# Technology, Learning and Working:

# Blind and Vision-Impaired People's Use of Technology

For

Aid for the Blind Society Queensland

*Howard Middleton*

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## Context and overview

The 2004 report "Clear Insight: The Economic Impact and Cost of Vision Loss in Australia" prepared by Access Economics for the Centre for Eye Research Australia reports that over 480,000 Australians are vision impaired in both eyes and over 50,000 of these people are blind. The report's projections indicate that blindness is set to increase by 73% over the next two decades to more than 87,000 people (aged over 40). What is potentially more disturbing, if Australian figures mirror US statistics, is that there has been a decline in employment rates of blind or vision-impaired (BVI) employees during the 1990s that is much worse than the rate of decline for people with other disabilities and for those without disabilities (Gordon, 2001).

Part of the decline can be accounted for by the reduction in the demand for the low-level manual tasks that BVI workers have traditionally undertaken. However, the decline has occurred during a period of strong economic growth. If BVI workers are no longer competitive in the new economies (Dryden, 2001), one of the challenges may be to see how they could engage in tasks that are in demand. Further, if new skills are required, the role of education needs examining in terms of its contribution to the preparation of BVI students for life and employment. Overlying issues concerned with learning and working is the role technologies play in facilitating access to information, and to make possible the various actions required to live, learn and work when you are blind or vision impaired.

## Objectives and scope of report

The objective of the research project was to identify and analyse technologies that aid the blind and visually impaired in educational preparation for work, and in employment. The research also aimed at identifying strategies that either assist or aid employed blind and visually impaired workers in developing their skills to participate at higher levels in their current employment positions. As well, the research aimed to provide conclusions and recommendations that would inform the development of better education mechanisms for the blind and visually impaired.

In terms of scope, the research covers general issues extracted from the literature, and specific immediate responses to the issues by BVI people in education or employment, or those working with BVI students. In addition to the research project, two other sections are included in the appendices of this report. The first is a current annotation of a range of assistive technologies. The second is an annotated bibliography of documents of interest for readers who may wish to pursue issues in more depth.

It is important to note that one group of BVI people who are not included in the research, other than when they feature in the literature, are people who have reached retirement age and who are no longer in the paid workforce. Some research defines this group as the over 65 group. This group is significant in terms of impairment, with Vanderheiden (1990) reporting that in the US 50.1% of the over 65 age group suffered from impairments, while the figure for the total

population was 20.3%. However, it is assumed that many of the conclusions drawn from the research reported here will be relevant to the over 65 age group. Further, a number of issues specific to this group argue for studies that focus on the retired or over 65 age group.

## Key findings

The key findings from the literature review and study are as follows: The literature review reveals that while there have been many research projects concerning aspects of BVI, there are few that provide useful overviews and the collection of those research reports that address specific issues represent a less than comprehensive coverage of the issues. That is, there are many gaps in our understanding of how BVI people learn and work and how technology assists and might assist in that learning and working, and the nature of other factors that facilitate or hinder BVI people's engagement with the world. There are, however, studies reporting important advances in assisting BVI people in learning and working.

These include the development of technologies that BVI people can understand on their own and technologies that have the specific purpose of making BVI employees competitive with sighted employees. In terms of learning, the picture from the literature is less clear, with studies providing little depth or breadth in terms of what helps or hinders learning. In terms of engagement, there appears to be a need to refocus attention on the importance of Braille. The emergence of other assistive technologies has tended to be seen as replacing Braille, rather than complementary to it. The need to provide more robust programs to develop communications, social, organisational and daily living skills in BVI students was also a key finding to emerge from the review of literature.

The findings from the interview data suggest cost and availability are issues for both students and workers. In addition, all feel the need to fit in. This desire to fit in is heightened for students, given that the teenage years can be difficult even for students without BVI. Technologies that do not highlight their disability are preferred.

## Findings for practice

Overall, the following findings for practice emerged:

- Insufficient emphasis on learning Braille, and at an early age;
- Insufficient numbers of teachers and support staff trained in Braille;
- Limited use or understanding of transition programs for students and unemployed or underemployed BVI people;
- Absence of appropriate social programs for BVI students;
- Little awareness of improvements designed for BVI that help sighted people, e.g., standardised ATM consoles and lift lights and audible signs that anticipate the arrival of lifts; and
- Emerging understanding of the need to develop technologies that are discoverable, rather than learnable.

## Recommendations

The findings emerging from the study lead to a number of recommendations, as listed below.

- Need for more research into all aspects of blindness and vision impairment;
- Need for more overview research and research examining the ways BVI people interact with technologies;
- Advocacy for the importance of BVI students learning Braille at an early age;
- Advocacy for the training of appropriate numbers of teachers and support staff in Braille;
- Development of research into the role and value of the range of technologies in assisting BVI students to achieve educational and work goals consistent with their potential;
- Advocacy for the development of specific work experience programs (such as those trialled successfully in the US) and undertake research into the utility of such programs;
- Development of more accessible (cheaper and less intrusive) assistive technologies;
- Development of assistive technologies sensitive to the psychological and social needs of adolescents, i.e., technologies that allow them to lead as normal a life as possible;
- Advocacy for the development of universal design where possible, to reduce costs and to improve the regard BVI people are held in by the sighted community flowing from the benefits universal design provides for all;
- Advocacy for the development of technologies with operations that are discoverable rather than learnable. This is a sub-set of the aim of universal design, that again benefits all in the community;
- Need for self-advocacy through the development of practical lifestyle management skills (e.g., shopping and cooking for themselves, using public transport confidently and independently) as well as skills in communicating effectively and confidently and participating in a range of social activities as equal members;
- Need for significant others, primarily parents and teachers, to raise expectations and encourage children to be more independent/self-sufficient. This involves professionals working with these groups to develop understanding about what is possible for BVI students to aim for; and
- Exploration of the idea of compensatory abilities and the implications of these for learning and employment.

# Technology, Learning and Working

## An examination of the role of technologies by blind and vision-impaired people

> 70% of America's working-age blind who want jobs cannot find them, and 30% of those who are working are underemployed in relation to their qualifications. Advocates blame discrimination, a drop in Braille literacy and a lack of training and rehabilitation. The level of joblessness among the blind has remained stagnant for decades. Too often, blind and visually impaired children languish in school because they are not held to the same standards as their sighted peers. The education system is increasingly letting blind kids down. The news, however, is not all grim. Technology has drastically altered the typical workplace, and it can make many jobs easier for blind people to perform. (Dobbs, 1999, p. 96)

Dobbs' mostly pessimistic observation can be translated to the Australian context with varying degrees of accuracy. However, one conclusion to be drawn from the literature is that we need to understand the situation of BVI people in Australia better, so that we can develop strategies to assist BVI students in their learning (both academic and social) and to enable BVI people to undertake employment in a wider range of occupations than is the case at present or in occupations that provide greater affordances to employment of BVI people. It is for these reasons that this project was initiated.

## Project aim

Developments in technology over the last 20 years have enhanced the possibilities for learning and working for people with vision impairments. Computers with speech or Braille output peripherals, or portable speech-output PDA devices, or GPS-controlled tactile navigational maps, are some examples. However, while there is a range of technologies that are available, there is little known about:

- The kinds of technologies being used by visually-impaired people;
- The effectiveness of those technologies in assisting visually-impaired people in learning and working; or
- Other factors that help or hinder BVI people in learning, working or living.

## Background

Internationally, much BVI research has focused on accessibility to technology that has impacted on legislative changes, practice and public opinion. Gashel (n.d.) analysed American legislative developments concerning The Rehabilitation Act 1973 and argued that although the National Federation for the Blind initiated significant change, a greater push from organisations and citizens is required to implement equal access for all users of technology. This push comes through a developing awareness, a positive culture and action within organisations and in the wider society.

Blind Citizens Australia (BCA) (n.d.) also argue that action by a wide range of

stakeholders is required to develop awareness of the issues faced by BVI people in living, learning and working. The stakeholders range from government departments, public utilities to companies, product designers and researchers. One area that has been noted regarding awareness is the cost of blindness and its impact on these areas. That is, there is a growing awareness of the cost of current approaches to addressing vision impairment.

The economic and social costs of blindness also appear to be a significant concern for policy makers, legislators, organisations, and educators. Many studies (e.g., Meads et al., 2003; Meads & Hyde, 2003; Newell & Gregor, 1999; Sherman, 2001) have investigated the costs of managing BVI, to identify the most effective strategies.

A number of Australian based studies have examined the state of social, training and employment conditions for blind and visually impaired people in Australian society. For instance, the Australian Government's focus has been on the provision of information in accessible formats including Braille, tactile, audio and large print (BCA, 2003).

Other studies have looked at specific requirements for particular groups. For example, BCA have examined the situations of vision-impaired women in relation to training and development, with the aim to establish support networks.

Still other studies (Capella-McDonnell, 2005) have examined vocational rehabilitation services aimed at facilitating competitive employment for BVI people. That is, services that may assist BVI people to attain and retain employment appropriate to their education and training.

This study, then, examines the literature, and examines primary data to provide useful findings about the current situation of BVI people internationally and within the Australian context. Furthermore, the study provides findings and recommendations that should prove useful in informing action to improve the educational, employment and general living prospects for the blind and vision impaired.

# Review of Research Literature

## What is the research telling us about BVI people in terms of learning, working and living?

The review of literature focuses on reports or publications of research projects conducted by university researchers, government departments and non-government organisations (NGO). These reports and publications were collected along with other documents such as submissions to government by NGOs. They are included, whether they were specifically research or are submissions or reports, as they helped to fill out the picture of the state of blind and vision-impaired people's interactions with technology and the world of learning and work, and to inform the development of the research methodology and data collection process. The assumption in the research was that each of these documents represented the collective views of a range of groups with an interest in the issues associated with blind and vision-impaired people.

The review of literature is structured in the following way. Firstly, literature dealing with learning for BVI students is reviewed. Then, literature providing data on the state of the world of work for BVI people is reviewed. Lastly, literature examining more general issues that impinge on living, learning and working by BVI people is examined. This provides the overview of the extent and dimensions of the issues facing BVI people. It needs to be said that there is overlap across the sections. That is, research examining access to Web pages, conducted primarily for general living, may be relevant to learning or working. However, the research has been situated within the section relevant to the perspective the researcher was working from in each case.

## Learning for BVI students

### *Introduction*

The literature on learning and BVI can be grouped into five general categories: (a) analyses of the effectiveness of legislation designed to assist BVI students in educational settings; (b) assumptions and biases against BVI students, often termed ableism; (c) analyses of technologies with discussion of the benefits of Braille as an active technology that develops skills; (d) more variable analyses of other technologies in terms of their level of active engagement by students; and (e) training for teachers of BVI students in general and in Braille, in particular.

### *Legislation*

Smith and Wild (2006) provide an analysis of the U.S. Disabilities Act (1975) as it applies to BVI students in terms of the concept of "least restrictive environment" (LRE). LRE sets a number of rules that govern how access to education is provided for students with disabilities, including BVI students. The Act

- requires children with disabilities to be educated with their peers without disabilities, to the maximum extent possible;
- ensures a continuum of alternative placements (e.g., regular education classrooms, resource classrooms, or special schools for students who are visually impaired);

- provides for supplementary aids and services (resource room or itinerant instruction) in conjunction with general education;
- specifies that a student's educational placement is to be reviewed annually; and
- requires that placement is to be determined by a student's Individualized Education Program team, which includes the parents and educators who are involved in the student's life (Smith & Wild, 2006, p. 592).

The overriding principle, according to Smith and Wild (1996), is that decisions are based on considerations of the individual needs of the child and that least restrictive environments should be considered before more restrictive ones. Smith and Wild note, however, that despite the Act, decisions on educational placement are not always made on the basis of what is best for the student, and can be based on the category of disability, significance of the disability, space and so on.

Many researchers are concerned that although the least restrictive environment policy is evident it is not universally implemented in education environments. The major issue in contention is that the focus is primarily towards the integration of disabled students with abled students and that in removing segregation and discrimination, the setting may not provide the most suitable environment for all BVI students to learn.

***Ableism***

Hehir (2002), BCA (2005) and Gale (2001) term the issue of BVI students needing to fit in as "ableism", defined by Hehir as:

> the devaluation of disability that results in societal attitudes that uncritically assert that it is better for a child to walk than roll, speak than sign, read print than read, spell independently than use a spell-check, and hang out with non-disabled kids as opposed to other disabled kids. (Hehir, 2002, p. 23)

In particular, the primary problem with ableism is that the needs of disabled (including BVI) students can be hidden, understated or not understood, according to Gale (2001). This is a result of the focus of integration of BVI students into abled student learning situations. Long term this has created a culture of learning misinterpretation regarding the needs of disabled students. Further, because they are generally a minority in learning situations, they can suffer from indirect discrimination, which further hinders the ability to understand BVI students' learning needs.

Academic and vocational skill development is a core focus of policy improvements regarding the best strategy to educate BVI students. Unfortunately, ableist biases have affected education policy, resulting in BVI students being required to learn like the mainstream. Gale (2001) comments that the significant decline in Braille education in Australia, due to the integration of BVI students with non-BVI students, together with their minority status in mainstream classes, is causing much anxiety among aware educators. Further, this is hindering the skill development of BVI students.

Hehir (2002) in particular, argued that the removal of Braille education is harming BVI students' learning as they are instead employing a passive approach of listening to taped books. In a similar way, low vision students are being forced to read print although their disability hinders them from reading efficiently, resulting in them becoming functionally illiterate. Some BVI students also comment on their problems, stating that they were forced to read print to "fit in" with the majority in classes and make them "more like sighted people". Advocacy groups, including the National Federation of the Blind in the United States (Hehir, 2002) and the BCA in Australia (BCA, 2005), are campaigning for the use of Braille in BVI education. These groups argue that the current situation and education standards and literacy levels of BVI students are unsatisfactory and require a significant revamp.

A severe problem hampering the development of Braille education is the culture and understanding (or misunderstanding) of many mainstream policy makers and educators regarding BVI education needs. Hehir (2002) and BCA (2005) argued that the reluctance to intervene in the early education of BVI students to avoid labelling them is a major issue. That is, BCA argue that learning Braille is most successful if started early, and to delay doing so hampers educational development. In addition to the problem caused by delayed learning of Braille is the problem caused by, according to BCA, educators and policy makers taking the position that disabled students should not be challenged.

Hehir (2002) and Gale (2001) suggest that these ableist biases can be removed through greater research into developing special education programs that focus on understanding the uses of Braille and technology in BVI education. Again, it is interesting to note that Braille is not seen as a technology. Further, identifying the individual learning issues and implementing appropriate personalised mechanisms to improve students' learning is vital. Weikle and Hedadian (2004) argue that programs must be developed to identify literacy problems and implement interventions in early childhood. Parental and family unit support in recognising and understanding their child's needs is also vital to achieving these standards. A key part of these programs is to identify the different needs of students to provide them with a learning mechanism that is both efficient and effective for them.

From a broader policy perspective, the Australian Federation for the Blind (Gale, 2005) advocates the development of programs to support the development of literacy through

- confirming the importance of Braille as the key to acquiring literacy skills for children who are blind or have low vision;
- raising the status of Braille literacy within service-providing and consumer agencies and with families, educators and the wider community; and
- providing a consistent, national basis for promoting Braille literacy.

Gale (2001) argues that the development of a universal Braille code is vital for Australian educators to stay in touch with the rest of the world. This would promote an integrated approach and global communication. These ideas suggest that to develop suitable standards and practices, developing awareness and a unified stance is of primary importance to change ableist culture.

Trief and Feeney (2003) examined the issue of what pre-college preparation was required for BVI students. While Trief and Feeney concluded that assistive technologies are important, they stressed that it is also important to include courses that develop social, communicational, organisational and daily living skills. Moreover, participants stressed the importance of learning Braille at an early age if students were to be successful at the college level.

***Braille versus other assistive technologies***

A different approach is taken by Weikle and Hedadian (2004), who challenge the use of particular technologies, contesting the relevance of many assistive technologies in developing literacy among disabled children. With many disabled children unlikely to develop required literacy skills, Weikle and Hedadian argue that in many instances assistive technologies only compound the problem, by providing passive activities. Gale (2001) argues that the current overreliance on technology to support learning has also added to the decline of skills. In particular, the overenthusiasm of educators to divert to technology as a primary learning mechanism rather than a support mechanism is hindering the teaching of literacy skills. Again in talking about technologies the assumption is that this includes computer and other technologies but not Braille.

The Australian Braille Authority (1999) agrees, suggesting that technology teaches listening skills as opposed to the desired reading skills. It would appear to be the case that there is a continuum of technologies, ranging from those that require significant interaction with the person and the development of skills, like Braille, on one end. On the other may be text readers, or talking books, which can be accessed passively and do not require the development of skills to any great extent.

Another school of researchers have taken a favourable view of the potential of technology (again, assuming this to be technologies other than Braille) and suggest that it is a viable mechanism to support BVI learning. Abner and Lahm (2002) argue that it is not assistive technologies that are the problem; it is the inability of students to access them that is causing standards to fall. Results from their study of Kentucky (US) BVI teachers suggest that students' limited access to assistive technologies is the primary issue. A further issue is the lack of education available to teachers regarding provision of "dynamic" training, incorporating assistive technologies.

This is seen as directly influencing the student access problem with many teachers not trained, aware, or confident in employing assistive technologies in educational settings. Abner and Lahm (2002) suggest that teacher training and certification is vital. More also needs to be done within educational settings to develop awareness of the power of assistive technologies among teachers, school boards and policy makers. Further, according to Abner and Lahm, educators must take an administrative perspective of keeping thorough records of the technologies and their training and students training and access requirements.

***Technologies for learning***

One specific technology that appears to assist BVI students, and learners generally, is the newer generation of digital talking books. Lockerby et al. (2006) conducted a pilot study examining the use of the talking books created with the DAISY (Digital Accessible Information SYstem) standard. The 3-year study found that most participants found the books easy to use while some thought parts were confusing and responded that training was necessary to gain the most benefit from the books. DAISY type talking books are available on CDs that can be read on specialised players or on computers.

Participants in the Lockerby et al. (2006) study reported favourably on the navigational capabilities of the books. Users expressed a preference for the players over use of the books via computers, possibly indicating a desire to fit in with their sighted peers and not stand out as different. A recurring theme, however, was that some thought that the relatively high cost of players, such as the Victor Reader Pro player, would prevent many BVI people from using the devices. The study involved participants of all age levels and the use of the system for social, educational and employment-related activities.

The importance of the use of talking books has been taken up by the U.S. National Library Service (NLS) for the Blind and Physically Handicapped, and is reported by Taylor (2004) in a paper examining the new initiative. Taylor reports on the NLS initiative to replace all tape based books with digital talking books (DTB). Taylor argued that the new format is an important advance as it allows the creation of DTBs of varying degrees of complexity, and gives users greater flexibility in using the books with the capacity to set bookmarks, highlight portions of text and conduct keyword searches. Such capacity will, according to Taylor, enhance the use of talking books for students, recreational users and people in the workforce. In addition, NLS is trialling a system of Internet delivery of digital audio magazines.

Stevens et al. (1997) investigated Mathtalk technology, a project that has developed multimodal interaction (using algebra earcons) to allow BVI students to access and interpret mathematics material. Employing a visual and auditory format, the key to the technology is its ability to understand algebra notation. In particular, the active and passive elements of visual and listening reading respectively, are built into the system to facilitate the mathematical function when using the system.

Two positive themes were identified from the analysis – that the system provided "compensation for lack of external memory and provision of control over information flow". Through identifying these themes, Stevens et al. (1997) argued that the technology can turn a passive listener into an active reader and provide the user fast and accurate control over complex information. Hence, this technology potentially provides insight into the possibilities of developing multimodal mechanisms to facilitate active literacy skills among BVI students.

Access to education facilities as well as technologies is a current issue that is facing many BVI students. In Australia, the ability of tertiary BVI students to access education has been poor, with many complaints from students at many universities (BCA, 2003). The concerns relate to the ability to access services in a

format that is relevant to their learning needs. This has left many students depressed, with low self-esteem concerning their learning. A further concern is the limited support services provided at many tertiary institutions, resulting in a self-service approach, which unfortunately does not suit all students. In particular, access to course materials and practical classes is hindered by students being forced to use cheaper systems of access, a result of budget reductions. Another outcome of budget reductions has been the reluctance to outsource design of services to specialists, resulting in inferior access.

