_\_\_\_\_

Dr Tilda Loots (Supervisor)

Tel: (012) 420 4146

**Appendix B: Parent consent form**



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

**Faculty of Education**

**Department of Educational Psychology**

June 2012

To Whom This May Concern

**REQUEST TO PARTICIPATE IN A RESEARCH STUDY AT XXX SCHOOL**

Your child is invited to participate in a research study on the experiences of blind high school learners regarding computer use. I envisage that this study could give other researchers, policymakers, educators and computer programmers a better understanding of how blind children experience computer use and related assistive programs.

The fieldwork for the study will take place once the schools have re-opened after the July holidays. Data for the study will be collected through separate, once-off, individual interviews with selected learners followed by a concluding focus group discussion with all participants (the learners involved). Your child's interviews will take place on the school grounds, after school hours, in order to prevent this research project from interfering with his/her timetable and academic work. I estimate that an interview will last between 60 and 90 minutes, and the focus group discussion approximately 45 minutes.

Your child's participation in this research project is voluntary and confidential. You may decide to withdraw your child from this study at any time. If you have no objection and are

willing to grant consent to your child to participate in this study, please sign this letter as a declaration of your consent. Signing the letter implies that your child will be participating in this research project willingly and that you understand that you may withdraw your child from the research project at any time. The identity of your child will be protected at all times

Should you require any additional information please contact either myself or my supervisor, Dr Tilda Loots.

Signature of parent/legal guardian of child: .....

Date: .....

Kind regards

---

Mr Gert Grobler

Tel: 082 570 5645

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Dr Tilda Loots (Supervisor)

Tel: (012) 420 4146

**Appendix C: Grade 10-12 Learner assent form**

- I understand that my parents have granted Mr. Grobler permission for me to take part in his project.
- I am taking part of my own free will.
- I have been informed that I can quit at any time should I want to.
- If I do not want to take part in this project, nobody will be angry with me.
- I understand what Mr. Grobler's project is about and that if I choose to take part, nothing bad will happen to me.
- I understand that my school marks will not be affected by this study.
- My name will not be used in Mr. Grobler's project and my work will only be used if I want him to.
- I understand that if I have any questions about the project, I can ask Mr. Grobler.
- I agree that I want to take part in Mr. Grobler's project.
- I agree to be interviewed by Mr. Grobler and that he can use my words or work in his project.

I have gone through this letter with my parents or a sighted person whom I trust.

Sign between the lines if you agree to take part in Mr. Grobler's research study.

.....  
.....

## Appendix D: Interview schedule

1. Tell me about your earliest recollection of a computer.
2. What do you generally use computers for?
2. What meaning does a computer add to your life?
4. If you were able to, in which ways would you like to use a computer more often?
5. What do you think would help you use computers more often?
6. What prevents you from using computers more than you would like to?
7. How would you describe the perfect computer for you?
8. What are your views/comments on Jaws?
9. How would you describe the value (if any) of the internet to you?
10. Describe the thoughts and feelings you experience when you are required to do research on a computer?
11. Computers, cellphones and tablets are continuously evolving and improving.  
How are you experiencing these devices' accessibility options?

## Appendix E: Research journal (extracts)

### Section 1

*I think I'll have to start at my proposal if I want to properly align and structure my thoughts with the process. To me this feels like the/a beginning. I feel ecstatic that my proposal was accepted the first time around. My topic is important to me. I feel I owe the kids at the school my help. If their voices find three people I'll be happy. Though I feel I owe them, I'll let them do the talking.*

*I know medical model is sometimes seen as disempowering, yet I believe a good foundation allows for dynamic development. Conceptualizing disability according to the ICF provides me with a concrete framework and concepts which are globally accepted from whence to investigate blindness. Simply googling open source software and inferring that such software is a viable solution circumvents the voice of the blind user and it provides a privileged, First World perspective as opposed to a South African perspective. Though I could have mentioned more open source alternatives, I decided to negate their mention due to inferior design or compatibility issues and the fact that I wanted to investigate the root of the problem instead of taking a symptomatic, technocentric approach.*