***Teacher training***

Teacher ability is another area of concern in facilitating the learning requirements of BVI students. As a result of minimal or no training, teachers are forced to teach disabled students without fully understanding their needs or the best methods to facilitate their learning (BCA, 2005; Gale, 2001; Hehir, 2002). Ensuring education providers are given the opportunity to learn relevant skills to provide individualised learning programs is vital to solving this problem.

In the Australian context Gale (2001) and BCA (2005) found that the number of itinerant teachers of Braille was low and cannot possibly cover the required scope of teaching. This suggests that specific training not only of BVI educators but also of general teachers is vital to fulfilling the supply requirement. Moreover, specific training is crucial to developing a comprehensive understanding of, and commitment to, the Braille code amongst teachers.

BCA (2005) argue that if teachers have appropriate training they will take a proactive and confident approach to teaching Braille, and that all primary and secondary teachers should be given Braille instruction as part of their college training. Further, the development of professional Braille training credentials not only for teachers but also for teaching support staff is necessary to support the learning process for BVI students (Gale, 2001).

In an Australian national survey, Gentle (2000) identified that among the small number of Braille teachers (299) and support staff (128), only 63% and 30% respectively had a proficient knowledge of the Braille code. This suggests that much work needs to be done to develop the skills of BVI teachers and support staff. The Gentle (2000) study makes a number of recommendations:

- that refresher courses in Braille should be offered by those Australian institutions at which there are Braille training programs;
- that Braille training programs should include instructional methodologies and information on Braille programming needs as well as instruction in Braille formatting and layout guidelines, Braille translation programs and embosser technology;
- that educational institutions should offer Braille training programs in mathematics, music, chemistry and computer codes;
- that distance education courses should be made available and promoted as a component of professional development; and
- that greater networking is necessary between states and territories. (Gentle, 2000, in Gale, 2001, accessed from www.icevi.org/publications/educator/Fall_01/article7.htm)

***Summary***

The literature concerning learning and BVI students identifies a number of tensions in terms of provisions for BVI students to receive appropriate learning. Legislation makes clear the rights of students with disabilities to access appropriate education with their non-disabled peers. However, some researchers argue that this leads to ableism, where the need to appear to fit in with their able peers overrides the particular needs of the BVI student. What the literature appears clear on is the need for BVI students to learn to read Braille and at as early an age as possible. The difficulties in doing this are exacerbated by the lack of suitably trained teachers and support staff. Assistive (non-Braille) technologies are examined, with some researchers arguing that they slow down BVI students' learning, some arguing they are useful if used by suitably qualified teachers, while others suggest they can be used as complementary to Braille. However, there appears to be no research which examines the relationship between different assistive technologies and the bases upon which many work.

## The world of work and BVI

> Blindness is more feared by the public than any ailment with the exception of cancer and AIDS (Dobelle, 2000, p. 3).

***Introduction***

A recurring theme in terms of the literature on BVI people in the workforce is that the greatest barrier to be overcome is the negative attitudes and misconceptions of fellow workers and employers. These range from ignorance of the nature of the disability to incorrect assumptions about the tasks BVI people can and cannot perform. However, the research does provide examples where particular technologies have enabled BVI people to gain employment, and to be successful in areas requiring the abilities to undertake complex tasks, where the ability to see would generally be assumed to be a prerequisite (e.g., Ebert, 2005).

***Transitions to work***

Youth employment or the enabling factors that support the transition of BVI youth to employment is a major issue for legislators, designers and educators as well as BVI youth. Many studies, including Shaw et al. (2007), Blackorby and Wagner (1996) and Kirchner and Smith (2005), examined the lifestyles of young BVI people to determine employment-related experiences, across varying demographics. In particular, they analysed various American studies including two major studies – the National Longitudinal Transition Study (NLTS) and the National Longitudinal Transition Study 2 (NLTS-2).

The NLTS (www.sri.com/policy/cehs/dispolicy/nlts.html) was conducted between 1983 and 1993 and surveyed more than 8,000 high school students, of whom 875 were visually impaired and enrolled in special education in the 1985-86 school year. The NLTS-2 (www.nlts2.org/) began in 2000 and will continue until 2009. A comparison of results by Shaw et al. (2007) identified the promising finding of an increase in the latest study of 25.8% (NLTS = 36.6%; NLTS 2 = 62.4%) in visually-impaired students finding paid employment since leaving high school.
However, results regarding current paid employment are less promising, with the NLTS-2 cohort dropping 34.8% (from 62.4% to 27.6%) and an actual decrease of

2.3% (NLTS = 29.9%; NLTS 2 = 27.6%) between the two cohorts. Further, the NTLS identified approximately 25% of students as unable to find competitive employment appropriate to their qualifications. This signals that much work needs to be done to ensure that access to long-lasting, continual and competitive employment opportunities is available for BVI citizens.

Blackorby and Wagner (1996) investigated the first NLTS study and analysed employment, including competitive employment, hourly wages, post-secondary education and residential independence. They suggested that the low wages achieved in paid work was an issue that was reducing the ability of BVI people to develop independence. However, this was seen across both disabled and abled youth. Of concern was the lower level of education standard seen generally across disabled youth. However, young BVI students generally attained very high levels of post-secondary education. They also attained independence early compared to other groups, but had difficulty in the job market attaining competitive positions at reasonable pay rates.

Blackorby and Wagner's (1996) study raises questions about the nature of the transition of educational skills to the job market. Employment gaps continue to widen against disabled females in comparison to males. Ethnicity was also of concern, with white disabled youths having many more opportunities than Hispanic and African American youths in gaining employment. In addition, while gaining a high school diploma increased skills and chances of employment; it did not guarantee employment to any great extent. Blackorby and Wagner argued that individualised transition planning was the key to ensuring increases in successful transition for all disabled students. It would appear that concerted efforts by all stakeholders will be vital to improving the situation.

Kirchner and Smith (2005) argued that in the NLTS-2, demographic factors of gender, race, ethnicity and household income did not account for distinctive patterns in the results concerning BVI students' transition. Further, health and self-care skills were not identified as causal factors. Kirchner and Smith suggested that BVI students had high expectations that were often not realised on reaching paid employment. However, Kirchner and Smith found that a college education was considered valuable to attaining higher wages in later years of transition, suggesting the importance of higher education in the long term.

Shaw et al. (2007) argued that many of these statistics reflect government disincentives to access paid work and negative employer perception towards BVI employees. The authors point to the fact that demographic factors including access to public transport and psychosocial factors including development of skills and access to social networks can also play a part in the opportunities for BVI youth to reach their potential. Suitable circumstances in the domains of academic activity, daily living, and social and vocational lifestyle were also considered important in providing a successful transition to paid employment.

In a study of BVI student transition in Canada, Shaw et al. (2007) investigated the impact of vision impairment on youth employment in males and females in the 15-21 and 22-30 age groups. Employment status, job-search preparation, job-search strategies, and the extent to which these factors varied by degree of vision loss,

age, and sex, provided the constructs for measurement. The findings identified that like in previous American studies, Canadian employment rates were quite low despite comparable qualification to their sighted peers.

Despite this trend across studies, however, Shaw et al. (2007) reinforced the view of the need for BVI students to become educated to increase employment opportunities. Further, Shaw et al. found that, on the one hand, there were few students who submitted numerous employment applications, but on the other hand, few who were not proactive in their job search activity. Many respondents suggested the barriers to employment entry were too high but the majority were optimistic that they would overcome these barriers one day. As well as these barriers, it seems that the culture among Canadian BVI students is also hindering the development of proactive job-search strategies.

Dick and Jones (n.d.) investigated factors involved with hiring disabled students in an academic library setting. Dick and Jones argued that traits of intelligence, courage and determination are inherent in the majority of disabled youth and that these traits were highly valued among employers. However, facing the pressures of the job market can be difficult for disabled youth and this is further exacerbated by employer and employee misconceptions and the design of work areas and tools that are not suitable. In the library setting, identifying suitable positions and reorganising recruitment and interviewing strategies were seen as important to supporting disabled students to gain employment. Further, collegial support, adaptation and training as well as appropriate evaluation mechanisms were seen as vital. It was suggested that strong work experience and good university supervisor references could aid in the transition.

Maynard and Riccobono (2004) reported on a project by NASA and the National Federation of the Blind in the US to inspire BVI students to consider careers in sciences, technologies, engineering and mathematics related areas. The report details the results of a range of collaborative activities, including two summer science camps sponsored by NASA. The success of the collaboration appeared to be the result of efforts by the sponsors to develop a range of complementary activities that used non-visual techniques. There appeared to be spin-offs for NASA in addition to the increased interest generated in BVI students.

In a study examining technology-based support activities to make the transition from school to work or further study, Kim-Rupnow and Burgstahler (2004) examined the perceptions of college bound youths in a technology based transition program. The study concluded that the use of multiple technologies worked best in developing self-determination, and social and career skills.

In a similar study, BCA (2003) identified many factors that hindered BVI citizens from seeking and retaining employment. BCA argued that the situation was discriminatory, continually problematic and a significant resource drain and a legal burden. BCA noted that employment testing and systemic factors including inaccessibility to public infrastructure and services and trends in employment creation and technological change were reducing BVI employment opportunities. These conditions were seen as negatively impacting employment attainment. Added to these factors, employment growth is developing in industries that are not

well suited for BVI citizens, and accessible formats of technology and adaptive equipment to support BVI employees' access to basic information in the labour market are expensive to acquire. These factors were regarded as impeding efforts to measure the impacts and success of the Disability Discrimination Act in the workplace.

***Working***

American research in work environments including Livermore et al. (2000) analysed the national policy and programs available to BVI citizens to support them in securing and maintaining employment. They suggested that the government has had success in providing cash assistance, in-kind transfers (in-kind transfers involve transfers of commodities (i.e., rice, kerosene) or services (i.e., health, education) to poor and vulnerable groups – www1.worldbank.org/prem/poverty/safety/inkind/index.htm), education, training and rehabilitation support, tax credits, accommodation support, assistive technologies and vocational rehabilitation. However, continued research initiatives were seen as vital to providing the information basis for continually improving opportunities for BVI citizens.

In an Australian study, Smith (2002) examined the issues faced by BVI Australians in the workforce. The focus of the study was to determine if BVI people in the workforce faced problems and if so, whether the problems were an unavoidable consequence of their being BVI or whether the problems could be overcome by reasonable adjustments, to equipment, work processes or the work itself. Smith found that many barriers could be overcome by adjustments to workplaces; however, the greatest barriers to BVI participation in the workforce were the negative attitudes and misconceptions of colleagues and employers.

***Rehabilitation***

Capella-McDonnell (2005) examined vocational rehabilitation services in relation to competitive employment for the blind and vision impaired. The Capella-McDonnell study identified four factors that are necessary to develop competitive employment outcomes. These comprised (a) receipt of education as a rehabilitation service that resulted in an educational certificate or degree, (b) having worked since the onset of the disability, (c) reason for applying to vocational rehabilitation related to obtaining a job, and (d) the relationship between the counsellor and the consumer being rated as high quality (Capella-McDonnell, 2005). While this research report show that there is a range of technologies used by blind people in various social settings, there still remains the need to establish the kinds of technologies that have been found to contribute positively to the learning and working situations and prospects of blind people.

Gilbride et al. (2000) investigated employer attitudes towards disabled employees, including BVI employees. BVI employees rated among the highest in terms of their encountering difficulties in their work, and many employers held reservations about employing BVI people. Results also suggested that in many cases employers had limited knowledge of government-run vocational rehabilitation services for employees, with many having a mixed opinion of the success of vocational rehabilitation.

***Attitudes***

Berry and Meyers (1995) investigated non-disabled employees' affective, behavioural and cognitive responses concerning attitudes towards disabled co-workers. Attitude and situation proved to be influential factors in responses, suggesting that to integrate disabled employees successfully, support must be provided to all employees. Berry and Meyers suggested interventions including provision of information about specific disabilities, situation specific training and sensitivity training (including having qualified disabled people provide the training). Berry and Meyers suggest further that disabled people should be involved in the design of the training and should be provided with instrumental and affective support throughout their employment to deal with negative situations.

***Technologies for work***

Glinert (1992) and Newell and Gregor (1999) analysed the design of technologies for disabled people to support employment access and sustainability. Glinert and Newell and Gregor found that technologies were generally designed for and by abled designers, impeding the fit of the technology to disabled users. Newell and Gregor suggest further that many technology users in employment will have some form of disability, even if only minor, suggesting that disabled people are the majority. The implication of Newell and Gregor's work is that the issue of disability should be taken more seriously than it is at present. Moreover, according to Newell and Gregor, impediments in the current computer industry culture are also hindering the development of suitable hardware and software.

One issue is functionality versus usability, where many designers focus on building in excessive functionality that is not necessarily usable, especially for disabled people. Newell and Gregor (1999) argue that this perspective must be changed to take a more universal and user-centred approach to developing suitable technologies to support all employees. An innovative and aware technology philosophy will develop the culture to facilitate improvement, more closely achieving the needs of all users, and in doing so, will foster gains in design cost effectiveness.

Kieninger (1996) described the development, or as he calls it the "growing up", of HyperBraille and its application in terms of graphical user interfaces for a wide range of applications. Kieninger explains that the development of HyperBraille was done not to create another tool to access graphical user interfaces, but to allow BVI people to participate as fully competitive employees in information technology environments.

Writing in the journal *Nature*, Ebert (2005) reports on a study of a number of current BVI scientists and technologists who have developed technologies to allow them to pursue their careers, despite their lack of sight. These include a touch-sensitive pad that incorporates a map that when touched activates a voice that reads out the city at that location. Another solution is software that reads out mathematical solutions and helps BVI mathematicians write mathematics.

Another solution to the problem of reading the specialised maps of the upper atmosphere consists of a system where colours have been translated into musical notes. Standard maps of the ionosphere use colour to indicate variables such as electron density and light intensity. The user moves an electronic pen around a

touch-sensitive tablet to explore three-dimensional images. The important point to be taken from the Ebert (2005) paper is that they show the possibilities for BVI employees, when there is some determination to develop technologies to allow BVI people to undertake tasks normally requiring sight. Ebert demonstrates the ingenuity possible when determination to achieve a solution is present.

***Summary***

What the studies examining BVI people's experiences in employment suggest is that negative attitudes toward BVI people in the workforce do impact negatively on the kinds of occupations they have and their feelings about work. Further, government disincentives and the culture among many BVI students is a further disabling factor in employment transition. However, the evidence suggests that long-term opportunities for transition of higher education skill are available and technologies are being developed that allow for employment, and to compete in a wider range of occupations. Furthermore, the development of technologies that BVI people (and sighted people) could work out how to use for themselves (sometimes referred to as discoverable rather than learnable) suggests that many technology developers understand the need to provide both functional and psychological support to enable employees to fit in and compete. The challenge is to translate examples of people succeeding in occupations that are appropriate to their skills and qualifications, into more general occurrences.

## Living and BVI

***Introduction***

While the main focus of this study is on issues concerned with the factors that either assist or impede learning and working for BVI people, the review uncovered a range of issues that could be categorised as general living issues. These issues have been included in this general living section because they could not be categorised as specifically relating to learning or to working, for example, design of Web pages that are accessible to BVI, or streetlights at intersections that are compatible with BVI needs. They have been included because most overlap – that is, if you have difficulty getting to work because of difficulties in crossing intersections or accessing buildings, these issues become work or learning issues. The literature on living and BVI can be seen as fitting into the one category of access with sub-categories of: the idea of universal design that facilitates access; access to buildings, transport and general living; and specific information access technologies such as Web access software and hardware.

***Universal design***

One area where groups are approaching the issue of technologies to assist disabled people, including BVI people, is called variously, "universal design" (Vanderheiden, 1990), "design for all" (Ekberg, n.d.), or "user sensitive inclusive design" (Newell & Gregor, 2000; 2001). There are several overlapping propositions advanced under these banners. Firstly, the argument is advanced that it should be possible to produce many products in such a way that while designed for people without disabilities, they incorporate features that make them accessible to disabled people. The argument is also advanced that if these features are incorporated at the development stage, rather than as add-ons, the cost may be nil or negligible. An example of this is the sticky keys on Mackintosh computers

where it is possible to activate a key that allows keys that normally need to be pressed together, to be able to be pressed sequentially. This is the case when using the function control-alt-delete to restart a program that has crashed. This feature is built into every Mackintosh computer.

Sherman (2001) argues that there is a significant cost benefit in designing universal accessibility into software and Web sites by developers and vendors. Sherman suggests that this can produce more effective cost reductions when built into initial designs over more expensive add-ons, producing a better return to companies. Newell and Gregor (1999) argue that the perception of the expense and limited payback associated with technology accessibility design is unwarranted and can be minimised through careful planning of the early-stage design process.

Organisations are now required under legislation to provide accessible opportunities for all users to access technologies (BCA, 2003; Gashel, n.d.). The W3C (www.w3.org, 1993; 1997) provides comprehensive design guidelines and support for designers of Web content for the World Wide Web to promote universal design and accessibility. The primary goal of the W3C is to develop awareness of accessibility requirements and achieve successful compliance from designers. The main principles are that information must be perceivable, interface components must be operable, and information about and operation of the interface must be understandable by all potential users.

Newell and Gregor (1999, p. 81) provide a series of questions for designers of assisting technologies:

- Does the equipment which I provide comply with the legislation concerning use by disabled employers?
- To what extent do designers need to take into account the needs of employees who are not considered ‘disabled’, but have significant temporary or permanent dysfunction, and should features be available in equipment design to allow employees to return to work as soon as possible after an accident? (For example, design for effective and efficient one-handed operation of equipment would enable a hand- or arm-injured employee to return to an effective working situation sooner than if they had to use standard equipment.)
- Should designers make specific accommodation for the known reductions in abilities which occur as employees get older? (For example, larger or clearer displays, louder sound output, pointing devices which cope with slight tremor, less requirement for short-term memory, or the need to learn new operating procedures.)
- What are the specific obligations designers and employers have to provide systems which can be operated by employees who have been disabled by the technology they have had to use? (For example, the effects of RSI.)
- Is it reasonable for system designers to assume that equipment will always be used by someone in full possession of their faculties and, if not, how should this be taken into account when designing technology for the workplace? (For example, should it be possible to vary the level of awareness of speed of response required to cope with periods of fatigue?)

Balbo (1995) and Fukuda (2005) argue that usability metrics are necessary to aid designers in creating usable technologies for BVI people. Balbo analyses user interface measurement software and suggests that general design guidelines, questionnaires, metrics, usability labs, predictive models, automatic monitoring systems and automatic rule-based critics are all positive mechanisms to measure the usability of interfaces. In particular the automated evaluation and modification abilities make the automatic critics highly useful for designers. Fukuda focuses on Web page accessibility for BVI users, arguing that as Web technologies have developed they have become less accessible to BVI users. Fukuda suggests that Web navigability and listenability metrics have improved and will continue to improve design environments and aid designers in understanding and creating useable Web sites for BVI users. The core focus is on creating standards for Web design including headings, text, tables, forms, intra-page links and labels.

Two studies (Jacko et al., 2004; Jeong & Gluck, 2003) that investigated employment of universal design principles in visual technologies provide examples of development opportunities. Jacko et al. investigated the success of multimodal feedback (auditory/haptic/visual) for older BVI AMD (age-related macular degeneration) people with deteriorated response performance to computer-interface stimuli. Results suggested that multi-modal feedback could increase performance for both AMD and non-AMD older people, suggesting that taking a universal design approach to the technology may be relevant.

Jeong and Gluck (2003) investigated multimodal design incorporating haptic, visual and auditory displays in a geographical map use experiment among sighted users. The experiment found that haptic displays produce a faster and more accurate response than auditory and combined displays. However, participants suggested that they were more satisfied with the combined system. It would appear to be the case that while further research is required, multimodal and universal design can provide effective outcomes for all users.

A number of studies identified universal design principles and guidelines for designers. Connell et al. (2001) advanced seven principles that they regard as important in guiding the design of products that can be defined as complying with universal design ideas. The principles are:

> **PRINCIPLE ONE:** Equitable Use
> The design is useful and marketable to people with diverse abilities.
>
> **PRINCIPLE TWO:** Flexibility in Use
> The design accommodates a wide range of individual preferences and abilities.
>
> **PRINCIPLE THREE:** Simple and Intuitive Use
> Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
>
> **PRINCIPLE FOUR:** Perceptible Information
> The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

**PRINCIPLE FIVE:** Tolerance for Error
The design minimizes hazards and the adverse consequences of accidental or unintended actions.

**PRINCIPLE SIX:** Low Physical Effort
The design can be used efficiently and comfortably and with a minimum of fatigue.

**PRINCIPLE SEVEN:** Size and Space for Approach and Use
Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Horton (2002) provided basic guidelines for positive universal design, including

- Favour clarity and consistency;
- Supply text alternates for all relevant non-text elements;
- Provide equivalent alternates;
- Use structural markup and style sheets; and
- Use flexible layouts for graceful transformation.

On a cautionary note, however, Miles (2003) questions the value of efforts to develop universal design, or design for all, by arguing that such approaches ignore indigenous concepts, knowledge and skills that are important in meeting the needs of disabled people.

***General technologies***

Newell (1993) and Newell and Gregor (1999) investigated the development of the "human-machine interface" and discussed adaptations throughout history that have provided suitable interfaces for BVI users. These include, for example, developments in predictive and adaptive interfaces and conversion of graphics to text in Web-based environments. Brewster (2002) and Brewster and Pengelly (n.d.) argued that the development of visualisation through technology is crucial to provide BVI people with a rich and flexible environment to access information. Synthetic speech and Braille are identified as only offering limited opportunities to convey information. This significantly impacts BVI users in accessing and keeping up with developments in complex information. Developments incorporating virtual, interactive and real-time access are argued to offer BVI users opportunities to access required information by employing human-machine interfaces.

***Compliance issues***

Many cases of large corporate and governmental non-compliance with design guidelines are evident. In an assessment of US Government Web sites, Ellison (2004) concluded that the US Government has not met its accessibility goals and requirements. In a study examining compliance with Section 508 of the US Rehabilitation Act, 50 US Government home pages were tested for accessibility. Only 11 of the 50 (22%) met the accessibility standards. However, of those that did not meet compliance standards, 17 required only minor adjustment, suggesting that monitoring and maintenance was poorly managed.

BCA (2003) and Lebihan (2000) outlined examples of two cases where both the Australian Taxation Office (ATO) and the Sydney Olympic Games Organising Committee (SOCOG) came under scrutiny for not complying with design guidelines. Complaints from BVI users about SOCOG centred on design of the Web sites that hindered users from accessing information. The issue with the ATO was the design of the Web site, which reduced the ability of people to lodge BAS statements, a vital component of the tax reporting for business activity.

***Web accessibility tools***

Research into technologies to assist BVI people to access information via the Web represents the largest single are of research into technologies for BVI people. Sherman (2001) argued that issues of accessibility in software and Web design for people with disabilities needs to be done as part of the development process, rather than as an add-on. Sherman agrees with universal design researchers, arguing that if accessibility is done in an integrated way, the development can provide better solutions and significantly cut cost, a perennial issue for developers of technologies for disabled users. Linley (2000) reports on a study examining the issue of how disabled people are excluded in society, using public libraries as an example. Linley explored the issue through the themes of access, information provision, provision of specialised services versus integrated approaches, tackling discrimination, and the nature of partnerships to address discrimination. Linley identified good practice and argued for a policy approach in addition to the current approach of providing access.

Alternatively, Newell (1998a & b) argued that computer access technology has tended to have a higher priority than other access technologies, suggesting that a wide range of facilitating options could be available or developed for BVI users. Technologies including Microsoft Enable (www. microsoft.com/enable) and Sun Microsystem Access (www.sun.com/tech/access) were discussed as specifically providing accessibility. Microsoft, in particular, has paid detailed attention to building accessibility into its Vista products through collaboration with assistive technology companies in the design process (microsoft.com/enable, 2006).

Maeder et al. (2004) assessed the Web accessibility standards of IBM including the Home Page Reader BVI technology. In particular the paper investigated the Accessibility Observer tool for designers. The tool provides a “low-vision” and “blind” mode that simulates BVI users and visualizes the usability of the technology. The authors suggest it retains a strong ability to interpret the BVI environment to indicate accessibility requirements.

A number of studies have examined specific tools that support accessibility in Web-based environments. Takagi et al. (2004) and Asakawa (2005) argued that although accessibility design guidelines have aided in the creation of universal Web content, the ability of current evaluation tools to support truly universal design is quite limited. For example, although a Web page may be technically compliant according to its html tagging, it may still actually not be usable. Takagi et al. argued that

> It would be better if such tools paid more attention to real usability, especially on time-oriented usability factors, such as the speed to reach target content, the ease of understanding the page structure, and the

> navigability, in order to help Web designers to create not simply compliant pages but also usable pages for the blind. (p. 177)

As a result of their research, Takagi et al. (2004) designed "Accessibility Designer (aDesigner)". The Takagi et al. study examined the use of visualization tools employing gradations and colours to understand the true usability of Web pages for BVI users. Takagi et al. suggest aDesigner could: reduce workload and costs of repairs; establish a high level of accessibility with less usability testing required with real users; and through focusing on the user experience and actual productivity, could create a more accessible and usable Web page. Asakawa (2005) also analysed the uses of aDesigner, suggesting its ability to allow the user to learn about compliance and usability with no training requirement makes the tool useable and effective. Home Page Reader is also analysed, with Asakawa finding it a highly effective technology but with the disadvantage of requiring training for advanced usability.

Asakawa and Itoh (1998) examined the state of BVI technology development and design guidelines in Japan in terms of Web accessibility. Poor real-time and in-time access to information and shortcomings of the DOS environment (typical Web access point for BVI users) to allow BVI users to find hyperlinks and read two-dimensional information effectively has plagued accessibility. Asakawa and Itoh provide a prototype system that employs numeric key assignment to allow intuitive operation, fast-forward key for quick reading, hyperlink reading and HTML tag conversion into voice and synchronisation with Netscape Navigator. Results suggest the infant elements of the system can be used from beginner to advanced levels easily but that the more advanced components require developed skills. Asakawa and Itoh recognised that the system would not fix all access problems for all users in all Web sites, but as global standardisation develops further to support universal accessibility, the system should become more effective.

Craven (2006) analysed assistive technologies including screen readers to support BVI users and suggested universal accessibility was still a major issue. In particular, where Web material has not been designed for use with assistive technologies, interpretation of the material by the technology can be problematic. Reinforcing the universal design philosophy, Craven suggests the employment of universal design to remove or reduce these problems. Further, designers can gain advice in accessible design from numerous sources including the W3C (www.w3.org), Web Standards project (www.Webstandards.org) and regional and local legislative sources. However, although funding and research has created awareness of these issues, little has been done to support its development. The implementation of more structured compliance measurement tools would also assist in implementing action.

In an American study, Axtell and Dixon (2002) evaluated the effectiveness of accessibility technologies, specifically analysing WebVoyage 2000 (the online public library access catalogue by Endeavour) technology among BVI users. Employing Section 508 of the Rehabilitation Act of 1973 as the assessment standard, WebVoyage 2000 scored favourably. Issues for review included that labelling, content structure and navigation required more logical development to

provide greater usability. According to Axtell and Dixon, libraries should provide more suitable labelling for pages and content in customisable areas of the system.

Hudson (2004) employed the W3C (www.w3.org) guidelines to examine the development of Adobe PDF document accessibility for the Web. Focusing on format standardisation, the guidelines failed to recognise the PDF format although it is widely used, creating problems for design to achieve assistive technology accessibility. Despite these problems, Adobe has incorporated the guidelines in the design of later versions including Acrobat and Reader 6 and above, providing a higher level of compliance. Hudson provided guidelines for preparing accessible PDFs but argued that problems including legacy documents, that is, documents created in previous PDF formats, and variable assistive technologies will continue to stall developments and suggests caution in using the format.

King et al. (2005) also investigated Web tools for the disabled, including BVI Web usability. They argued that maintaining a larger and possibly multi-faceted Web presence creates a more complex and difficult standards compliance environment to manage. In particular, King et al. discussed numerous systematic processes and solutions including using fixed design templates and enterprise-wide compliance monitoring processes that cover all accessibility standards. This also provides a framework to negate or ameliorate the negative effects of human differences in interpretation.

King et al. (2004) undertook a study examining the responses to the use of a Web page design tool called TeDUB. The system uses a number of interfaces and representation techniques to make diagrams with unified modelling languages (UML) usable by blind people without the need for help at any stage by sighted people. The study was conducted with 36 users who reported positively on the system.

Zajicek et al. (1998) argued that the ability to search for relevant information efficiently and make quick and effective decisions is vital for BVI Web users. Zajicek et al. examined the Brookestalk Web browser prototype, a technology that offers these opportunities to users. The prototype employs information retrieval techniques to summarise Web pages allowing for efficient decision-making processing as to its usefulness for BVI users. Although positive results were identified, areas for improvement included: offering different voice options but making them optional rather than fixed; promoting different functional options to increase their usability; and a summary function that is more consistent with actual content, as on many occasions it did not clearly represent actual content.

Questions have been raised, however, as to the realistic possibility of providing universal accessibility. Edwards (1995) and Snyder (1994) investigated the development of graphical user interfaces (GUI) and argued that BVI users should have the opportunity to access information like sighted users. However, the problems associated with non-visual interface design relates to the inability to exploit the powerful visual element. Although adaptations including non-speech sound offer opportunities to create interfaces for BVI users, their relatively modest success to date is an indication of the inability of developers to capture the properties of visual channels.

Research by Edwards and Mitsopoulous (2005) investigated the ability of non-visual widgets to provide the communication of visual element for BVI users. The research concluded that although the current technologies are supportive, they do not clearly represent the visual environment. However, the technological elements are available, suggesting that further research may develop a suitable non-visual interface environment, moving closer toward universal accessibility.

Early adaptive BVI interfaces focused on auditory icon (non-speech sound) technology. Buxton (1994) and Gaver (1989) analyse the SonicFinder created by Gaver at Apple Inc. Sonicfinder is an audio software technology that represents visual actions via audio representations of that action. The system created opportunities for users to have a deeper and more flexible access to information in computer environments by creating a relationship between sound and information. Buxton argued that technologies such as the SonicFinder are vital to representing human traits in computer technology design more clearly. Further, taking into account sensory elements including feel, sight and hearing is vital to representing the sensory spectrum more thoroughly, providing a broad coverage of the potential information access opportunities. According to Buxton, technologies should be developed with these human traits in mind.

Earcon auditory (non-speech sound) technology is a further development that has been significantly researched, with the emphasis being on possible ways sound could enhance typical visual user interface environments. Brewster et al. (1992; 1993), Brewster (1998) and Bolke and Gorny (1994) examined Earcon technology in auditory human-computer interfaces and argued that the technology was highly useable and successful. Brewster et al. (1992; 1993) analysed the sound structure of Earcon technology and suggested that the structured nature of the technology and use of musical timbres rather than unstructured bursts of sound made it a credible communication technology. Brewster et al. (1993) also concluded that musicians were no better equipped to use the technology than non-musicians, suggesting the technology is quite simple to use, offering potential for BVI use. Brewster (1998) found that Earcons provided a more usable, structured interface than typical graphical user interfaces for many users, leading to greater productivity through the ability to reduce working error.

Petrie and Morley (1998) investigated the technologies for specific uses for blind people in the Microsoft Windows environment. Petrie and Morley's research found that task completion time was significantly shortened through use of the technology. Further, they provided guidelines for Earcon development. Bolke and Gorny (1994) analysed assistive interfaces, in particular the StereoPhonic User Interface for the Blind (SPUI-B) employing hearcon technology. Bolke and Gorny were particular interested in examining the problems BVI people faced in gaining sufficient feedback using the computer mouse. Employing spatialised sound, the BVI user can customise their interface environment creating more flexibility as an assistive tool. However, Bolke and Gorny suggested that graphical issues indicated that the ability to develop adaptive interfaces that retain similar powerful characteristics as graphical interfaces was minimal.

Alty and Rigas (1998) argued that typical graphic user interfaces shut out blind users. Their research advanced Earcon research and investigated the use of music technology to communicate information to BVI users employing an auditory interface. Although the system was potentially promising, problems were identified relating to context in understanding content. Alty and Rigas argued that further research needs to identify the musical interpretation capability of users and how to provide perceptual support.

Vickers and Alty (2002) investigated potential musical structures to present complex information in computer language programming environments. Their research found that music could be used as a successful communication medium. Further, users would not require musical training to use the system. In a similar study Alty et al. (1997) found that music has potential uses within standard GUI environments, including program debugging and algorithmic audiolisation, further suggesting universal uses of the technology as well as for BVI use.

In a study examining the MOOSE haptic interface, O'Modhrain and Gillespie (1997) argued that this technology is feasible and useful, particularly given that it was Microsoft Windows compatible. O'Modhrain and Gillespie discussed future opportunities to use the technology employing the Web. Jacobson (n.d.) investigated map provision employing the NOMAD and "Talking tactile maps" technologies. Through providing a tactile and auditory (multimodal) feedback interface, Jacobson suggests that the strengths of the technologies are in their simplicity and that they have vast opportunities to develop with the Internet and be useful also for sighted users.

Jacobson (n.d.) suggested that materials should be presented in a combined tactile and audio presentation. In an experimental environment, Asakawa et al. (2002) tested the auditory/tactile interface among BVI users, gaining positive results including that subjects could identify visual representations. The auditory component was suitable for intuitive recognition while the tactile component suited synthesising information that required concentration. This suggests that the auditory/tactile interface retains strong potential and with further research into commercialisation could present a valuable supporting technology.

The varying results of each research initiative into haptic and tactile assistive devices suggest that close performance monitoring will be required to develop each system to promote usability and feasibility. Hayward and Astley's (1996) study developed specific guidelines and performance metrics for haptic technology design. The metrics included peak force, peak acceleration and frequency dependence. Hayward and Astley argued that haptic technologies are different from traditional robotics due to the bi-directional or read-write focus, thus requiring revised performance measures that take into account the human connection to the technology. Coutaz and Caelin (1991) developed a taxonomy to evaluate multimodal interfaces and identify the differences between multimedia and multimodal systems. The French Pole Interface Homme-Machine Multimodale system provides an analysis tool to develop understanding of the adequacy of multimodality and to develop tools to provide adequate multimodal systems. Coutaz and Caelin developed a classification system and discussed the implications for technology architectures.

***General access technologies***

Winberg and Bowers (2004) analysed assistive and cooperative interface technologies to facilitate collaboration between blind and sited users. In an experiment, blind and sited participants were paired and worked through a series of tasks using sonification technology. Results suggested that the sonic interface provided an appropriate technology to facilitate collaboration. Further, Winberg and Bowers provided ideas for future development, including manipulability of interfaces, provision of relevant functionality, and developing coherence between the sonic and graphical interfaces.

Davis (n.d.) examined a range of different tools for blind and visually impaired people including mainstream and specialist media. The examination included analysis of such factors as media guidelines, media appropriateness, and the knowledge of visual impairment issues by producers of media tools. The Braille 2000 Working Party (1999) identified the necessity of updating Braille codes and practices in Australia to reflect the characteristics of changing technologies. In particular, the research investigated resource issues for training of the visually impaired, including the development of SmartCard technology.

Many researchers have investigated haptic and tactile visualisation technologies including the TACTICS tactile system (Fritz et al., 1996), Impulse Engine 3000 (Colwell et al., 1998), MOOSE haptic interface (O'Modhrain & Gillespie, 1997), PHANToM (haptic graphing) interface device (Brewster, 2002; Fritz et al., 1996; Massie & Salisbury, 1994), NOMAD and "Talking tactile maps" (Jacobson, n.d.) and Web-based auditory/tactile interfaces (Asakawa et al., 2002).

These technologies employ tactile and haptic functions to provide virtual textures and three-dimensional objects for blind users in Web-based virtual environments. Brewster (2002) reports on a study examining the use of non-speech sounds combined with haptic and tactile (multimodal) techniques to allow people to interact with visual data in the form of graphs. The two studies found that the combined techniques improved the speed and effectiveness of the visualisation process over individual methods.

Fritz et al. (1996) argued that the TACTICS and PHANToM system provided a significant opportunity to acquire information without requiring vision, and argued that these tools could also be used by sighted people, suggesting again that a universal approach to design was relevant. However, Fritz et al. argued that although the technologies contained significant promise, the feasibility and economics of producing these technologies for large-scale use was questionable.

Colwell et al. (1998) also warned in their study that in designing haptic interfaces it cannot be assumed that outcomes for blind users will represent the intentions of the designer, suggesting that although haptic technologies have potential, further research is required to develop a closer fit. Both groups suggest that the technologies provide considerable potential for blind users but require significant research.

***General living access***

Infrastructure development is a key issue with regard to BVI access to services. Barlow et al. (2005) examined the issue of BVI pedestrians' use of current methods for negotiating signalised crossroads. They found that BVI pedestrians encountered considerable difficulty in: locating crosswalks; aligning to cross; determining the onset of the walk interval; maintaining a straight crossing path; and completing crossings before the onset of perpendicular traffic at complex signalized intersections (Barlow et al., 2005, p. 587).

In their submission to the Productivity Commission Review, entitled the Review of Building Regulations, Blind Citizens Australia (BCA) make the point that the current Australian Disability Discrimination Act (DDA) (2003) does not provide instructions for builders or designers for the provision of Braille, raised tactile or audible maps or signs, or safe and detectable paths to a building from a street.

Standardisation through industry-based codes was suggested as having a significant impact on the development of the design environment, providing a possible solution. Further, the BCA (2003) argued that although recognition of the needs of BVI citizens was developing, there was still the need to upgrade physical infrastructure to provide tactile ground surface indicators, audible announcements on public transport, and Braille and tactile signage in necessary areas, on a continuing basis.

The BCA (2003) argued, however, that the impact of the DDA in recent times had improved access to building facilities, signage at public toilet facilities, shopping centre and product signage and access to banking services and public transport. This suggests that the legislation is having a positive impact on BVI citizens but must be developed further. Thus, more work needs to be done to implement change more practically, thoroughly and effectively to provide for all BVI users.

***BVI women***

BCA (n.d.) examined the situation of visually-impaired women within communities in relation to training and development. In particular, the BCA research aimed at investigating and developing support networks for women, and identified that information access is limited and requires a greater awareness of the issues among the wider community. Ruben (1997) suggests that BVI women required two main areas or rehabilitation – independent living skills and vocational training.

Although the current philosophy towards placing the BVI person in charge provides autonomy to access services and support confidently, this has not always proved successful for women. Evidence suggests that the majority of women in need are elderly and have more limited access to adaptive equipment and skills (Ruben, 1997). This, together with a lag between the time of training access and enacting of skills, determines that a high level of support is necessary. Mentoring and job shadowing are identified as two possible solutions.

***Government services***

BCA (2003) found that the Federal Government has not been fulfilling all of its responsibilities regarding access to technologies, services and information, but

noted that the situation was improving. BCA's research identified impediments that continue to hinder developments, including failure to incorporate BVI requirements in the design of all programs, Web site and building inaccessibility, public transport access, employment discrimination, limited prisoner access to rehabilitation services and education, and lack of student access to services, resources and teacher support. With limited access to funded service provision, BCA (2003) suggests the current trend towards self-service is a serious problem that is deterring BVI citizens from engaging in everyday activities.

***Research directions***

An examination of BVI learning skills and adaptation to learning environments presents an interesting view of BVI educational development. Newell and Gregor (1999) posed an interesting argument, suggesting that BVI students develop and retain "special skills" that enable them to operate successfully in learning situations. Further, these skills can provide long-term contributions to employment and are skills that able-bodied people may only use or develop in emergency situations.

Newell and Gregor's (1999) argument suggests that abled people are rarely able to practise these special skills and hence they would be considerably underdeveloped compared to their disabled counterparts. Examples include a deep understanding of auditory environments and understanding and use of non-visual information. Newell and Gregor argue that these environment need to be researched to understand the facilitating elements in order to incorporate this understanding in the design of appropriate technologies. Further, this will develop the understanding that researchers and practitioners have of communication issues with BVI users.

In British studies, Meads et al. (2003) and Meads and Hyde (2003) investigated the national cost effectiveness issues of age-related macular degeneration treatment and the associated costs concerning employment of doctors and training. They suggested that the development of drugs, technologies and training are expensive, and current research into cost-utility is inconclusive, requiring significant research, discussion and government support. Thus, conjecture and uncertainty regarding the real costs of BVI and accountability is evident. However, all researchers agree that the costs are necessary to ensure appropriate living standards and conditions for BVI people.