*If the problem was so easy to address, I would have taken an action research approach to this study.(2012-08-7)*

*I believe that there are three nuclear variables in blind computer use: the blind user, the technology and his/her support group. I'm also a firm believer in the "change your mind as a first step to changing your world. Should blind computer users wish to alter their world or some aspect of it, they will first have start thinking about it. In order for me to be helpful or to help others to be helpful, I first need to understand the mind of the blind computer user.(2012-08-18)*

*I do have a pretty good idea of what to expect next week. I have been working at the school for the past couple of years. I'm also positive that I've taken every precaution to prevent doing harm and I have also met all of the ethical requirements of the University with diligence. As a final precaution I've also prepared myself mentally to assume the mindset of the researcher and not teacher and I'm certain that my intellect and emotional intelligence will allow me to avoid role confusion during the interviews. I'm really looking forward to the experience and I'm especially interested to hear the learners' stories and opinions.*



## Section 2

*Participant 1 has a superior intellect. Though he is completely blind, his general knowledge appears to be on par with that of a university student. I've gained many insights from this interview. The main one is that it is possible, with moderate funding and sufficient aptitude and intellect, for a blind learner to excel academically in a mainstream curriculum. (2012-08-25)*

*Participant 2: I experienced her as your typical teenage girl. Her current life values seem to revolve around her social status and peer group. That being said, she appeared responsible and hard-working and able to keep her socialisation from interfering with her academic responsibilities. I would say that I gained the most insight into the social wants and needs of a blind person from her. (2012-08-25)*

*Participant 3 he was a very serious and reserved young gentleman. I found this interview more challenging due to his introverted nature. Nonetheless when he started talking, his responses were calculated and carefully considered. I remember thinking back to the TED talk on introverts and how they were responsible for the majority of societal success. This participant had a low socio-economic background and represented previously disadvantaged communities. I am of the belief that his combined intellect, stable family relationships and supportive school environment has allowed him to transcend these circumstances and make a great academic success of himself. One thing that I would have to add to my observation is the fact that he was not as competent with JAWS as the other learners. It appears that these 1st access to a computer had only occurred 4 years before the interview. If one takes that into consideration, he's made leaps in advancing himself. From his accounts and the level at which he discusses computer use, I would definitely call him computer competent. (2012-08-25)*

*Participant 4 came from a single parent paternal home. The socio-economic circumstances allowed him some access to computers, though according to his accounts, he had to improvise and improve his own accessibility if he wanted to use the computer effectively. This participant to me appeared to have the same intellectual abilities as participant 1. He placed tremendous value in reading and writing (literature). It is through his eyes that I have come to realise that the blind person's world, just like a lot of sighted people are not able to afford world experience, is created and substituted by literature. (2012-08-25)*

*I find it truly amazing that all blind participants with access to home computers, used them extensively to complete their homework. It would appear that they favoured computers above brailers and that it was cumbersome and excessive to rewrite already completed*

*assignments in Braille. With the shift towards more technological approaches to education and the increased adoption of e-learning strategies, blind learners who are computer competent should theoretically benefit from electronic subject material, in a sense streamlining access and learning. (2012-08-21)*