Noonan (2000), Simpson (1999) and Astbrink (1996) investigated technologies including television, audio, SmartCards and Braille in social situations including education and employment. Noonan's (1999) investigation of social issues includes employment conditions in relation to e-commerce initiatives. The study found that there was a lack of research into issues associated with disabilities and e-commerce and an unexpected general lack of awareness by the e-commerce industry regarding disability and accessibility issues. In addition, there appeared to be little research examining the effects of disability on employment participation.

Newell and Gregor (1999), Biermann (1997) and the National Science Foundation (1997) discussed the growing awareness of the needs of disabled people with regard to access to information. They argued that a structured research strategy is vital to ensuring these needs are met. The research themes included the following:

- Creative interfaces capable of understanding the full spectrum of user diversity in motivation and interests, abilities, knowledge and experiences.
- Understanding and representing user diversity. What really are the functional characteristics of all potential users?
- Common dimensions on which users can be classified (e.g., perceptual and motor abilities, educational, cognitive maturation, literacy).
- Dynamic (rather than static) characterisation of users.
- Flexible interfaces and universal design.
- The development of technology that adapts to the user's requirements rather than the user having to adapt to the technology, including self-adapting and learning interfaces and interfaces which predict user behaviour.
- What kind of information is each modality more suited to expressing, and can/should/how do we perform effective inter-modality transformation?
- How do people with disabilities (particularly sensory ones) perceive particular types of information?
- How can we present information in different modalities without changing its meaning (e.g., subtitles)?
- How do we translate information across modalities?
- How best do we present information most effectively to people with disabilities in the various modalities (e.g., slow/fast speech) and what does this tell us about improving our presentational techniques for ordinary people?
- Universal representations of data to give appropriate "hooks" for those situations where one modality is not appropriate (e.g., auditory versions of icons and pictures, when the users are visually impaired or their eyes are busy).
- How to design interfaces which do not require good memory and language abilities.
- How to design cognitive prostheses: this is an immensely difficult problem, and one for which there is a very great need. As the world gets more complex, and more reliant on vast amounts of data, we will all need good cognitive prostheses, not just the elderly.

Newell and Gregor (1999) point out that these themes were developed from the initial agenda of how to provide universal access, rather than the issue of improvement in human-machine interface design. This suggests a focus on the wider cultural process of access rather than on the specific technology to facilitate it.

***Summary***

The literature on what might be termed general issues of living for BVI people concentrates on two major areas. The first is general access and the technologies that might facilitate such access and the push for universal design. The second area is Web access technologies. The literature suggests that some headway has been made in terms of awareness of issues of general access and mobility support but much more is needed. The principles of universal design are becoming more widely known but are not always observed. The research literature on assistive technologies has concentrated overwhelmingly on Web access devices. However, the quality of the research is variable and thus it is difficult to draw definitive

conclusions. Some acknowledgement of this may be found in the calls for the development of metrics for evaluating assistive technologies.

## Conclusions

The literature surveyed for this project allows one to draw certain conclusions about the situation for blind and vision-impaired people in terms of the aspects that assist and inhibit learning, working and living. These aspects include a variety of technologies but also include funding and the cost of assistive technologies and the attitudes of sighted people to BVI people in schools, the workplace and the community. The literature examines assistive technologies, but provides little indication of the ways in which a range of technologies might work together. In terms of work and BVI people, the literature explores issues of employers' and employees' attitudes to BVI people and the biases that arise from misconceptions about the kinds of work BVI people can and cannot do. The literature does provide some limited examples of transition programs that appear to assist BVI students to move into occupations more appropriate to their abilities. In addition, the literature includes examples of specific assistive technologies that have allowed individual BVI people to work successfully in occupations that require high-level skills that would generally be regarded as limited to sighted people. The literature on general living concentrates on access generally and Web access specifically. In terms of access generally, the research examines and extols the virtues of a "universal design" approach to the development of all technologies, where features that make devices BVI-compatible are automatically built in rather than being an add-on. Access to information via the Web is an important topic for research with a concentration on technologies to assist BVI people to access the Web.

# Research Methodology

The research methodology for this study is both descriptive and analytical. The orientation is qualitative in that the research sought to use the literature to provide a broad description of issues and themes concerning BVI people. To this broad description is added the more in-depth data and analysis provided by semi-structured interviews with BVI people in employment and education, and people working with BVI students.

The project was undertaken as an exploration and mapping exercise. That is, the aim of the methodology was to provide an examination and analysis of the current situation in terms of visually impaired people's use of technologies to assist learning, working and living. The methodology for the project consisted of a literature review followed by semi-structured interviews.

***Literature review***

The literature review consisted of a review of Australian and international research into the related issues of visual impairment, learning, working and technologies. Further, the literature review was used to inform the development of the interview questions. The search provided two kinds of documents. The first were reports by researchers on studies examining topics related to blindness and vision impairment. These ranged from reviews of research literature to individual studies. These are included in the review of literature section. The second documents are those that include government publications such as policy documents (but not research publications), and submissions to government by NGOs and community groups. These latter kinds of documents have been utilised within the literature review in this research as they constitute the views and opinions about BVI of particular groups. They contribute to an overview that includes views from groups, government departments, and international perspectives. These documents thus provide the basis of the overview that complements the more fine-grained data obtained from individual BVI people from the interviews.

***Semi-structured interviews***

Semi-structured interviews were the other data source for the study. The interviews are described as semi-structured as they conformed to the pattern of comprising a standard set of questions that were asked of all interviewees. In addition, the interviewer was able to explore areas of interest to the research revealed by interviewee responses to the standard questions or to responses to exploratory questions. Semi-structured interviews were used (a) to ensure that key questions were put to all interviewees, providing a comparative measure across all interviewees, using as the basis for the questions issues revealed in the review of literature; and (b) to reveal issues that were not identified in the literature. In this sense the use of follow-up questions provided a measure of "groundedness". That is, while the set questions were based on issues identified in the review of literature and predictions based on that material, the grounded nature of the follow-up questions allowed the respondents to raise issues that were relevant to their situation, but that were not addressed in the set questions.

***Research questions***
Specific research questions included:

- What are the current work and education situations for BVI people?
- What is offered to blind people concerning education?
- What are the future possibilities?
- What technologies are BVI people using to assist learning and working?
- How could the situation be improved?

These questions offered the research team the opportunity to investigate the issues openly to develop suitable recommendations for education and work development for blind and vision-impaired people.

***Research participants***
The initial intention with the research was that it would focus on BVI high school students and a selection of people who were employed and regarded as being successful in their chosen occupation. The criteria for making the latter judgement were quite subjective and based on evaluations of those who identified the person, or from information that was publicly available.

After the commencement of the project it became clear that additional categories of participants would be both necessary and useful. There were two reasons for this. Firstly, obtaining sufficient numbers of students for the study was always going to be problematic. Securing participation for research is always a difficult task as people are generally reluctant to put themselves under the microscope. This is particularly so for high school age students, who are going through a stage of life where they generally feel conspicuous, a feeling that could be expected to be intensified by being BVI. In a more general sense the reluctance was magnified in this case by the fact that most of the BVI population already feel conspicuous and in fact feel that they live life under a microscope. Secondly, it was decided that useful information and perceptions could be obtained from those who work with BVI students. As a consequence, four other groups were included in the study. These comprised teachers in BVI units, a student teacher training to become a teacher of BVI students, teacher aides within a BVI unit of a high school, and one high school teacher who has BVI students in her class. Thus the subjects included:

- 3 BVI people in the workplace (Group 1);
- 3 BVI high school students (Group 2);
- 2 BVI trained teachers of BVI students (Group 3);
- 3 Teacher aides (Group 4);
- 1 subject teacher who has BVI students in regular class (Group 5); and
- 1 BVI trainee teacher (Group 6).

Because the BVI community from which the participants come is located within a relatively limited geographic area, and because of the need to preserve the anonymity of participants, no further description of participants is provided. This is not seen as providing any limitation on the utility of the data or research generally because no attempt has been made to generalise on the basis of particular responses from particularly individuals with particular circumstances.

***Data Analysis***
Two approaches to the analysis of data were adopted:

- Firstly, the interviews were analysed manually to identify key themes and ideas;
- Secondly, the interview transcripts were analysed using Leximancer automated text analysis software. This second analysis served three purposes: (a) it provided a measure of confirmation and where necessary, adjustment of the themes and ideas derived from the manual analysis of interview data; (b) it addressed the issue of researcher bias that could distort the manual analysis of data; and (c) because the Leximancer analysis is capable of analysing all data simultaneously, it was possible to detect more overarching themes and relationships than might be the case with manual data analysis.

## Manual analysis of interview data

In the six sections that follow, the key points to emerge from a manual analysis of the interviews are summarised. The points are not necessarily in the same order and some questions (which are included in the Appendices) were not addressed. However, the summaries represent interpretation of the questions by the respondents and the aspects that they considered important. At the end of each section a summary is provided. The summary attempts to represent not just the responses to the questions but the emphasis placed on particular responses by each respondent. To accomplish this required a two-stage process where firstly, the interview tapes were played to identify all responses, which became the points below, and then the tapes were replayed to establish relative emphasis. This relative emphasis is captured in the summaries.

***Group 1. BVI people in the workplace***
The points identified below are the summaries of the responses to the questions listed in Appendix 5. However, they do not always correspond directly to the listed questions, because people's responses did not always correspond precisely with the nature of the questions posed. In addition, the nature of follow-up questions varied across participants.

***Employee 1***

- Importance of having a job
- Fear of change
- Need to feel part of a team
- Need to feel a sense of equality/equal ability
- Ability/need to advocate for oneself. This requires determination
- Life is a battle
- Fear of being perceived as the most dispensable employee within the workforce
- Technology supports independence/productivity
- Self-training in the use of technology and developing adaptive strategies to meet work needs is important to success

- Minimal/inadequate provision of training in the use of technology and adaptation to workplace needs
- Importance of an understanding and supportive employer/manager to success in work
- Negative/disabling impact of the attitudes of sighted people including co-workers

***Employee 2***

- Need for technology to assist mobility and to allow reading in public places
- Recent government funding cuts have made mobility more difficult
- Affordability of tertiary education relating to mobility and access needs
- Low expectations of BVI by sighted people makes things harder and the need for self-advocacy/determination
- Time taken in travel and limitations of public transport
- Importance of work for psychosocial wellbeing and additional income
- Importance of engagement in generic interests, i.e., horse-riding, gardening
- Flexicare assistance with reading mail etcetera and shopping
- Blindness as motivation to take interest in a wide range of things
- Limited by people's expectations of BVI people in career goals
- Belief that there is more to life than work
- Belief that BVI have less access to professional work and consequently are not comparably respected
- Reliance on government Disability Pension and DEET as well as personal determination/perseverance to achieve personal/career goals
- Impact of lack of family support
- Mobility needs
- Importance of being able to think independently – "You'll always find someone who knows better than a blind person"
- Regaining hearing in preference to sight (Note: hearing was lost in 40s; while born blind)
- Technologies used – dictation machine (Lannier), STD computer with JAWS. Synthetic speech screen reader. I have a special box that links all together and used with one ear, rather than two ears. Windows XP and Outlook. JAWS, Openbook scanning software – it will scan and read, bar code reader, SARAH – scans and reads and CD player which is DAISY (Digital Accessible Info System) compatible, PARROT
- Need for speech accessible DVD players
- Awareness of design for mobility overseas – sound-activated devices in walls and speaking trolleys
- Importance of healthy attitude by sighted people towards BVI
- Prohibitive nature of Newstart initiative
- High cost of technology

***Employee 3***

- Arouses suspicion that he is not vision impaired
- History of deliberate change, learning new skills
- Motivated to help others for reasons including the need to remain active and productive
- Technology used

  Pocket Frame – cuts Braille paper into size for use in Braille printer

  Parrot Plus – pocket size phone book with memory for approx 50 msgs

  Window Eyes – speech program like JAWS (which is seen as the industry standard). It is cheaper than JAWS and has accelerated speech
- Innovative

***Summary***

Three aspects of living and working emerged as important to employed BVI people. The first was the need to be gainfully employed, for both financial and self-esteem reasons. The second was the sense that life as a BVI person was a struggle, largely because of the inaccurate and inappropriate perceptions of fellow workers and people in general about the nature of the disability. This, in turn, meant that sighted people perceived the disability as placing more restrictions on what BVI people can do than is in fact the case. More importantly, given that in a real sense we never know what any human (including BVI people) is ultimately capable of, the perception reduced the degree to which BVI people are "given a go", despite interview data indicating BVI people want to and are prepared to do so. The third was the response to the question about technologies. All used a range of technologies. There was variation in what was included under the term technology, with some seeing it as ways of accessing information while others saw it as any device that assisted, ranging from talking books to audible direction strips. The high cost of assistive technologies was raised by all respondents as a problem.

***Group 2. BVI high school students***

***Student 1***

- Conscious of the nature of "seeing" through other senses including sound, spatial awareness
- Use of the word "see/ing"
- Use of nicknames, e.g., "blindies", "sighties"
- The importance of and need for full participation in all aspects of life and school
- Recognition of schooling as a means to employment
- Significance of family/parental influence on career aspirations
- Need to be independent
- Preference to stay within comfort zone
- Limitations of technology/software, e.g., JAWS and/or Web sites
- Use/fulness of technologies that minimise the need to learn "non-standard" features/functionalities

- Use/fulness of technologies that appear “standard/conventional” but equipped with assistive technologies/software
- Use of Braille for symbol-heavy (non textual) material
- Strategies to access costly technologies, e.g., pirating
- Importance of having control over one’s life and independence
- Ability/need to self-advocate/determination/persistence
- Need to feel a sense of equality/equal ability
- Frustration/determination arising from limited choices/abilities
- Nature of acceptance of blindness – I wish it were not so but I have to get on with it
- Negative/disabling impact of the attitudes of sighted people including teachers
- The desire to seek out their own kind
- Need for assessments/software to be designed for blind/VI students
- Reluctance to use white cane because of perceivable difference
- Life is a battle
- Need for designing for mobility

***Student 2***

- Time spent at support unit productive
- Career choice
- Unaware of influence on career choice
- Difficulties arising in the company of sighted peers
- Enjoyment of generic/mainstream activities
- Preference for being sighted
- Technologies used
- Limited use of Internet through choice/lack of need
- Generic/mainstream interest in pop stars
- Adaptive technologies that inconvenience sighted people
- Need for assessments/software to be designed for blind/VI students
- Need for designing for mobility/reading in public places

***Student 3***

- Time spent in BVI unit useful for catching up and resting from all the walking
- School’s inability to cater for more particular safety needs (brain tumour requiring a shunt) limits access to sporting activities
- Enjoyment of singing, art, music and maths
- Need for determination – imposing “can-do” attitude on herself
- Skilling of teacher aides – difficulty when teacher aide and teacher are talking at the same time
- Importance of teacher aide
- Nature of difficulty with reading – limited sight puts constraints that a fully blind person would have obviated with use of voice technology
- Psychological impact of impairment and willing herself to cope and achieve

- Awareness of some perceived “advantages”
- Preoccupation with impairment and brain tumour
- Ability and desire to help other BVI students is a significant motivator
- Desire for her sight
- Importance of being able to talk/imagery/journaling about condition/feelings
- Types of technology: use CCTV, magnifier, pico. Use pico in unit. Main school classes I use magnifier and a “handy slope”/”slope desk” – the angle prevents neck pain. Zoom text. A program called MAGIC for VI not blind, for typing and surfing the Web
- Need to carry technology around
- Believes in the need to know from external authority the degree of her impairment

***Summary***

The major point to emerge from the interviews with students was the need for affiliation – the need to fit in. This came out in the desire to have technologies that did not obviously flag that they were BVI,and the desire for technologies that students can work out how to use rather than having to be taught. Students expressed more personal reactions to the negative comments of their sighted peers. Uniformly, the students wished they had sight, with varying degrees of acceptance that they had to get on with life. However, they were aware of what they wanted from technologies and this provided some insights into their view of the world and of what they might be able to do in it. Familiarisation with technologies varied, with two using a wide range and the other a much smaller range.

***Group 3. BVI trained teachers of BVI students***

The points identified below are the summaries of the responses to the questions listed in Appendix 6. However, as with the employed BVI people and students’ responses, they do not always correspond directly to the listed questions, because people’s responses did not always correspond precisely with the nature of the questions posed. In addition, the nature of follow-up questions varied across participants.

***BVI teacher 1***

- Experience and training in BVI and special education
- Reframing by changing name of centre in order to change perceptions/relationships
- Role includes structuring, management, liaising with peers and external agencies and supporting students
- Trying to meet the need for self-advocacy and increase access to information and choices
- Recognition of the rate of change of technology
- Need for cooperation from parents, teachers, teacher aides and a shared vision
- Types of technologies – Zoom text, JAWS, picos, CCTV, hand-held magnifiers
- Size and weight limitations of technology, e.g., CCTV can be prohibitive
- Psychosocial problems of students not always related to BVI-ness

- Closeness of relationship between teachers and BVI students practised within a supportive rather than academic nature – "We tell them they (mainstream teachers) are their teachers, we are their support".
- Need for parents to encourage and allow children to be more independent
- Support of school admin allows flexibility – "We are not fighting admin"
- Aspirations for BVI students to participate in society as independent, self-advocating and productive members
- Satisfaction in the provision of an environment that supports and encourages BVI students to express themselves freely

***BVI teacher 2***

- Generic special education training
- Role in case management and functional social education
- Students enjoy doing "normal/everyday" things like making coffee, running under a sprinkler
- Need for students to understand why they are doing something
- Size and weight limitations of technology, e.g., CCTV can be prohibitive
- Influenced by Texas School for the Blind
- Support the practice of developing close interpersonal relationships between BVI students and teachers
- Lack of interim/transition traineeship between school and uni/TAFE
- Possible providers lack knowledge of needs of BVI students
- Range of technologies: Zoom text, JAWS, picos, monoculars, writing on board appears on students' screen. Laptops, gym technology. Water beeper. Cane. Talking calculators. Scanner turns pages.
- Impact of parental influence and need for their support and cooperation
- Aspirations for BVI students to set and achieve goals that they truly desire
- Emphasis on social rather than academic skills
- Lack of full-time BVI teaching positions

***Summary***

All teachers and teacher aides interviewed for the research were from the one BVI unit within a state high school. The unit is well regarded and all who work there appear committed to, and supportive of, the work of the unit. The key points to emerge were a belief that developing close relationships between BVI students and teachers was important, and that parents needed to understand that their influence was important and their support was vital to the work of the BVI unit. All staff is committed to providing as normal an environment as possible. A range of technologies is used, but staff noted that the size and cost of many assistive technologies was a problem.

***Group 4. Teacher aides in BVI units***

***BVI teacher aide 1***

- Few months experience with BVI students
- Perceives her role as helping students to cope and teachers to make material/methods more accessible

- Importance of care/love in helping BVI students at school
- Perception of happy and collaborative staff as contributing factor
- Absence of training for the job
- Need for better teachers who are strong in subject knowledge and classroom management
- Need for more teaching assistance
- Perceives a lack of care by mainstream classroom teachers for individual students
- Concerns re self-advocacy/protection of BVI students in out-of-school/social contexts

***BVI teacher aide 2***

- Absence of training/experience with BVI prior to current work but has worked as volunteer with sighted children
- Support with note-taking and socially related "levellers"
- Need for social/emotional aptitude when working with BVI
- Belief in need for BVI to achieve/fit in academically and especially socially; the impact of peers
- Believes that students at this location have a slight advantage in terms of familiarity with teachers
- Believes there is value in having a community culture
- Need for adequate staffing
- Value of assistance from independent stakeholders such as Lions and Rotary clubs
- Values support from school administration
- Desire for students to adjust well into society and be self-aware

***BVI teacher aide 3***

- Nature of experience – on-the-job training in adult education and primary special needs resource preparation
- Values working indirectly with students while providing psychosocial support
- Regrets but accepts insufficient turnaround time for preparation of teaching materials
- Focus on social skills at unit
- Need to overcome low expectations of parents
- Academic deficiency is most evident with students who have multiple disabilities
- Use of Braille according to students' needs/preferences – not regarded by school as imperative because other voice-based technologies seem to be preferred
- School's provisions are broad-range including BVI-friendly walkways etc. – The school is very supportive. No discrimination with kids. Try to keep walkways clear and have top and bottom rails and yellow paint and tactile matting

- Types of technology – JAWS, pico, CCTV, specialised kitchen, laptops rather than Braille machines. All students have access to laptops, either own or school's
- Tendency for teachers to sometimes seek "easy" relief - Some teachers might say "go back to the unit" if things get tricky
- Need for parents to raise their expectations
- Values courage and determination of BVI students

***Summary***

All teacher aides reported that the unit was a happy place to work and provided a positive, supportive environment for BVI students. Staff had a shared idea of the goals of the unit and worked collaboratively to achieve them. Teacher aides expressed the need for better training for working with BVI students. In addition, concern was expressed about mainstream teachers' attitudes to BVI students: that they were less prepared to persist when difficulties arose and were inclined to send BVI students back to the unit for a quick fix, even when the problem was not related specifically to the student's disability. All expressed concern about low expectations of BVI students.