**Appendix F: Example extracts from transcribed interviews with coding as part of data-analysis<sup>53</sup>**

*Interview 1: School1*

|    |  |                            |
|----|--|----------------------------|
| 1  | R: Can you tell me about your earliest recollection of                 |                            |
| 2  | computers?   |                            |
| 3  | You know, just the first time that you used it.                        |                            |
| 4  | P: I think it was in grade 3 or something. No, wait, that wasn't       | Empowerment and            |
| 5  | the first time... But okay, that's the first time I used it with a     | agency                     |
| 6  | screen reader -sort of. And used the default narrator.                 |                            |
| 7  | R: How did it actually feel to be able to interact with the            |                            |
| 8  | computer?  |                            |
| 9  | P: It was all new to me so it felt really good at the time and I was   | Empowerment and            |
| 10 | little, so of course I was excited (chuckles).                         | agency                     |
| 11 | R: Ah, I can imagine...  |                            |
| 12 | R: What were your hopes and your dreams?                               |                            |
| 13 | P: At that point I didn't really have many hopes and dreams, I         | Connectedness to the       |
| 14 | just wanted to play on the computer.                                   | "normal" world             |
| 15 | R: So you figured you could play a lot of computer games?              |                            |
| 16 | P: I didn't really know what I could do at that point. I didn't know   | Recreational               |
| 17 | what I can and can't do yet.   |                            |
| 18 | R: Do you think that your interest in computers... What sparked        | Willingness to             |
| 19 | your interest in computers?  | explore/inquisitive nature |
| 20 | R: You know, the spark... You know, when the bug bites you,            |                            |
| 21 | when would you say did you become really interested in                 |                            |
| 22 | computers?   |                            |
| 23 | P: I don't know, maybe like, um... From grade four. We started         |                            |
| 24 | learning it in school. Like, the keyboard and all that stuff. I really |                            |
| 25 | can't remember but somewhere, like in from grade 4 to 6,               | Practice makes perfect     |
| 26 | somewhere along the line...  |                            |
| 27 | R: It started making sense?  |                            |
| 28 | P: Yea, I started figuring it out.                                     | Willingness to             |
| 29 | R: What for you was the best part of a computer or, what do you        | explore/inquisitive nature |
| 30 | enjoy about computer use?  |                            |

<sup>53</sup> All names mentioned in interview examples are pseudonyms.

*Interview 2: School1*

|     |   |                                     |
|-----|---|-------------------------------------|
| 278 | R: So it's quite a long time?   | Time-consuming                      |
| 279 | P: Yes sir.   |                                     |
| 280 | R: And then to recognise and navigate, is it fast? Does it            |                                     |
| 281 | respond instantly or not?   |                                     |
| 282 | P: No, it's not fast in responding.                                   | Time-consuming                      |
| 283 | R: A bit lagging?   |                                     |
| 284 | P: Yes.   |                                     |
| 285 | R: Okay, so if you want to improve it we can make it                  |                                     |
| 286 | faster?(computer)   |                                     |
| 287 | P: Yes Sir.   |                                     |
| 288 | R: How would you describe the value of the Internet to you?           |                                     |
| 289 | What value does the Internet hold for you?                            | Connectedness to the "normal" world |
| 290 | P: The fact that everything is there, like everything.                |                                     |
| 291 | R: Okay, describe everything -5 things making everything.             |                                     |
| 292 | P: Music, gossip, the latest news, celebrity news, fashion,           | Recreational                        |
| 293 | movies.   |                                     |
| 294 | R: Do you use it for e-mailing sometimes?                             |                                     |
| 295 | P: Yes Sir.   |                                     |
| 296 | R: Who do you e-mail mostly?  | Connectedness to the "normal" world |
| 297 | P: Friends... My aunt, I always e-mail my aunt.                       |                                     |
| 298 | R: And she also... She responds?                                      |                                     |
| 299 | P: Yeah, she responds.  |                                     |
| 300 | R: So that's how you guys communicate.                                |                                     |
| 301 | P: Mmmm (affirms).  |                                     |
| 302 | R: But I don't use it a lot.  |                                     |
| 303 | P: It's Facebook I use a lot.   |                                     |
| 304 | R: Okay, so you'd rather use Facebook?                                |                                     |
| 305 | P: Yes sir.   |                                     |
| 306 | R: Can you tell me which part of the Internet is difficult for you to |                                     |
| 307 | work with, or what difficulties you experience when you are           |                                     |
| 308 | working with the Internet   |                                     |

*Interview 3: School I*

1 R: The first one I would like you to do is, and also, feel free to  
2 tell me in as much detail as you can, I want you to tell me about  
3 your first recollection of a computer?

4 P: My first recollection of a computer was actually sitting in this  
5 cold computer room with the keyboard in front of me and  
6 learning the home row which is ASDFJKL and... So um, I was  
7 really fascinated with Jaws the way it actually said things and  
8 um... I guess my fascination was what, you know, led me to  
9 actually learn how to type. To actually duplicate what Jaws says  
10 when the teachers type. Does that make sense?

11 R: Yeah, so, I mean, basically it was the interaction that lead  
12 you to...

13 P: Yeah, first word I typed was ELVIS.

14 R: ELVIS? You still remember that now?(Laughing) how old  
15 were you then?

16 P: Five, six maybe.

17 R: That's nice. Elvis, I suppose I won't forget it either.  
18 and you're saying the interaction part is what drew you to the  
19 computer? What else did you find engaging or, you know...

20 R: What else did you like about computers?

21 P: Well, um... Computers were easy. I mean if you look at it from  
22 the music point of view, you don't have to get up and select  
23 CD's from the shelf. It's just a matter of space and enter and  
24 backspace and all that stuff. But, you know, it also helps when  
25 you're trying to write stuff. I mean, when I was in mainstream  
26 school which was grade 7 and 8 and some of grade 9, I used a  
27 laptop to do most of my work because most of the teachers  
28 could not read Braille or all of them. So, it was easier for me that  
29 way.

Willingness to  
explore/inquisitive nature

Empowerment and  
agency  
Recreational  
Academic support

*Interview 4: School1*

- 68 R: Do you use your computer for communication? Facebook, all those  
69 things?  
70 P: Yes Sir.  
71 R: Are you allowed time in the class?  
72 P: No, not in class Sir. For IT, it does open sometimes. It was open  
73 today.  
74 R: What do you normally do during IT period?  
75 P: I usually use it for Facebook, yeah maybe Facebook.  
76 R: Do you have a lot of friends?  
77 P: No, no.  
78 R: What is "not a lot"? Ten, fifteen, thirty?  
79 P: No, like fifty or something.  
80 R: 50 people sounds like an army to me.  
81 R: Do you think you would have normally had that many friends?  
82 P: Ag, no. (Smiles)  
83 R: Does it allow you to keep in touch with people?  
84 P: With the world, yes Sir. It keeps me updated in what's happening.  
85 R: How do you find the communication? Have you learnt how to use  
86 jaws with Facebook?  
87 P: No, I normally enlarge the print. I don't use jaws with facebook.  
88 R: Is it difficult?  
89 P: Yes Sir. It takes long.  
90 R: Why does it take long?  
91 P: Sometimes it just can't tell you some stuff. Like maybe, let's say  
92 you wanna read some stuff on Facebook, like on someone's wall or  
93 something. It's gonna tell you some other stuff that you don't want to  
94 hear. When you are just looking at it, you can just read the message  
95 and pass and the time that we have here isn't enough for, if you use  
96 jaws. Because you might end up not doing exactly what you went  
97 there to do.  
98 R: I understand. So it's more time-consuming. Jaws takes more time.  
99 R: Because it reads every single thing?  
100 P: Yes Sir.  
101 R: If you are able, would you like to use a computer more often?

Connectedness to the  
"normal" world

Access

Time-consuming

Limited  
exposure/Awareness of  
assistive technology  
among blind learners &  
their caregivers.

Time-consuming

*Focussed Group Interview 1: School*

859 Interviewer: I'm glad that you guys are not just numbers over  
860 here, and I think it's the right place to be.

861 Interviewer: Ok, the last one, the easiest one. If you had to tell  
862 the Minister of education what to do to promote independent  
863 computer use among blind learners, what would you say to  
864 him/her?

865 Peter: I guess, help them to get computers at home maybe.  
866 They should be encouraged to use computers more often.

867 Jeff: Well, I don't think the Minister has much knowledge of this  
868 stuff, actually I'm sure of it.

869 Interviewer: If she doesn't know, then maybe you can go teach  
870 her. Awareness. The thing is I think maybe they are also not  
871 aware.

872 Peter: Because blind people forms like, it's a small community -  
873 some people are generally not really aware of them.