***Group 5. Teacher with BVI students in regular class***

- Nature of teaching experience and expertise with disabled students
- Reason why schools have to develop their own system for supporting BVI students
- Cost constraints Site license
- Difficult – keeping track of where BVI students are and who they are with. Assisted with type-chart software
- Pivotal role of Head of BVI unit
- Interventions to support teachers and students – Adjustment book
- Has not had training for work with BVI students except info provided by unit staff
- Need for adapting teaching strategies/methodologies
- Need for social/structural interventions to assist BVI in regular classrooms
- The significance of achievements by BVI in helping them integrate, treated equitably
- Need to understand needs of BVI students
- How third parties could assist but possibly hinder more than assist
- Need for design of more portable technology
- Need for less costly technology/equipment
- Need for parents to maintain an active role even as kids get older
- Desire for full membership in society and setting goals that are personally valued

***Summary***

The response of the one mainstream teacher with BVI students in her class is to outline the changes made to accommodate BVI students and to note those features still required, for the school to be doing the best for BVI students. For example, the

use of software to track BVI students' progress, the intervention process to support teachers and students and the adapting of teaching strategies to accommodate BVI students in a mainstream class. Aspects noted as being required included better staff training, parental involvement and less bulky and cheaper technologies.

***Group 6. Trainee teacher for BVI***

- Aspirations as a teacher of BVI students for them to be independent
- Importance of student ownership and staff flexibility/willingness to accommodate
- Staff can be too accommodating
- Values gaining working knowledge of BVI students and the differences of BVI units among schools
- Perceived deficiency in academic training
- Need for skills to transition to life beyond schools/institutions
- Need for range of technologies including slope boards
- Favourable perception of support from parents and school administration for BVI students

***Summary***

With only two weeks experience in the BVI unit, the student teacher was reluctant to express particularly strong views; however, she did indicate that the success the unit achieved seemed to be due to shared views amongst staff about how BVI students should be supported. This included BVI and school administration staff. As an observer, the student teacher felt that staff were sometimes too accommodating to BVI students in aspects where they could be treated in ways more closely resembling those with mainstream students. The example given was conduct inside and outside the classroom. The issue of a lack of transition programs for life after school was raised, as were the problems of cost and portability of assistive technologies.

***Findings from manual data analysis***

All the participants in our research study were users of one or more forms of material technologies, many of which are also used by sighted people. These include white canes, raised surfaces in public areas, public transport, computers, TVs and CCTVs.

All the participants felt that they were reasonably proficient users of these technologies. Most reported a reasonably high degree of success in using these technologies to perform daily tasks and accomplish short- and long-term learning and work related goals. In this regard, most participants spoke with some degree of satisfaction and even enthusiasm about what they were able to do with the technologies they were using.

Where enthusiasm gave way to ambivalence, frustration and some resignation was when participants talked about how they accessed (or were unable to access) desired technologies and the difficulties they experienced as a result of extraneous circumstances surrounding their use of technologies. These fell into four main categories:

- Availability of technologies and infrastructure designed to assist BVI with their physical manoeuvring and access to and within public places. These reports are mirrored in the literature (e.g., BCA, 2003);
- Portability of technologies, e.g., moving CCTVs between classrooms and carrying equipment of significant weight and bulk as if it were a part of their physical body. This is part practical and part psychosocial problem, where BVI students do not want to draw attention to their disability or to their difference;
- Cost of technologies specifically designed for BVI people; and
- The attitudes and expectations of sighted people whether individually or as collective entities such as workplaces, schools and providers of goods and services toward and of BVI people.

So, the participants in this study could generally be described as ordinary people having to live a slightly extraordinary and sometimes exceedingly extraordinary life depending on what goals they set for themselves. The justification for this statement derives from the observation that mainstream society is designed and structured primarily for sighted people. Our data reveal the ramifications of this status quo on several levels:

- physically;
- financially; and
- psychosocially.

***Physically***

Physical access to and use of amenities and services is difficult, for example, negotiating steps in public places, especially in places that are not familiar to the user, or having to place greater reliance on taxis because buses and bus routes are not always convenient – given that BVI people are often travelling with extra physical baggage such as a Braille reader.

The technologies for BVI people are thus far predominantly adaptive technologies. In other words, these technologies are adaptations of technologies designed for sighted people. Such an approach to the provision of technologies for BVI people does not come without limitations.

In the case of a BVI person, the effort required in using technologies that are adapted from those designed for sighted people can and does pose problems above and beyond those that a sighted person may encounter. These problems arise in a range of situations, from keypads on older ATMs to Web pages. It would seem that built into these designs (whether intentionally or not) is the assumption that the user will recognize or be alerted when something has gone wrong. Sighted users often are able to see and respond to the alerts; however, this is not always the case with BVI users. For example, electronic forms can disappear or reformat without the users' knowledge.

On an even more fundamental level, the infrastructure in a society of predominantly sighted people does not comprehensively meet the needs of BVI people. The participants of this study felt that inadequate provisions were made for

them in a number of areas, such as public transport, access to goods and services, and mobility within public areas.

***Financially***

Technologies adapted for BVI people as well as those designed exclusively for them are significantly higher in cost than those designed for sighted users (e.g., digital book readers can cost up to $4 500). This makes access to needed and desired technologies difficult and sometimes simply unaffordable. Examples of these given by participants included voice-activated software, Braille machines, and reading books.

***Psychosocially***

There were a range of responses that have been classified as psychosocial on the basis that the responses relate to how BVI people feel and relate to others, in terms of them being BVI. Participants' responses included:

- Desire to participate fully and equally at all levels of society
- Do not wish to be held back in their goals because of prevailing lower expectations and unfavourable attitudes in a society dominated and designed for/by sighted people
- Feel that their needs are not met adequately and/or willingly – almost all report struggling/fighting to get equivalent treatment as their peers. In most cases it would appear that the lack of provision is not a deliberate one but more one of ignorance or oversight
- Do not wish to stand out because of their physical handicap whether in the classroom or in public places. Especially true for teenagers who are trying to establish an identity in which they do not wish to be defined by their blindness
- Do not wish to be treated as "needy", yet do not want their BVI-related needs ignored
- Regard their attitude as being the most important determinant of whether they succeed or not followed by the support of significant others, e.g., parents, partners
- Believe that they are limited in their choice of goals – mostly in music, IT, desk-bound administration. An exception is one lady who runs a very lucrative business.

## Automated text analysis of interview data

After manual analysis of interview data, above, data were analysed using the Leximancer automated text analysis software program. This involved analysing the data to identify significant themes and concepts and relationships between these.

***Leximancer automated text analysis[1]***

Smith and Humphries (in press) have demonstrated the utility of Leximancer for textual analysis. (*Note*. Leximancer can process a variety of file types, including .doc, .html, .htm, .txt, .xml, and .pdf.) Leximancer software is highly automated, extremely easy to use, and produces readily interpretable output from default settings. Thus, this kind of analysis is particularly beneficial in self-assessment of

[1] The following outline of Leximancer methodology is closely based on Grimbeek et al. (2005).

one's own activities, because it provides a fairly unbiased and objective method of reviewing complex text and a clear process of justifying decisions about text selection.

***Content analysis phases***

Leximancer commences content analysis by undertaking a conceptual analysis (thematic analysis) in which it detects and quantifies predefined concepts within the text. It continues this content analysis by undertaking a relational analysis (semantic analysis) in which it quantifies relationships between identified concepts within text.

During the initial conceptual phase, Leximancer scans the text to identify frequently used terms (concept seeds) from which it generates a thesaurus of terms. It also identifies names (e.g., start-of-sentence). It excludes nonlexical and weak semantic information (e.g., 9, &), and nontextual material such as menus. This phase of analysis can be turned off, so that self-defined concepts can be used instead. As part of this phase of content analysis, Leximancer identifies frequently used terms around which other terms cluster. For example, "fleas" and "bite" cluster around "dog", "hound", and "puppy". An iterative process ensues in which some of the potential concepts are eliminated. This process converges on a stable state containing most highly relevant concepts, in which a shortlist of concepts is defined by a longer list of thesaurus terms.

In the second phase of relational analysis, Leximancer measures the co-occurrence of concepts within text. It does so by specifying a set length of words or sentences (called window). It moves this window sequentially through text, noting co-occurring concepts (usually in three-sentence blocks). Results are stored in the co-occurrence matrix, which stores the frequency of co-occurrence of all concepts against all others. The results of this analysis can be accessed via a spreadsheet (spreadsheet.txt). The final stage of relational analysis (cognitive mapping) represents information vision for comparison (concept map).

***Concept mapping and other protocols for descriptive outputs***

The reporting of results utilises a series of descriptive analyses, the most immediate of which is provided by the concept map. The concept map provides a visual summary of concepts and their co-occurrences. The concept map provides information about the results of the content analysis in a number of ways, accessible via three slide bars (i.e., concepts, theme, and rotation). The concepts slide bar allows the viewer to vary the number of visible concepts to show only the most frequent or to include by increments those less or least frequently used. The rotation slide bar allows the viewer to rotate the array of visible concepts to optimise their interpretability, usually by aligning one of the most frequent – and conceptually relevant – concepts with the horizontal or vertical axis. The theme slide bar allows one to identify what might be described as prototypical concepts (i.e., highly frequent concepts around which others cluster). The size of thematic circles can be varied from (a) a minimum setting (Figure 1 – only concepts visible), through (b) intermediate settings where circles identify a number of locally distinct concepts, to (c) a maximum setting in which one or two thematic circles encompass all concepts.

## Results

The analyses reported immediately below summarise the totality of interview responses from staff in school settings, school students, and employees in the workforce.

***Initial analysis***

With the idea of selecting for relevance, unrelated concepts such as *kind, feel, think, Yeah,* were excluded, and semantically similar concepts such as *teacher* and *teachers*, *student* and *students* and *kids*, *impaired* and *vision, read* and *Braille* were merged.

Table 1. *Initial Analysis: Ranked Concept List*

| Concept | Absolute Count | Relative Count |
|---|---|---|
| students | 292 | 100% |
| work | 178 | 60.9% |
| school | 142 | 48.6% |
| teacher | 135 | 46.2% |
| people | 127 | 43.4% |
| time | 112 | 38.3% |
| vision | 104 | 35.6% |
| Braille | 91 | 31.1% |
| help | 58 | 19.8% |
| blind | 58 | 19.8% |
| computer | 49 | 16.7% |
| class | 44 | 15% |
| years | 42 | 14.3% |
| day | 41 | 14% |
| training | 39 | 13.3% |
| life | 27 | 9.2% |
| Jaws | 26 | 8.9% |

As one might expect, the seven most frequent concepts included *students, work, school, teacher, people, time,* and *vision (impaired).* It is important to note that the data in Table 1 do not represent a simple frequency count. The counts represent the number of each concept that has a significant relationship with the most numerous concepts, which in Table 1 are students.

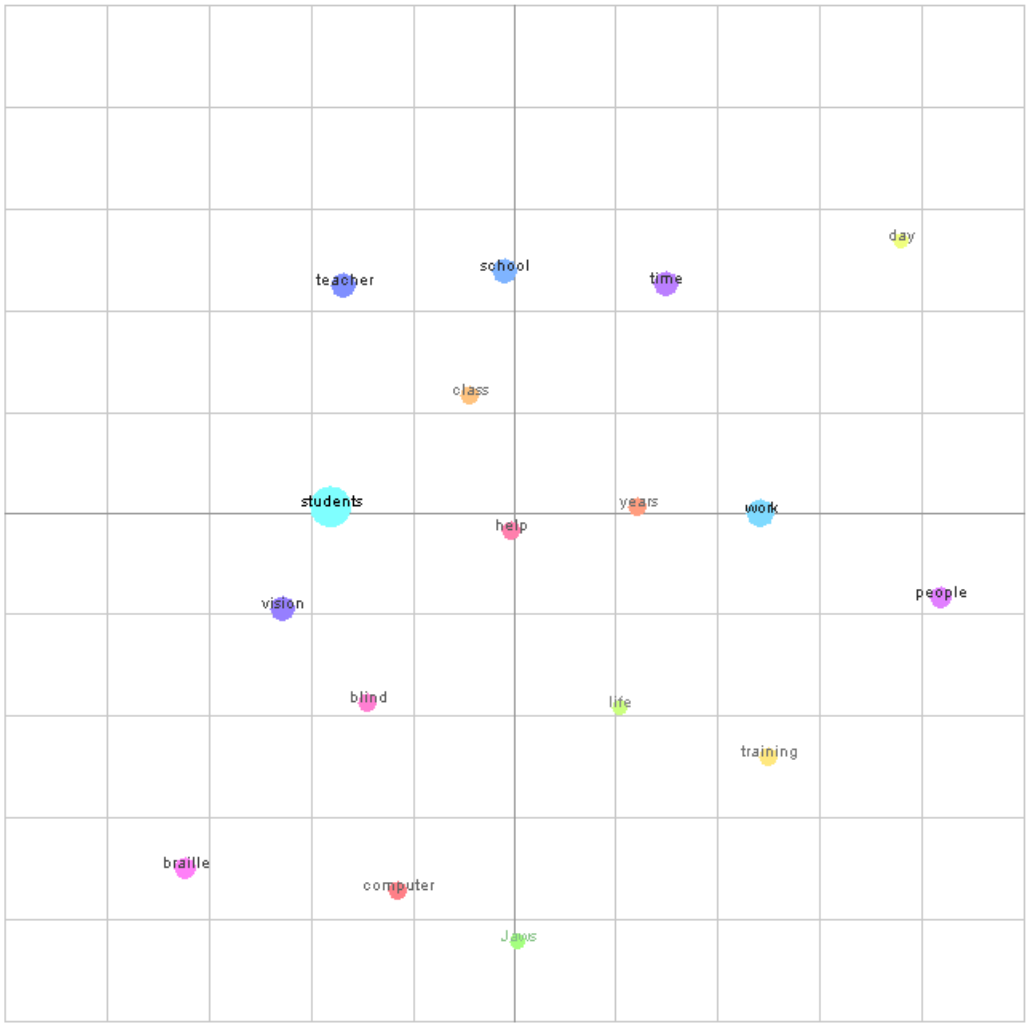



*Figure 1*. Concept map for all interviews, with the concept, *students*, aligned to horizontal axis.

The concepts in Figure 1 were rotated so that the most frequent of them, *students*, aligned with the horizontal axis, as did *years* and *work*. *School*, *help*, and *Jaws* then fell into alignment with the vertical axis.

With this in mind, the four quadrants can be understood as follows: The upper left quadrant reflects talk about students in relation to structural organisational settings (*teacher*, *class*). The upper right quadrant reflects talk about school and work in terms of dynamic aspects (*time*, *day*, *years*). The lower right quadrant reflects talk about what else is required (*JAWS; life*, *training*, *people*). The lower left quadrant reflects talk about the extent to which vision-impaired and blind students can use assistive technologies (*JAWS*, *computer*, *Braille*) to read and learn.

A more general reflection on the content of these interviews is that they tended to focus on school settings, on teacher training, teacher work, and teacher organisation, as mediating agencies in assisting blind and vision-impaired students to read and more generally to learn.

One of the more dire reflections to be gleaned from logbook extracts (see Appendix 7) is the extent to which teachers, teacher aides, and school administrators, though excited by the potential of assistive technologies, are also concerned by the lack of academic progress of these vision-impaired and blind students. Talk about educational achievement focussed on topics such as the extent to which these students fell behind as a consequence of being withdrawn from regular classes, and an apparent failure to provide instruction in Braille more generally.

In regard to talk about Braille, one question is whether assistive technologies suffice for vision-impaired or even blind students or whether Braille should be taught more universally.

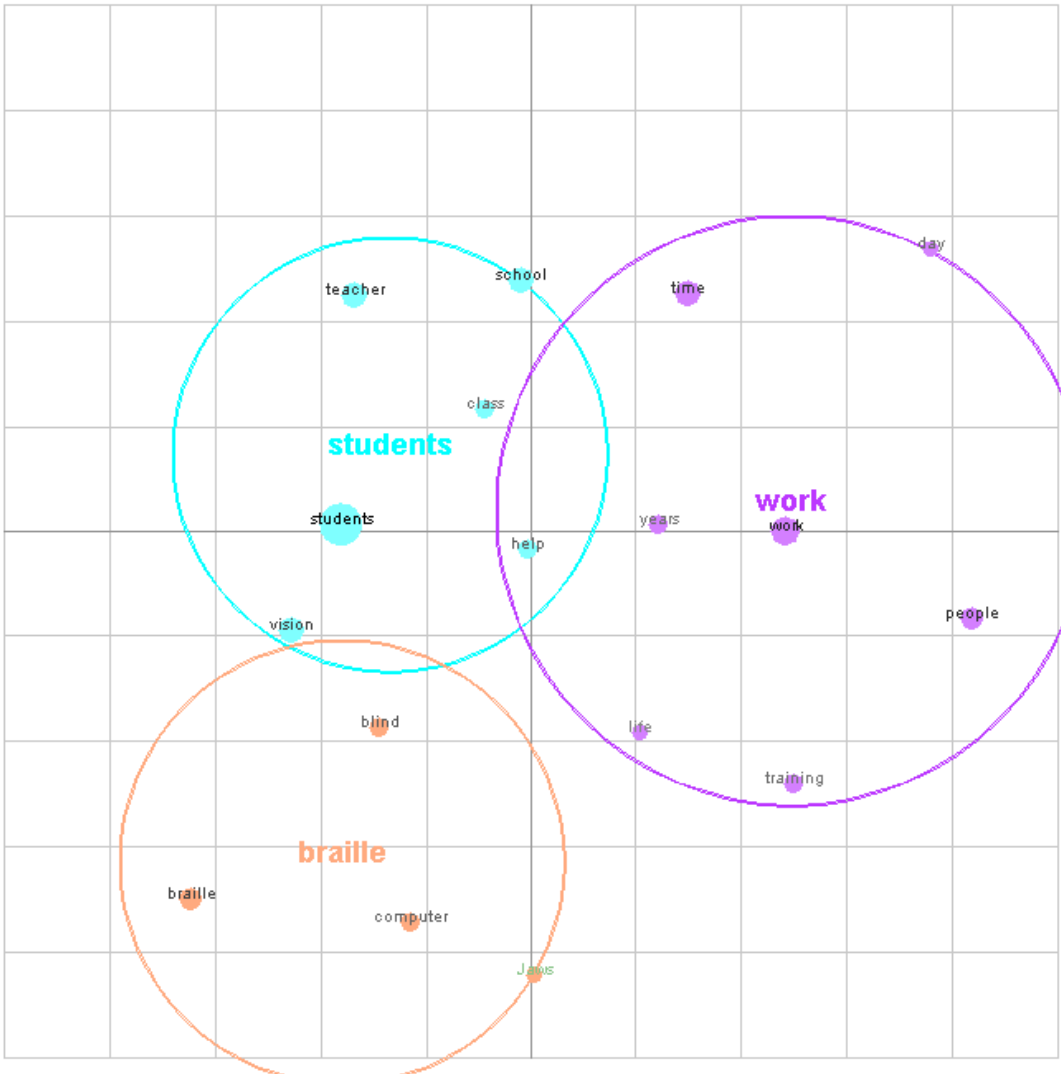



*Figure 2.* Concept map for all interviews, with the concept, *students*, aligned to horizontal axis, and thematic overlay

Leximancer includes an option that further highlights the influence of major concepts by overlaying thematic circles. As shown in Figure 2, the four quadrants, with the concept, *students*, aligned as previously along the horizontal axis, can be summarised in terms of *students*, *work*, and *Braille*. That is, another way of

summarising the talk across these many interviews is that they concerned the work itself, the students, and Braille.

In Figure 2, as indicated previously, work encompasses the dynamic aspect of school life, teacher preparation, and community support for this educative work. Talk about students focuses on the clients, vision-impaired students, in the context of the school, the class, the teacher, and the help to students available via these agencies.

Finally, talk about Braille focused on the extent to which blind (and vision-impaired) students benefit from assistive technologies, such as JAWS more specifically and computers more generally, as platforms that complement the teaching of Braille and assist students in reading and learning.

***Text analysis with staff, students, employees, and interviewer identified***

A limitation of the above analysis is that it does not identify the extent to which this material can be identified with the talk of staff, students, employees, or the interviewer. With that in mind, a follow-up analysis sets out to identify these more explicitly.

Table 2. *Tagged Text Analysis: Ranked Concept List*

| Concept | Absolute Count | Relative Count |
|---|---|---|
| Staff: | 752 | 100% |
| Stdt: | 536 | 71.2% |
| Empl: | 378 | 50.2% |
| students | 292 | 38.8% |
| work | 178 | 23.6% |
| school | 142 | 18.8% |
| teacher | 135 | 17.9% |
| people | 127 | 16.8% |
| time | 112 | 14.8% |
| vision | 104 | 13.8% |
| Braille | 91 | 12.1% |
| help | 58 | 7.7% |
| blind | 58 | 7.7% |
| computer | 49 | 6.5% |
| class | 44 | 5.8% |
| years | 42 | 5.5% |
| day | 41 | 5.4% |
| training | 39 | 5.1% |
| Int: | 33 | 4.3% |
| life | 27 | 3.5% |
| Jaws | 26 | 3.4% |

The list of frequently used concepts in Table 2, is as before, with the addition of Staff, Student (Stdt:), Employees (Empl:), and Interviewer (Int:) as frequently used names.

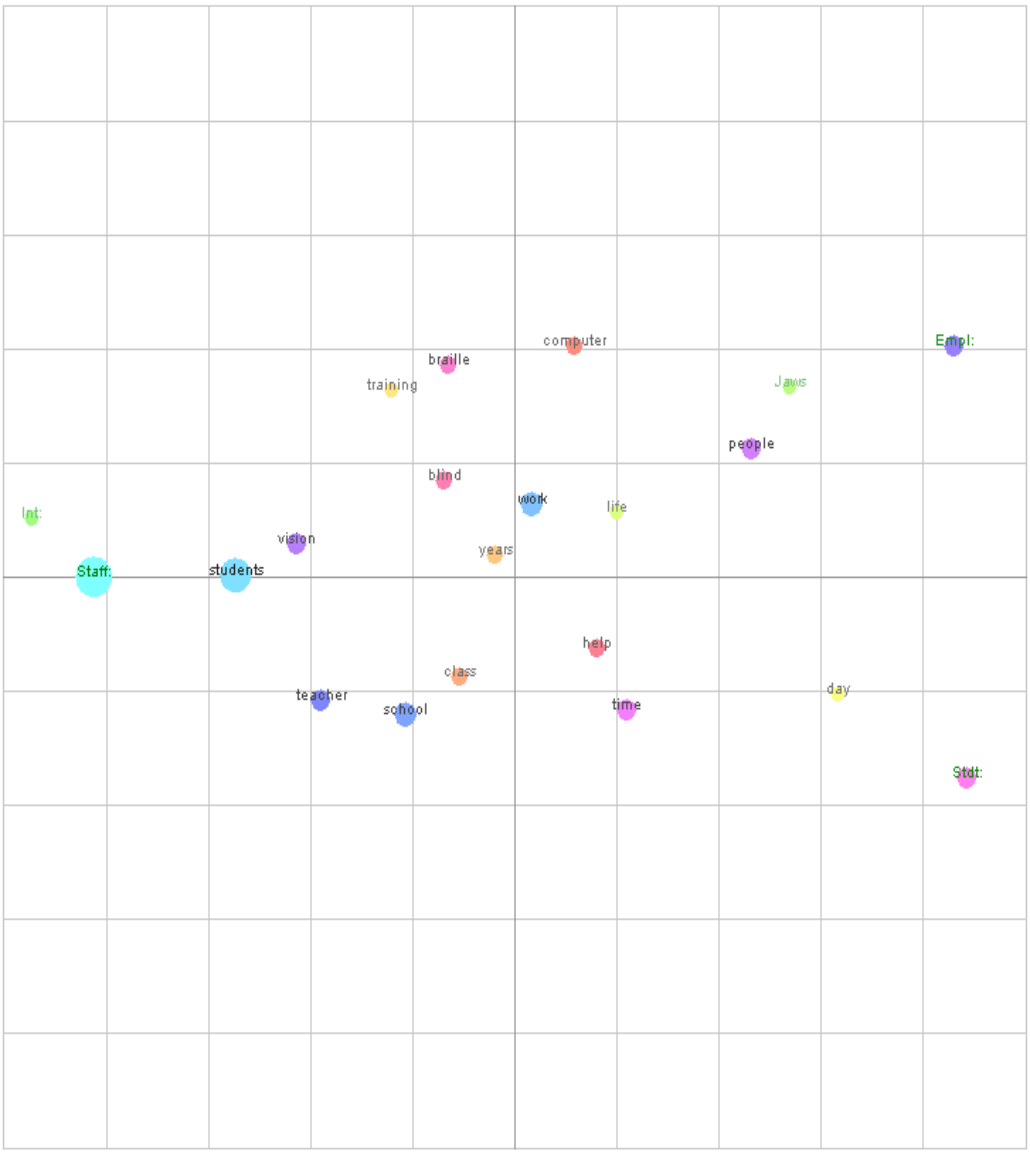



*Figure 3.* Concept map for all interviews, with the concept, *students*, aligned to horizontal axis, and participant tags.

With these names added, and the concept, *students*, aligned to the horizontal axis, the spread of concepts across quadrants in Figure 3 is much the same as previously, except that the display has inverted and quadrant contents have merged. Thus, the lower left quadrant is now related to structural aspects (*teacher*, *class*, *school*) and the lower right to dynamic aspects of school organisation (*time*, *day*). The upper half of the figure merges background considerations (*teaching*, *training*, *people*) and the use of assistive technologies, both software and Braille, to help students to read and learn.

What is of interest here is that school staff and the interviewer have clustered around content to do with the formal education setting, teacher training, and teaching Braille, whereas employees and students have clustered around content to do with the use of time, specific assistive technologies, and community support.

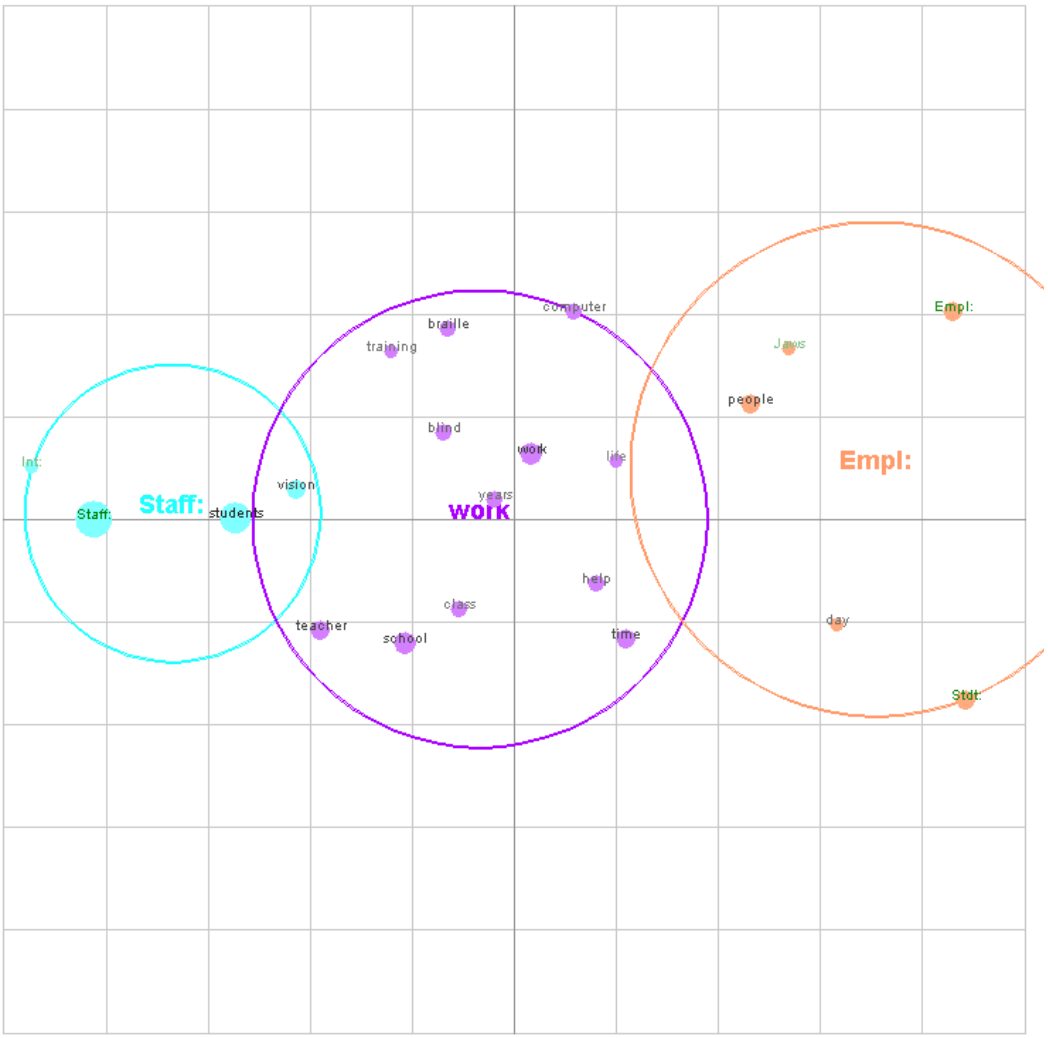



*Figure 4.* Concept map for all interviews, with the concept, *students*, aligned to horizontal axis, participant tags, and thematic overlay.

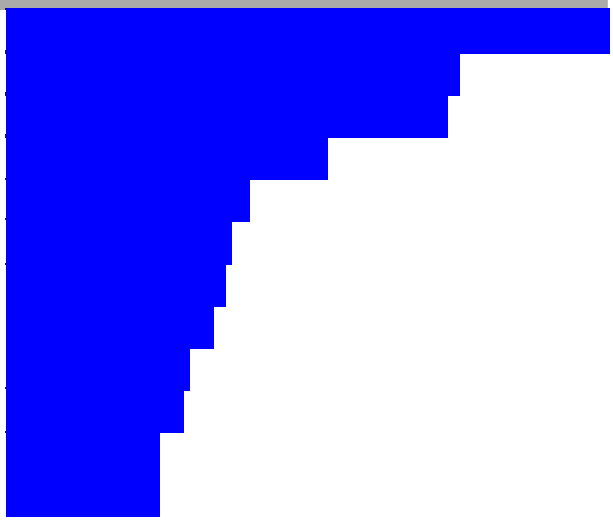
The addition of a thematic overlay in Figure 4 makes the division between school staff and the interviewer on one hand, and employees and students on the other hand, even clearer. While both parties focus on the work to be done for and by vision-impaired and blind students in school settings, they do so from quite distinct perspectives.

***Text analysis of student and employee interviews***

For this reason, the next text analysis in Table 3 and Figure 5 focuses entirely on the contributions of students and employees.

Table 3. *Student-Employee Text Analysis: Ranked Concept List*

| Concept | Absolute Count | Relative Count |
|---|---|---|
| people | 88 | 100% |
| work | 66 | 75% |
| time | 65 | 73.8% |
| school | 47 | 53.4% |
| Braille | 36 | 40.9% |
| help | 33 | 37.5% |
| day | 32 | 36.3% |
| teacher | 30 | 34% |
| computer | 27 | 30.6% |
| blind | 26 | 29.5% |
| Jaws | 22 | 25% |
| vision | 22 | 25% |



The seven most frequently used concepts in Table 3 include: *people*, *work*, *time*, *school*, *Braille*, *help*, and *day*.

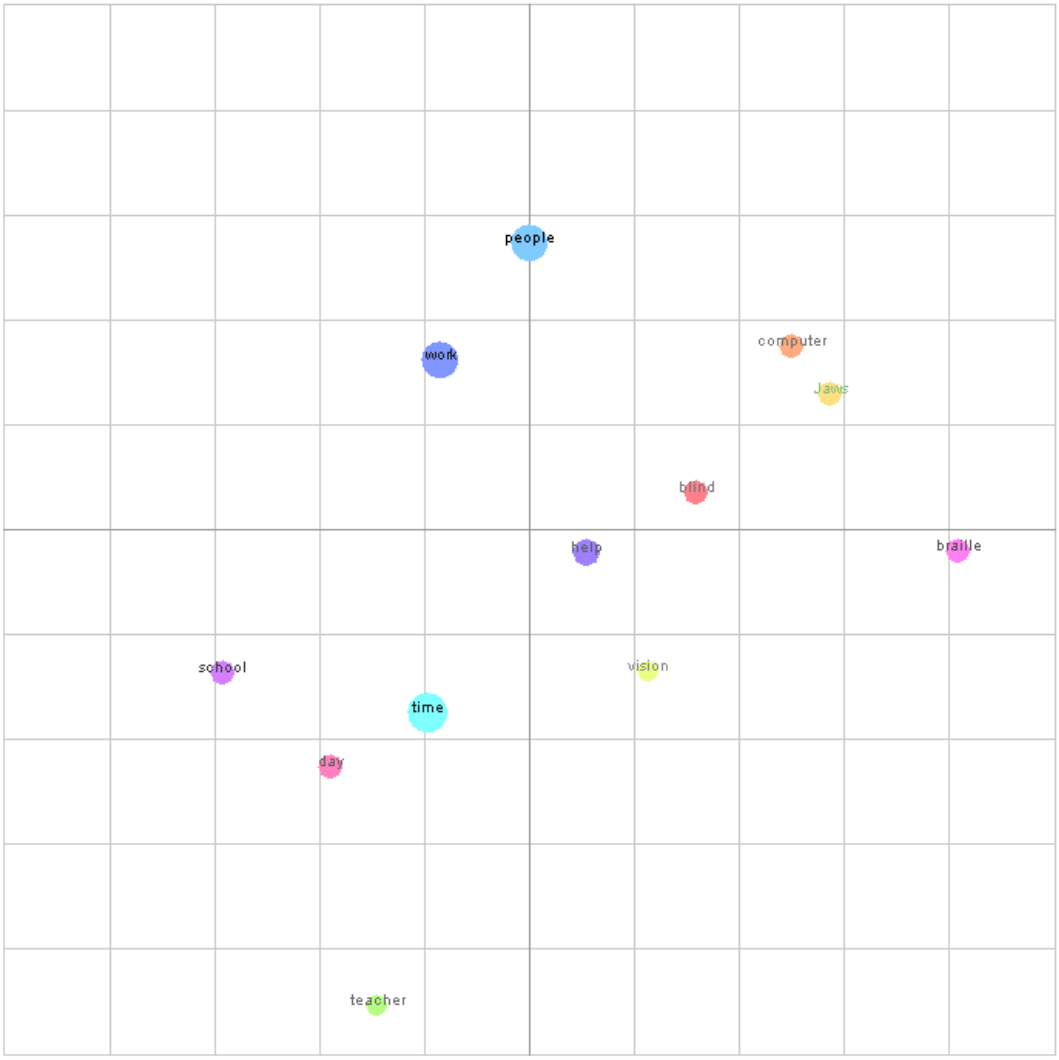



*Figure 5.* Concept map for student and employee interviews, with the concept, *people*, aligned to vertical axis.

The most frequently used concept in Figure 5, *people*, was aligned with the vertical axis. Bearing in mind that this concept tended to allude to supportive community figures such as the parental families, here, the students and employees appeared to talk about such people both in relation to their educational efforts (*work*: upper left quadrant) and in relation to the use of computer software, including JAWS, that might help blind students. With this in mind, the lower right quadrant focuses on the use of Braille by vision-impaired students, and the lower left quadrant focuses on spatial and temporal aspects of school organisation (*school*, *teacher*, *time*, *day*).

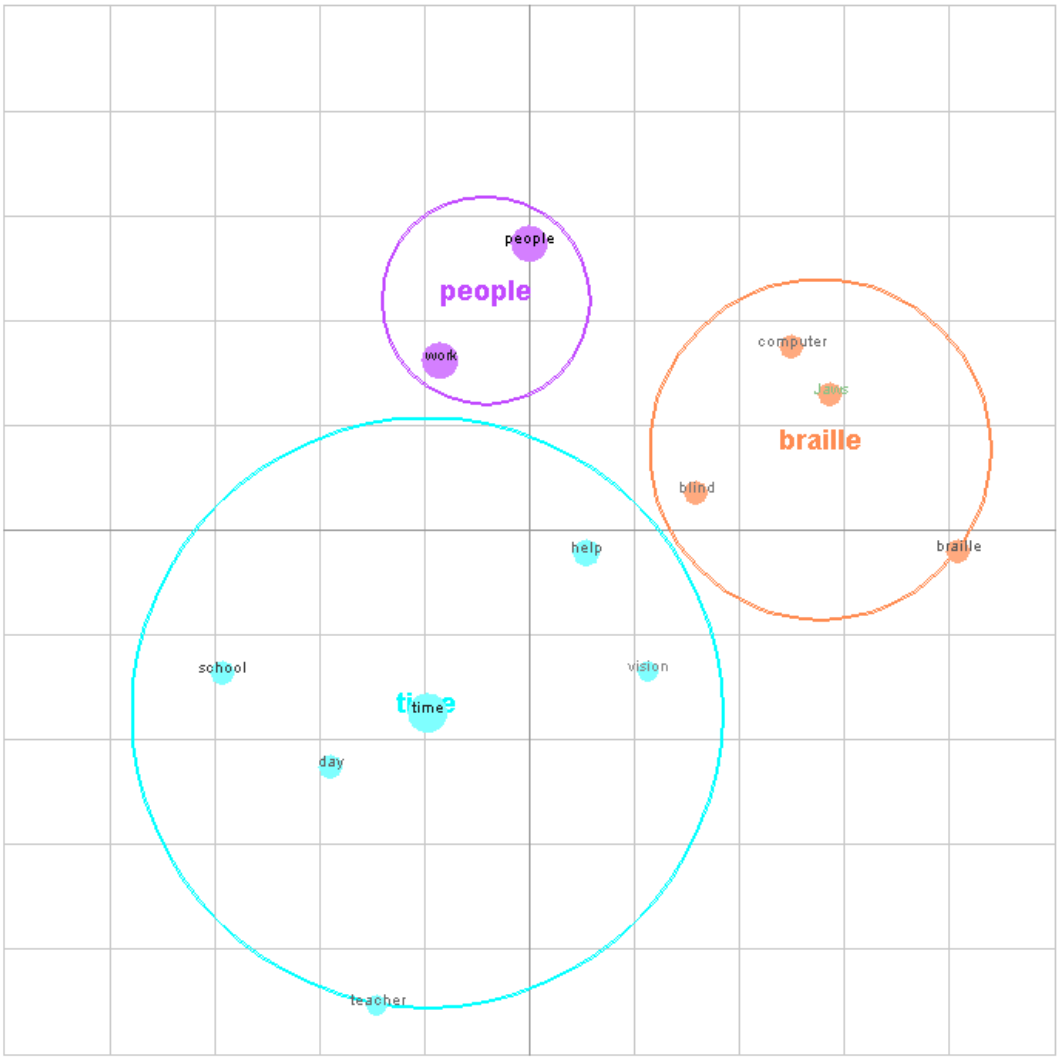



*Figure 6.* Concept map for student and employee interviews, with the concept, *people*, aligned to vertical axis, and thematic overlay.

These quadrant-based clusters are also consistent with the thematic overlay shown in Figure 6. That is, the concepts cluster around Braille (*reading Braille*), people (*people, work*), and time (*school, teacher, day, time, help, vision-impaired*).

Based on these clusters, one could conclude that students and employees tend to stress the importance of assistive technologies that include Braille, JAWS, and other methodologies that enable the blind to read and learn (and become employable).

Further, they stress the importance of community support in relation to the work required to gain employment.

Finally, they do not neglect the importance of both dynamic and structural aspects of school organisation as a means to help the vision-impaired gain those skills that can ensure future employment, more specifically, and an ordinary life, more generally.