874 Jeff: I think every person with different problems, they're all in  
875 their own little bubble.

876 Peter: You are going to become a writer one day aren't you?

877 Jeff: I'm so glad you guys are blind because you don't look at  
878 me weirdly when I talk about stuff like this.

879 Peter: We listen to you weirdly.

880 Interviewer: I'm going to use that as well, you need to listen to  
881 people weirdly.

882 Interviewer: John, last thing. I want you to answer this because  
883 you are quiet. What makes you want to be quiet and in this  
884 bubble? Why do you think you won't want to share with other  
885 people?

886 John: I just like, I don't like crowded places and stuff like that.

887 Interviewer: Can you guys identify with it?

888 Jeff: Yes.

889 Interviewer: Crowded places, you don't like too many people...

Access

Awareness among  
developers and public

Awareness & access  
among the blind

## Appendix G: An example of a table of meaning

### Theme 1 Barriers of blind computer use

| <b>Theme 1 Barriers of Blind computer use</b>  |                         |  |                         |  |
|--|-------------------------|--|-------------------------|--|
| <b>1.1. Financial implications</b>   |                         |  |                         |  |
| Interview 1  | Interview 2             | Interview 3  | Interview 4             | Interview group  |
| P: The cost, that's probably the biggest problem -getting computers everywhere and then maintaining it. (Participant 1, Line 144-146).   | (Participant 2, Line ). | R: What's the newest version of Jaws?<br>P: Thirteen. Poor buggers still haven't found a crack for that hey.<br>R: Have you experienced it yet?<br>P: Nah, I'm not bothered till I get a crack. (Participant 3, Line 271-274).                                       | (Participant 4, Line ). | Peter: considering that the one line Braille display is currently like 30,000 Rand...<br><br>Jeff: Oh, yeah sure. (Focus Group, Line 71-73).   |
| P: You get Braille displays but they are like one line. But they're one line... But they could work. But the problem is they are very-very expensive. (Participant 1, Line 154-156). | (Participant 2, Line ). | R: Netbooks are not that expensive these days. This one is a Gigabyte. I think Acer brought out a nice and thin one a while ago.<br>P: My dad has got this real tied up thing about money now so we can't go searching for... yeah... (Participant 3, Line 410-414). | (Participant 4, Line ). | Peter: That's why we all copy stuff illegally. We work with jaws anyway, so we have to do it with jaws. So then we can't really have a problem there, because everything else...(He implies that if they don't have jaws, they can't work on a computer.) (Focus Group 1, Line 598-601). |
| P: Last time I saw one it was like R30,000 that was a while ago so it's probably a bit cheaper by now, but still... (Participant 1, Line 158-159).                                   | (Participant 2, Line ). | R: So you actually find speech recognition, in some instances to be nice?<br>P: Yeah, I do, but I can't really sit around and train the thing because I don't have J-say (expensive program). (Participant 3, Line 440-443).   | (Participant 4, Line ). | (Focus Group, Line ).  |
| And then the cost of course. (Participant 1, Line 209-210).  | (Participant 2, Line ). | P: Well, I'm not sure because when I first started using computers I started using jaws but then, because jaws was such a rare commodity and because it was so expensive (Participant 3, Line 484-486).  | (Participant 4, Line ). | (Focus Group, Line ).  |
| (Participant 1, Line ).  | (Participant 2, Line ). | R: "40 min mode" what does that mean?<br>P: "40 min mode" well, it's when you haven't got it licensed.   | (Participant 4, Line ). | (Focus Group, Line ).  |



|  |  |   |  |  |
|--|--|---|--|--|
|  |  | <p>R: So it only works for 40 min?</p> <p>P: Yeah, but if you've got a crack...</p> <p>R: So you started off with jaws and you didn't find it easy and accommodating enough?</p> <p>P: No, I did -it was just the money. Back then it was still like 10 grand for every freaking version that came out.</p> <p>R: Is it still a big problem now?</p> <p>P: No! When you've got a crack it ain't a problem.</p> <p>R: Okay. (Laughs)</p> <p>P: I'm using jaws 12 now on my home computer.</p> <p>R: How many people in the visually impaired community do you think are using cracked versions?</p> <p>P: Plenty, because jaws is expensive, don't get me wrong. I mean a multi-user licence... The blind society, Natal blind society in Durbs, they paid 23 grand for a multi-user licence and that was about three people. (Participant 3, Line 496-513).</p> |  |  |
|--|--|---|--|--|

Appendix H: Examples of the researcher's meaning making and thought process

What do they say ???