# Findings and Recommendations

## Findings

***Findings from the literature***

The findings from the literature review are that while there are a comparatively large number of research projects being undertaken and reported, a large number of these are idiosyncratic, location specific, and in many cases it is difficult to see how they fit into the overall picture that might be used to improve learning and employment for BVI people. There are exceptions to this pattern with systematic studies over time examining significant aspects of BVI use of technologies. The Lockerby et al. (2006) study of the use of DAISY standard digital talking books is one example, and the National Longitudinal Transition Study (NLTS) and National Longitudinal Transition Study 2 (NLTS-2) are other examples. The Lockerby et al. study supported findings from the interviews that BVI people had a preference for technologies that did not flag their "difference'. The talking books can be used either on players that looked and had the functions of a CD player, or via software on a computer. However, the Lockerby et al. study concluded that most participants in the study preferred the players. There is strong support, however, for the teaching of Braille within the literature.

The government reports and submissions provided useful information in terms of government policy and its perceived shortcomings in terms of a wide range of access issues related to building codes and regulations. Findings from research espousing "design for all", "universal design" or "user sensitive design" provided positive examples of design approaches that could be developed further to provide additional assistance to BVI (and sighted) people and valuable positive social positioning of BVI people. That is, the knowledge by sighted people that the ATM they now find easy to use became that way in order that BVI people could use them, is an important message for sighted people to receive. The concept of discoverability rather than learnability of assistive device operating systems is also an idea that would be welcomed by BVI and sighted people.

The review revealed that there have been a significant number of studies undertaken to examine the use of a variety of technologies for accessing Web pages; indeed, this section represented the largest single part of the review of literature. The quality of the research reports varied and highlighted the need, expressed elsewhere, for the development of metrics for assessing technologies.

***Findings from the manual analysis of interview data***

The findings from the manual analysis of interviews need to be separated into those concerning employed people and those concerning learners. For employed people, a number of related conclusions can be drawn. Firstly, a range of assistive technologies are helpful and do, in many cases, make employment possible. What one can conclude is that BVI people feel the negative views about them and their capacity to work, while inappropriate and usually inaccurate, highlight the need to discover what BVI employees, in a range of occupations, might be able to achieve, and what technologies might be developed to make these achievements possible.

The findings from the analysis of the student data are threefold. Firstly, the overwhelming desire of school students is to fit in, to be "normal". The development of technologies that allow that to happen should be a priority. This includes reduction in weight and bulk of portable devices and increased emphasis on devices that do not require extensive training to operate. Secondly, students had a reasonable idea of what benefits technologies could provide and were quite proficient in using them. Thirdly, students were reasonably optimistic about their future.

Analysis of data about general living emphasised the difficulties BVI people encountered in accessing information, transport and the environment. However, all thought life was worth living despite being a struggle.

***Findings from the Leximancer automated analysis***

It is not surprising that educators and even the interviewer tended to focus on school issues per se. What is of interest is that students and employees (a selection of blind and vision-impaired people) emphasised the use of assistive technologies and Braille in the context of the support of influential community groups including parents, and in the context of the dynamic and structural aspects of school organisation. That is, students, employees, and school staff concur on the importance of appropriate school organisation, and in differing ways they emphasise the importance of assistive technologies in reading and learning more generally. If there is a difference of perspective it is in the relative weighting given to the school process and community support, and in the lack of student and employee interest in matters normally of interest to educators, such as whether staff are appropriate trained. That is, employees and students held a more pragmatic view about the world, that they wanted learning and support to gain suitable employment.

***Drawing the findings together***

In drawing together the findings from the literature review, the manual analysis of data and the automated analysis of data, some clear conclusions can be drawn. These can be addressed in terms of the two areas the research sought to address, namely learning and working, and the area that has emerged from the research, namely, living.

The literature review highlights the issue of the tension between learners wanting to fit in with their sighted peers, and their need to learn skills like Braille, that tends to set them apart as different. This tension does not emerge from either the manual or automated analysis of the interviews, with the interview responses focused on the need to fit in. In a similar way, the problem of insufficient numbers of teachers being trained in Braille features quite strongly in the literature, but training of specialist teachers only features once in the interviews, possibly highlighting the decline in the teaching of Braille, and indeed, of its role in learning.

In terms of employment, the literature allows one to conclude that negative peer and employer attitudes are a problem for BVI workers and that low employment is a problem for BVI people, as is employment at levels lower than qualifications or abilities. The literature does provide positive news in observing that there are

possibilities in terms of successful study-to-work transition programs, and the development of technologies that have allowed BVI people to work successfully in complex and challenging occupations. The expansion of transition programs and development of specific technologies would appear to be two areas for future growth. There was a clear correlation across the literature and employed interviewees regarding negative peer and employer perceptions, while there was little knowledge of transition programs or specialised technologies by interviewees.

The conclusions to be drawn about living are derived largely from the literature review and are concerned with research into assistive technologies and of issues like universal design and metrics for designers of technologies for BVI people. There are a large number of studies examining technologies for Web access, but almost no studies exploring how different assistive technologies might complement or negate one another in assisting BVI people in learning, working or living. There are few studies examining how various technologies work, in terms of the nature of the interaction between the person and the technology.

## Recommendations

The following recommendations are proposed as a response to the findings of the research. There is a need to:

- Undertake more research into all aspects of blindness and vision impairment;
- Undertake more overview research and research examining the ways BVI people interact with technologies;
- Lobby for the importance of BVI students learning Braille at an early age;
- Lobby for the training of appropriate numbers of teachers and support staff in Braille;
- Develop research studies into the role and value of the range of technologies in assisting BVI students to achieve educational and work goals consistent with their potential;
- Lobby for the development of specific work experience programs (such as those trialled successfully in the US) and undertake research into the utility of such programs;
- Develop more accessible (cheaper and less intrusive) assistive technologies;
- Develop assistive technologies sensitive to the psychological and social needs of adolescents. That is, technologies that allow them to lead as normal a life as possible;
- Lobby for the development of universal design where possible, to reduce costs, and improve the regard BVI people are held in by the sighted community flowing from the benefits universal design provides for all;
- Lobby for the development of technologies with operations that are discoverable rather than learnable. This is a sub-set of the aim of universal design, that again benefits all in the community;
- Develop self-advocacy through the learning of practical lifestyle management skills as well as skills in communicating effectively and confidently and participating in a range of social activities as equal members;

- Highlight to significant others, primarily parents and teachers, to raise expectations and encourage children to be more independent/self-sufficient. This involves professionals working with these groups to develop understanding about what is possible for BVI students to aim for.

## Appendix 1: Information sheet for parents

Griffith University Letterhead

# Technology, Learning and Working: Examining the use of Technology by Visually Impaired People

# INFORMATION SHEET FOR PARENTS

**Who is conducting the research**

Associate Professor Howard Middleton,
Ms Lucy Lopez
Centre for Learning Research
Contact Phone: 37355724
Contact Email: h.middleton@griffith.edu.au

## Why is the research being conducted?

This project is being undertaken to establish the kinds of technologies that are being used by visually impaired people in learning and work. The aim is to establish the kinds of technologies that visually impaired people find help them in their learning and work. An additional aim is to find out the kinds of technologies that might be developed to assist visually impaired people. The research is being conducted for the Aid for the Blind organisation by researchers from Griffith's Centre for Learning Research.

## What you will be asked to do

If you agree to allow your daughter/son to participate in the research they will be asked to complete a questionnaire. Some participants will also be asked to take part in an interview. If your son/daughter is invited to participate in an interview, it means they are using a particular technology and we would like to know how useful it is for their learning. If your daughter/son is not invited to be interviewed it means the technologies they use are used by a reasonably large number of people and we have already interviewed students about that technology.

## The expected benefits of the research

It is expected that the research will provide valuable information about technologies used by visually impaired students. Summaries of this information will be provided to all participants. In addition, findings provided to Aid for the Blind may assist in the development of new technologies for visually impaired people

## Risks to you

There are no risks in participating in the research.

## Your confidentiality

The information your son/daughter provides in the questionnaire and interview will remain confidential. The process will involve them filling out the questionnaire and if they are selected and they and you agree, being interviewed. Their questionnaire information will be transferred to a spreadsheet without details that identify them. If

they participate in an interview, this will be tape recorded and transcribed. They will be given the opportunity to listen to the transcripts being read to them so they can check the accuracy of the transcribing and of their responses. The tapes will be wiped once all data has been transferred to hard copy. Hard copy data will be stored in locked filing cabinets in the Centre for Learning Research rooms. Data will be available to Aid for the Blind and other researchers approved by CLR.

## Your daughter/son's participation is voluntary

Your son/daughter's participation in the research is voluntary. If you or your son/daughter chose to not participate in the research your/their decision will in no way impact upon your or their relationship with their school or organisation. They are free to withdraw from the study at any time.

## Questions / further information

For additional information about the project, contact: Associate Professor Howard Middleton on 3735 5724, e-mail h.middleton@griffith.edu.au or Ms Lucy Lopez on 3735 5856.

## The ethical conduct of this research

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Research Involving Humans*. If you have any concerns or complaints about the ethical conduct of the research project you can contact the Manager, Research Ethics on 3735 5585 or research-ethics@griffith.edu.au.

## Feedback to you

You and your son/daughter will be provided with a summary of the results of the study.

## Privacy Statement

The conduct of this research involves the collection, access and/or use of your daughter/son's identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent and the consent of your son/daughter, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your daughter/son's anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at www.gu.edu.au/ua/aa/vc/pp or telephone (07) 3735 5585.

## Appendix 2: Information sheet for students

Griffith University Letterhead

# Technology, Learning and Working:
# Examining the use of Technology by Visually Impaired People

# INFORMATION SHEET

**Who is conducting the research**

Associate Professor Howard Middleton,
Ms Lucy Lopez
Centre for Learning Research
Contact Phone: 37355724
Contact Email: h.middleton@griffith.edu.au

### Why is the research being conducted?

This project is being undertaken to establish the kinds of technologies that are being used by visually impaired people in learning and work. The aim is to establish the kinds of technologies that visually impaired people find help them in their learning and work. An additional aim is to find out the kinds of technologies that might be developed to assist visually impaired people. The research is being conducted for the Aid for the Blind organisation by researchers from Griffith's Centre for Learning Research.

### What you will be asked to do

If you agree to participate in the research you will be asked to complete a questionnaire. Some participants will also be asked to take part in an interview. If you are invited to participate in an interview, it means you are using a particular technology and we would like to know how useful it is for you. For if you are not invited to be interviewed it means the technologies you use are used by a reasonably large number of people and we have already interviewed people about that technology.

### The expected benefits of the research

It is expected that the research will provide valuable information about technologies used by visually impaired people. Summaries of this information will be provided to all participants. In addition, findings provided to Aid for the Blind may assist in the development of new technologies for visually impaired people

### Risks to you

There are no risks in participating in the research.

### Your confidentiality

The information you provide in the questionnaire and interview will remain confidential. The process will involve you filling out the questionnaire and if you are selected and agree, being interviewed. Your questionnaire information will be

transferred to a spreadsheet without details that identify you. If you participate in an interview, this will be tape recorded and transcribed. You will be given the opportunity to listen to the transcripts being read to you so you can check the accuracy of the transcribing and of your responses. The tapes will be wiped once all data has been transferred to hard copy. Hard copy data will be stored in locked filing cabinets in the Centre for Learning Research rooms. Data will be available to Aid for the Blind and other researchers approved by CLR.

## Your participation is voluntary

Your participation in the research is voluntary. If you chose to not participate in the research your decision will in no way impact upon your relationship with your school or organisation. You are free to withdraw from the study at any time.

## Questions / further information

For additional information about the project, contact: Dr Howard Middleton on 3735 5724, e-mail h.middleton@griffith.edu.au or Ms Lucy Lopez on 3735 5856

## The ethical conduct of this research

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Research Involving Humans*. If you have any concerns or complaints about the ethical conduct of the research project you can contact the Manager, Research Ethics on 3735 5585 or research-ethics@griffith.edu.au.

## Feedback to you

You will be provided with a summary of the results of the study.

## Privacy Statement

The conduct of this research involves the collection, access and / or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes. However, your anonymity will at all times be safeguarded. For further information consult the University's Privacy Plan at www.gu.edu.au/ua/aa/vc/pp or telephone (07) 3735 5585.

## Appendix 3: Informed consent for parents of minors

Griffith University Letterhead

# Technology, Learning and Working: Examining the use of Technology by Visually Impaired People

## CONSENT FORM FOR PARENTS

**Research Team** Associate Professor Howard Middleton,
Ms Lucy Lopez
Centre for Learning Research
Contact Phone: 37355724
Contact Email: h.middleton@griffith.edu.au

By signing below, I confirm that I have read, and understood the information package and in particular have noted that:

- I understand that my daughter/son's involvement in this research will include completing a questionnaire and possibly being interviewed;
- I have had any questions answered to my satisfaction;
- I understand that there are no risks involved;
- I understand that there may be no direct benefit to my son/daughter from their participation in this research;
- I understand that my daughter/son's participation in this research is voluntary, and should I choose to not allow them to participate, or they to decline to participate, there will be no negative consequences for their grades or progress within this institution;
- I understand that if I have any additional questions I can contact the research team;
- I understand that my son/daughter is free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3875 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to allow my daughter/son to participate in the project.

**Name** _____

**Signature** _____

**Date** _____ / _____ / _____

## Appendix 4: Informed consent for students and participating adults

Griffith University Letterhead

# Technology, Learning and Working: Examining the use of Technology by Visually Impaired People

# CONSENT FORM

**Research Team** Associate Professor Howard Middleton,
Ms Lucy Lopez
Centre for Learning Research
Contact Phone: 37355724
Contact Email: h.middleton@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include completing a questionnaire and possibly being interviewed;
- I have had any questions answered to my satisfaction;
- I understand that there are no risks involved;
- I understand that there may be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary, and should I choose to not participate, there will be no negative consequences for my grades or my progress within this institution;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the project.

**Name** _____

**Signature** _____

**Date** _____ / _____ / _____

## Appendix 5: Interview protocol for students and employed participants

Introduction

My name is Howard Middleton/Lucy Lopez and I am working with Griffith University on a project for Aid for the Blind, Australia. The project called Technology, Learning and Work Project, aims to gain an understanding of the things, including technologies that help blind and visually impaired people set and achieve educational and professional goals. In particular we are interested in talking to blind and visually impaired people who are recognized as successful achievers at school or at work. Your name has been given to me as one such person.

Questions

1. Age, gender, other disabilities?
2. How long have you been blind/visually impaired?
3. If blind, have you been certified as legally blind? If visually impaired, please describe the nature of your impairment.
4. What is the thing that takes up most of your time on a daily basis, eg, work, school, other?
5. How important is this to you? What are your goals in relation to this? In relation to the rest of your life? What would you rather be doing?
6. How have you come to choose these goals?
7. Who or what have you had to rely on to help you set and work towards your goals? Why have you had to rely on them? How have they influenced you?
8. Who or what do you believe could prevent you from achieving your goals? Why do you believe this? How could they affect you? External factors? Internal factors?
9. In the course of your school/work, what are the things that you find easy to do? Difficult? Please explain.
10. What do you believe helps you set and achieve the goals you have chosen in life thus far? External factors? Internal factors?
11. What do you believe is your most important attribute/quality in helping you succeed in life?
12. If there is one thing you could change about your life, what would it be?
13. What technologies assist you on a daily basis? At school/work? At home? Between home and school/work? How do they help you?
14. What would happen if these technologies were no longer available?
15. How would you like to see these technologies improve?
16. What technologies would you have instead, assuming you could design your own?
17. How could people/schools/workplaces/government/organizations help you and others like you? Who are they and what do they need to know/understand/do?

The nature of these questions and the environment in which the interviews are to be conducted should lend themselves to further exploration.

## Appendix 6: Interview questions for BVI unit in high school

1. What is your role, length of experience at this unit, length of experience with BVI students in total and length of any other teaching experience?
2. What do you see as your major responsibilities? Explain.
3. What do you perceive to be the things that are working well? Explain. Not so well? Why?
4. How has your training prior to the commencement of your work with BVI students and since helped you? Not helped you? Explain.
5. What changes would you recommend for future teachers of BVI students?
6. What do you feel are the needs of BVI students at school and in the broader context of preparing for their future? Explain.
7. To what extent are these needs being met/not met? Explain.
8. What are your needs in teaching BVI students/preparing them for the future? Explain.
9. To what extent are these needs being met/not met? Explain.
10. What could your school and/or other schools be doing to help?
11. Who/what else do you think could be of assistance? How?
12. What kinds of technologies are involved in your teaching/learning environment? How would you rate their efficacy? What are their strengths and weaknesses from a teaching perspective? From a learning perspective? How have you come to these conclusions?
13. Could you give us an example of how a particular technology has helped you/your student? How has it limited you/your student?
14. What improvements would you like to see in the design of technologies? In access? In use/provision? How might these come about?
15. What impact do parents/school admin/teachers of non-BVI students/other stakeholders (please name) have in the education of BVI students?
16. What are your expectations, hopes/desires for your students, now and for the future? For yourself?
17. Did you choose to be a teacher of BVI students? Why?
18. Would you like to continue as a teacher of BVI students? Why?

## Appendix 7: Initial interview: Logbook extracts from Leximancer analysis

| Location | Text | Comment |
|---|---|---|
| School/School teacher/School-Colleen - Teacher Aide.doc~1.html#S1_25 | She, the student has a great deal of difficulty in spelling and so it was taking most of the lesson for me to help her get the text onto the screen, so the teachers now are providing the text on screen, and she's manipulating it, you know for advertisements and things like that. So, yes, helping the teachers modify things, helping the students, being aware what problems they're having, what there weaknesses are. Like that particular student needs to touch type. | Concepts: students AND teacher |
| School/School teacher/School-XXXXXX - Teacher Aide.doc~1.html#S1_117 | P. Not really, because the other teacher aide deals with that, like if somebody wants something enlarged or whatever there's somebody who does it. So I guess in that way, there's something I haven't had to deal with, because due to my experience and training, I see myself as best in the classroom helping students, I'm not very good, sometimes I can touch type very fast, so you know that's, other people can do that better than I can and really if I'm not working with students I'm not very happy. | Concepts: students AND teacher |
| School/School teacher/School-YYYY - Head of Senior Schooling.doc~1.html#S1_108 | P. it's been managed by the classroom teacher, in other words you check the room you're allocated, because I had this student job in accounting and of course we have a fair amount of a syllabus, it has to be done in a computer room, so we had to make sure through the technician, that the room that we were using we actually put Zoomtext on a specific machine and John sat there, so if it was down to the individual classroom teacher to organise it. | Concepts: students AND teacher |
| School/School teacher/School-ZZZZZ-Teacher Aide.doc~1.html#S1_5 | P. I'm employed as a teacher aide, so I support the teachers so teacher aides where we have direct help with hands-on very hands-on so I mainly work with, that's what I do is support students in class and tutorials where we help them with their homework and sign language and just support them, just try to support them in their learning so that they can reach the stages that the other students in mainstream schools the levels they attain, that's our goal, that's our objective and we also look out for the social side of things for the students as well because that comes into play with the learning, with the education, the academics, social, side of things. | Concepts: students AND class |
| School/School teacher/School-AAAAA- Teacher Aide Interview.doc~1.html#S1_132 | P. Well, I think we certainly encourage Virginia like she's our present Braille user, her skills are improving she focuses ...before she would be happy to read, but more because she had to whereas now she's getting more into it. I think that's probably a maturity thing as well isn't it you know that and we Braille things out for her, they | Concepts: students AND class |

| | | |
|---|---|---|
| | at the moment, but because they are a true grade 8 students, all vision-impaired in the one class and they're reading a book at the moment, we actually got that on tape so that the three of them can sit and listen to it together. I think Virginia's Braille skills may not allow her to read the whole book and have it done in time. | |
| School/School student/School-BBBB year 9 student.doc~1.html#S1_138 | P. As I said in the Art class, most of those kids are in my other classes. | Concepts: students AND class |
| School/School teacher/School-CCCCC - Teacher Aide.doc~1.html#S1_13 | Since about '96 I worked assisting individual students in high school. | Concepts: students AND school |
| School/School teacher/School-CCCCC - Teacher Aide.doc~1.html#S1_33 | P. Only if, the students that I have on a regular basis, I'm in the classroom with them. Sometimes if they're away or if something else is happening in the school and they require me to work with an individual student here, I do. So I have done that from time to time. | Concepts: students AND school |
| School/School teacher/School-DDDDDD - HOSE.doc~1.html#S1_27 | P. I think, because we encourage students to be independent we have timetabled ECC, Expanded Core Curriculum lessons, and that is across VI as well as AST and we use that time they have in the Unit to have the ECC lessons which are all the other things that students need to learn,... ...because see in all the technology and social skills and ... Skills and huge range of things and I think that has helped us improve the students' access into the regular school. We also report on that, on the report cards, so it's seen as an actual important part of the curriculum, by them, the rest of the school as well as their parents. | Concepts: students AND school |
| School/School teacher/School-EEEEE - teacher.doc~1.html#S1_57 | P: I kind of do, because we have a good selection of student teachers through here, Nicole would be better on answering that, but, yeah, we have a fairly good range of students and depends on their school work or when they come it, I don't see much of that, I haven't see her teaching skills. Depends on what sort of personality they each inject into it, personalities is a big thing the VI students. Because they have personality, they may be ASD student who you need to be very monotone, sit down, pick up your pen, do your book. | Concepts: students AND school |
| School/School teacher/School-FFFFF - Head of Senior Schooling.doc~1.html#S1_4 | P. In teaching generally, this is my 20th year and I've been here for 5 years and before that I dealt with physically impaired students at Bray Park State High School which is a wheelchair access school. | Concepts: students AND school |
| School/School teacher/School-GGGGG- Teacher Aide Interview.doc~1.html#S1_201 | So it was all hand Brailled or so then when we came to high school, and because you know they do all different electives and they're all different year levels there is no way we could hand Braille all that needs to be done for high school students so we got the Duxbury.program, computer | Concepts: students AND school |