① Computers are New, Fun, limitless possibilities.  
They can ~~show~~ link to the outside world.  
help you be part. Talk is free & easy  
options for portability. Helps you know outside world  
Cyberspace is real!

② I do my assignments, Editing, Brainstorming (auto)  
Navigating in word is easy. research online  
like a second skin

③ audio games are fun  
we watch movies & listen to music - can download at a whim.  
Gives Gossip & Celeb news.  
we read for fun.  
we write for fun.

④ We have Patience  
we can figure it out.  
we can teach others.  
we know the keyboard. & can type with one hand.  
we are relatively good with Jaws.  
we know shortcuts  
we can search the internet.

⑤ Tech is expensive  
Parents have budget  
Software also expensive  
\$ = obstacle.  
Rare commodity/expensive

→ We use / my free  
\* stuff that is limited.  
→ we will resolve  
\* to privacy to help ourselves.  
→ we want to drive

6 Access to laptop would be my life  
Crowded unexplored places make us uneasy

7 - I can't work without a computer (biggest prob)  
- If I had one when I was younger, I'd be ahead..  
- New tech ~~isn't~~ feels less accessible to us.  
- Takes getting used to.

8 Remember shortcuts; procedural steps.  
Feels like designers of OS doesn't have accessib. at heart. *you can't just.*  
Sometimes get lost in ribbons & submenus.  
Can't see the changes  
\*Have to remember something we can't see.

Visual stuff; cross navigation & pictures are difficult.  
We need help with them → ∴ Better tech.

9 We need to see (touch) an equation to solve it.  
Less PCs = more time.

Slow ↑ Net.  
long ↓ = time

10 We also want quinces treat us different we don't like being overprotected. talk with us not about us.

11 Don't know brought up in a shell never learning/exposed. Enforced mental block.

12 Gary Player I didn't know what I can & can't do yet. Curiosity feeds the cat - helps. Figure it out yourself  
B learning → willing to work → go along with the process → you get a relationship with it.

12. you can do anything with it.  
Everything, like everything is there.  
It takes 2 years to figure out the keyboard.  
PC needs a lot of practice  
└ time to figure it out on your own.  
└ we want to learn powerpoint.  
└ ?? maybe to talk to you....  
└ want to customise our own programs.

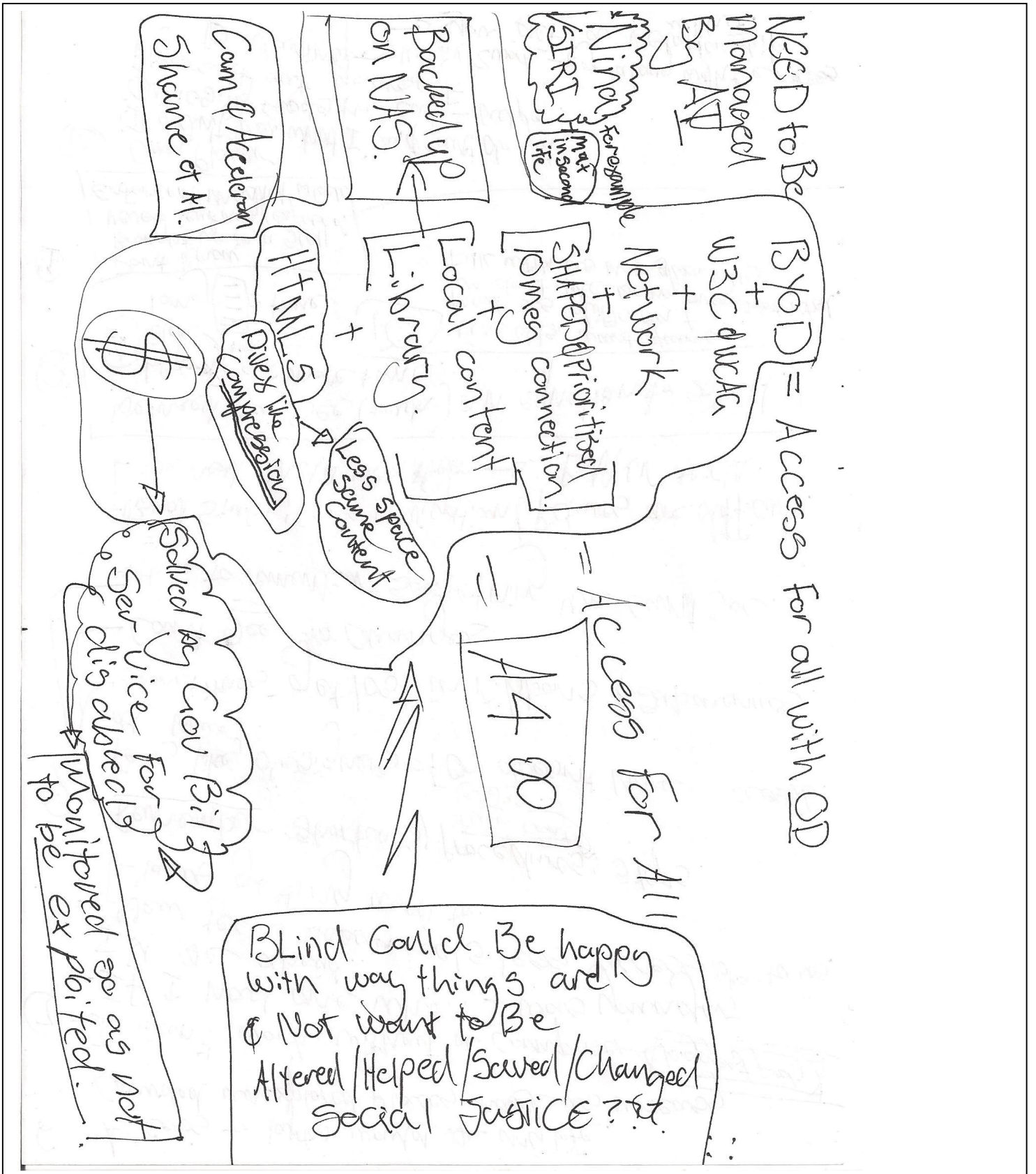
Patience Practice Remember.

13 Awareness → I should contribute.  
Know few programs.

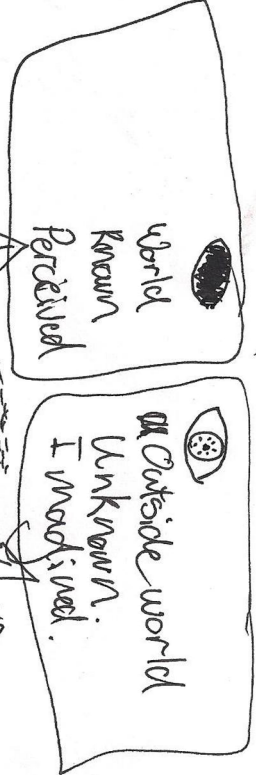
14 Dev & Publ.  
└ Join groups, websites, newsletters.

Bubble — in school it's not wrong  
We need it because in research you can't keep up.  
\* Fortified school of blindness.  
And you guys are blind — don't look at me weirdly  
We listen to you weirdly.

New stuff — Drive a Car  
raise the touchscreen keys.  
remote controlled pc's  
explain the pictures to us.



# Inside & outside - us & them



AC is the Bridge  
 Restricted parents  
 Permeability is reliant on:

- ① - Bridged Barriers.
- ② - Awareness of need.
- ③ - Exposure time & reward.

Sufficient Permeability  
 results in Self actualization  
 automation Integration

They need to listen  
 They need to listen

Wrong & Correct  
 Foundation Built by  
 PARENTS PEERS EDUCATORS