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| | program and it's just brilliant, its amazing, it allows you to put a lot of work through. | |
| School/School teacher/School-GGGGG - Head of Senior Schooling.doc~1.html#S1_157 | P. Because each vision-impaired student has different requirements, that's how I justify that, so that if we have one that requires Brailing, one that requires enlarging to 65%, one that requires enlarging to 35% and you see what I mean, it's coordination of all of that. | Concepts: students AND vision |
| School/School teacher/School-HHHHHH-Teacher Aide.doc~1.html#S1_84 | P. Well, I suppose the answer would be, the right answer would be, I yes they could do a lot more, but I mean apart from providing staff and staffing is you know the biggest sort after resources, isn't it? Like really, scaffolding, I think we don't do too badly with, oh we just got a big grant a lot of money came through from the Lions Rotary, I can't remember which one it was, and that was good, that enabled us to buy special software for the computer, our .....that paid for the license to be able to use it for the next 5 years. We also got some other reading equipment which will enlarge print, for vision-impaired students. | Concepts: students AND vision |
| School/School teacher/School-IIIII-Teacher Aide Interview.doc~1.html#S1_24 | The low vision kids are great and we've been fortunate I suppose in some ways that our vision-impaired students up until now probably only had that one disability so they had been academic and you know they're just great kids, you know they're. I don't know that's all I can think of, they're just a great group of people and I really enjoy the work that I do with them. | Concepts: students AND vision |
| School/School teacher/School-JJJJJ- Teacher Aide Interview.doc~1.html#S1_144 | P. No. No. We had another student whose vision is very very poor but unfortunately he has medical problems as well and due to the treatment that he has had, he doesn't have the sensitivity in his fingers to allow him to be able to read Braille well. So even though his vision probably warrants that he should learn Braille, he's not physically able to so we put everything onto his computer for him and he has the program on his computer that talks to him. | Concepts: students AND vision |
| School/School teacher/School-JJJJJ- Teacher Aide Interview.doc~1.html#S1_261 | P. I think we have 3 or 4 Pocodes. Some students, it won't enlarge sufficiently for them, so the students that don't have quite a severe low vision, they are very good, and they love them. They're portable, you just put them in your bag, you can take them out in class and you hold it over the print page in front of you and you can magnify, hopefully to the degree that you'd need it. | Concepts: students AND vision |
| School/School teacher/School-KKKKK - HOSE.doc~1.html#S1_5 | P. Yes, 2000. Most of us have been here since, well Nicole, myself, Nicole's at a conference today or the last 3 days, she's been at a conference in Sydney to find out about post school options for visual impaired students and she said it's pretty wonderful. We started off with two teachers here and one teacher aide, expanded since then. | Concepts: students AND teacher |
| School/School teacher/School- | P. Yes, and relation to teaching through senior | Concepts: |

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|---|---|---|
| LLLLL - Head of Senior Schooling.doc~1.html#S1_50 | school as well as I'm in charge of the Connect lessons. There seventy minute lessons per week. It's also through making sure that the teachers are, have the right resources and such for the students in the senior school who are also vision-impaired. | students AND teacher |
| School/School teacher/School-LLLLLL - teacher.doc~1.html#S1_39 | P: Sometimes the issues of lugging the technology around. The CCTV, bloody big and heavy and that means that the students that use the CCTV got to be in this building and we've got the other more portable Pcodes but that sort of thing but it's still, if a student really prefers the CCTV between big and, even the Braille machine, it's big and awkward, you look at them and they're always banged on the side from kids banging them into doorways. When a kid has got to carry books and a Braille machine and it's just big and awkward. | Concepts: students AND braille |
| School/School teacher/School-LLLLLL - teacher.doc~1.html#S1_95 | In terms of Brailing, apart from the ....., the students mostly carry the Braille machines to class which is as I said before, .....and use something smaller. But then I don't really know how to, the smaller thing works either. And as it only has one total at the moment. | Concepts: students AND braille |
| School/School teacher/School-MMMMM- Teacher Aide Interview.doc~1.html#S1_83 | P. I think if you're blind, yeah, and it depends where, at what age, you have lost your vision to, like some are born blind and they are learnt, they are taught Braille from a very early age and their skills may or may not be really good or they may get a problem later on in life or you know during primary school so they've got to start in grade 6 or 7 to start learning Braille so obviously by the time they get to us, because Braille in itself is the whole new world, you know yet they have to be taught how to read Braille and get their sensitivity up in their fingers and all that sort of thing, so you know it doesn't happen overnight, so it depends where along the track they got the disability as to where that is. But I don't know, you know we have students here at the moment that their English level might be grade 3 or 4 and they're at high school. | Concepts: students AND braille |
| School/School teacher/School-MMMMM- Teacher Aide Interview.doc~1.html#S1_141 | P. Virginia is now only Braille user. The remaining students are low vision students but all use some type of print depending on what size, you know, or their vision is. | Concepts: students AND braille |
| School/School teacher/School-MMMMM- Teacher Aide Interview.doc~1.html#S1_250 | P. Well, we have the computer programs, obviously, we have the zoom text which enlarges things on the screen, we have the JAWS that's a ... program for Braille users. We're using the Pcodes. Which students can take to class, which enlarges print, in front of them. | Concepts: students AND braille |
| School/School teacher/School-LLLL - teacher.doc~1.html#S1_86 | P: Everything. Well, we're lucky enough to have a Zoomtext sight licenses, which enlarges the text on the screen and JAWS is a program that reads everything on the screen, and so it allows blind or a student with a very, very low vision who can't read what's on the screen even with | Concepts: students AND blind |

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|---|---|---|
| | magnification, to navigate. In the classrooms students have access to things like Pcodes, which is a little handheld magnifiers, as well as being their binoculars, we have a video which attaches on the side of the whiteboard, which attaches to your whiteboard and anything you write on the whiteboard using special, the thing that goes into the end of the whiteboard marker so it sends a signal back to student's computer, it | |
| School/School student/School-TTTTT, student.doc~1.html#S1_250 | JAWS is more for fully blind kids use, but Zoomtext and Magic is something that VI kids would use to basically for a computer and you just use it for typing, exploring on the Internet and that sort of thing and that's another very useful thing that you can get for although it does cost a couple of thousand. | Concepts: students AND blind |
| School/School teacher/School-CCCCC - Teacher Aide.doc~1.html#S1_68 | P. Well every student is different of course, whatever their disability. I suppose I've learnt things about the computer and you know, different programs that assist them. Yes I had a bit of a big learning curve trying to teach one boy fractions. | Concepts: students AND computer |
| School/School teacher/School-LLLL - teacher.doc~1.html#S1_92 | There setting up in the science lab sort of almost like a Web broadcasting so that the lesson is recorded onto the student's computer. That's the sort of technology, the students have their own binoculars and glasses and a lot of students have their own laptops and we have laptops with the appropriate programs loaded on so that they can take the notes. We get all our books on tape or CD or you know the English novels they're reading and we can put assessment on there. | Concepts: students AND computer |
| School/School teacher/School-BBBBB - Head of Senior Schooling.doc~1.html#S1_95 | P. Because you have to be in the right computer room, which is not always easily accessed because other classes use them at those times. Then they have the specific computers that the student wants to use has, you make sure that it is Zoomtext is already been loaded, so that they can use the computer. | Concepts: students AND computer |
| School/School teacher/School-NNNNN-Teacher Aide.doc~1.html#S1_103 | Some of the old horrible computers. We just make do, it would be nice to have a computer in our office, but we don't, but you know, we make do, maybe it's better that the computer sits in here and the students can use it as they, that's what you're here for, so. | Concepts: students AND computer |
| School/School teacher/School-KKKKK - Head of Senior Schooling.doc~1.html#S1_124 | P. They would have difficulty because a) they may not plan well enough in advanced and then not realise that this isn't across the system and then maybe not have access for that particular student for a lesson or two until it could actually be placed on the computer for them. Yes. It does take pre planning. It's the same as anything else, it doesn't matter that it's a vision-impaired student with a particular program, its making sure that the program that you want to use is on the computers in the room you want to use, so its no different in relation to planning that way. | Concepts: students AND computer |

| | | |
|---|---|---|
| School/School teacher/School-BBBBB- Teacher Aide Interview.doc~1.html#S1_218 | P. I think for the work that I do, I think I have the skills that I need. So if I was working hands-on with the students, well then yes, I'd need more training in the computer program things. | Concepts: students AND computer |
| School/School student/School-DDDDD, student.doc~1.html#S1_247 | In year 7 I did some work with Christina and Keira who were to other VI kids, just starting, and I showed them how to use the Pcode that I was borrowing from the school, that the school was borrowing from the Vision Clinic, and I just brought it up to them after swimming and I would just talk to them and some pretty exciting stuff and Gabe, who was in year 5 now is in year 6, we did, she came up and she worked with one of them and I worked with another one of them, and I worked with her with the Pcode and all that and she worked with the other girl with the CCTV, it was really good. I helped Gabe and a few for computers using a special program called Magic and now there's Zoomtext and JAWS, there good for the VI kids to use. | Concepts: students AND Jaws |
| School/School teacher/School-JJJJ-Teacher Aide Interview.doc~1.html#S1_213 | P. No. Because being a vision-impaired unit, I guess as long as things for low vision kids are clean and clear and the right size print for them, which is easier enough to do, you know when you work with documents, with your Braille using students, with the Duxbury program and knowing Braille, you know that you can do the editing or if you need to do diagrams and hand Braille, you know labels for your diagrams and things like that. You know that new technology is coming in and I'm not really up with that or the use of that, because I'm not hands-on with the students, you know like they have the shortcuts for the computer. You know, I've used the mouse and click on what I want but with the shortcuts, you know I don't know though they've got with the ...programs and all those sorts of things that I'm not aware of because I'm not using them with the students so, but the other teacher aide, Jenny certainly knows that, her son is vision-impaired as well. | Concepts: work AND braille |

## Appendix 8: Assistive technologies

**Technologies for the Visually Impaired Inc.** (www.tvi-Web.com/) offers an array of adaptive devices, software and accessories specifically designed for use by blind or visually impaired individuals. Product lines include; adaptive computers, reading machines, Windows access software, speech synthesizers, refreshable braille products, voice recognition software, screen magnification software, CCTV products, braille embossers, braille translation software, tactile imaging products, various accessories, customized personal computer systems.

Some of the products found on their Web site are as follows:

**Portico** is a laptop for the Blind allowing them greater accessibility on the computer. From CompSolution's Assistive Technology Division, the Portico combines the mobility of a laptop, compactness of a notetaker, and the power of a desktop into one unit selling for much less then a product with comparable features and requiring less training to be productive. The Portico is a notetaker, a laptop and a desktop all in one.

Though Portico weighs less than one pound (with its standard battery) and is less than an inch thick, it offers similar features and power as found on a full-size, desktop computer. It operates on Windows XP - not CE, has the ability to run the world's most popular software, and the user can connect virtually any accessory imaginable through three USB ports, up to seven Bluetooth connections, a Firewire connection, modem, ethernet, PCMCIA, video, audio, and memory stick slots.

Portico works without using proprietary software and without synchronizing with a full size PC since it is a fully capable, stand alone computer. With it’s built in microphone and additional up to 15 hour battery, people can dictate documents and record meetings or classes. Because Portico can work with monitors and projectors through the video port, one can even conduct meetings or classes with it. When travelling, one has the ability to create documents, cruise the Internet, check email, use instant messaging, listen to music CD's, or play DVD movies for many hours between charges.

**Plextalk PTR2** is designed to be a high quality recorder with the ability to create DAISY 2.02, audio only, books and Music CDs. It can play DAISY titles, Music CDs and Audio File CDs and CF cards. It can be used as a CD-RW or memory card drive when connected to a computer. For quicker and easier editing of your DAISY content, the PTR2 is supplied with the Plextalk Recording Software (PRS). This package gives the user all the necessary tools to record, edit and finalize their own audio only DAISY 2.02 books.

PTR2 can be operated in 2 main modes called “Normal” mode and “Book Creator” mode. The user can switch between these 2 modes at any time. The PTR2 will be supplied with Normal mode set as the default. Normal mode gives the user a simplified interface and makes the process of creating a recording very straightforward. This mode of operation is ideal for a beginner or for someone who wants to make a recording quickly and easily. Some of the more advanced

recording and editing features are not available to users in this mode. Book Creator mode gives the user all the necessary tools to create a fully structured, audio only, DAISY 2.02 book including insert, punch in and overwrite recording, phrase editing and the ability to set heading levels.

**BRAILLEX 2D Screen** is a two-dimensional Braille display for personal computers. BRAILLEX 2 D Screen represents a completely new Braille display concept. Its newest feature is the possibility to display the structure of the complete computer screen at one time. In addition to the conventional 80 character horizontal display, it features a vertical display with four dots per computer screen line, which show an extensive "status" of the complete screen. Methodically, BRAILLEX 2 D Screen allows blind people to access the computer screen in a way which is very similar to the approach sighted persons use. They first look at the data structure as a whole, then locate the place which attracts their interest, and then start reading.

On the vertical display, every screen line is represented by four dots. The user can program them to show the presence and location of characters on the screen, or of groups of characters (e.g., numbers or line drawing characters to identify windows on the screen), furthermore colours, the cursor position, the display position, etc. This unique possibility to obtain a general view of the computer screen considerably increases the working speed. Next to each dot row in the vertical display the user can find a key which allows them to route the Braille line to the corresponding screen line. The user can then read the contents in detail. This very easy, intuitive and fast screen access is complete with the intelligent cursor routing feature. After having scanned the screen (for example for proof-reading a text) the user can route the cursor to where the user wants to modify text.

The unequalled working comfort of BRAILLEX 2 D Screen is complete with its Integrated Access Strategy program that reflects Papenmeier's long experience in accessing computer screens with a Braille display.

A platform for accessing Windows Together with Papenmeier's **WinDOTS** program, BRAILLEX 2 D Screen is a device for accessing the graphical user interface Microsoft Windows.

The **Portset Reader** is a reading machine. The Document Reader from Portset is a stand-alone machine for blind and vision impaired people. The compactly sized, stand alone tabletop unit incorporates the latest American/British Voice technology.

Designed for the visually impaired, the Portset Document Reading Machine fulfils the day by day need in independence, life and education. Advances in text recognition technology, combined with Portset's high quality speech synthesis, now make document reading a simple task. Portset's speech engine gives male and female voices high clarity precision and intelligence that is necessary for such an application. The user can select voice gender and can vary the speaking speeds and pitch. We have ensured that the machine is simple to operate and provides features that will suit a wide range of users. Speaking can be "entire page", or line-by line using cursor control to "scan" forwards or backwards through a document. The

user can request repeat speaking of indistinct lines or words, or text spelling. Speaking can be paused, allowing for speaking resumption. A volume control for speech output is used for the integral loudspeaker or headphone jack socket.

The **Robotron Columbus Talking Compass**. The Robotron Columbus speaks the four cardinal points, as well as the four inter-cardinal points, in a digitised human voice. Each Columbus has two languages stored.

**INDEX Basic-D Braille Printer** is a double sided Braille printer for continuous tractor-fed paper. An optimised design and effective production reduces the price and size of a high speed double sided Braille printer by 60%. The combination of low price, high speed (300 PPH), high quality, ease of use and small size, makes Basic-D suitable for homes, schools, the work place and Braille production centres that prefer to use continuous tractor fed paper. The Basic-D is controlled by an ink and braille labelled front panel. Combined with the speech feedback it is easy to install and operate.

**Index Basic-S** is a single sided braille printer for continuous tractor-fed paper. An optimized design and effective production significantly reduces the price and size of a high speed single sided Braille printer. The combination of low price, high speed (150 PPH), high quality, ease of use and small size, makes Basic-S suitable for homes, schools, the workplace and Braille production centres that prefer to use continuous tractor fed paper. The Basic-S is controlled by an ink and Braille-labelled front panel. Combined with the speech feedback it is easy to install and operate for blind and sighted users alike.

**Optical Braille Reader - OBR** OBR - Optical Braille Recognition - is Windows software that allows the user to “read” single and double sided Braille documents with a standard A4 scanner. The retrieved information can be used in all types of Windows applications or directly on an Index Braille Embosser.

The scanning process is simple and quick. The user can process two sides of a Braille-sheet in a single scan. Pressing the SCAN icon, starts the process of scanning. After less than thirty seconds the information is presented on the screen. Continue to scan the next page or start to use the information. The Braille information in a small letter or a complete Braille Book can be retrieved into computer form in the same easy way, even if the user does not read Braille at all.

The recognition from a good quality Braille document is excellent. But even scanning an old worn-out Braille document, the fault frequency is low. By using standard Windows functions your Braille handling system will be complete and effective.

**GOODFEEL 2.6** is a braille music translator which is able to transcribe Braille music quickly, automatically and accurately. GOODFEEL automatically converts several kinds of music files to Braille; the same files used to print the score for sighted players. To prepare and transcribe these files with GOODFEEL, the user does not need to know how to read Braille music.

**Braille Assistant** is a braille notetaker that works Global connectivity the easy way. Papenmeier, the German Braille specialist with more than 25 years experience in refreshable Braille, presents a new generation of note takers: BRAILLEX EL Braille Assistant (ELBA). A universal communications tool and a state-of-the-art Braille display for other computers, BRAILLEX ELBA is the most versatile portable Braille device around. The user can send and receive email or surf the Web, take notes or organize their day, share information with other devices or access their Windows based PC. BRAILLEX ELBA offers this with refreshable Braille and easily understood speech, in many different languages.

Full Internet and email access with BRAILLEX ELBA. The user doesn't need a computer to send or receive messages or to surf the Web. The built-in modem and friendly yet powerful software make sure the user stay connected. Superior hardware with large memory BRAILLEX ELBA features a state- of-the-art CPU designed for portable use with plenty of computing power and advanced power management. The 16MB of non- volatile flash memory and 32MB RAM can store thousands of documents. Rock-solid Linux-based software BRAILLEX ELBA uses a Linux based operating system. Although most users will never "see" the operating system, they take advantage of its advanced networking capability and its rock-solid applications.

BRAILLEX ELBA comes with a set of applications including a word processor email, Internet browser, Address Book, Day-planner, scientific calculator, etc. Ease of use Users of all levels will find the menu-driven control centre easy to learn and navigate. Windows users will find the shortcut keys they are used to. Text can be entered in grade 1 or 2 Braille, translation and reverse translation are available at any time. Ergonomic keyboard and patented Easy Access Bar

BRAILLEX ELBA is available with either a Braille or QWERTY type keyboard. The mechanics of the Braille keyboard were inspired by the technology used for piano keyboards. Another highlight of BRAILLEX ELBA is the patented Easy Access Bar, a long key situated on the front of the device. This joystick-like control moves the display up, down, back and forth in a very fast and intuitive way. The user can issue commands without ever taking your hands off the Braille display. In the control centre, the user uses the Easy Access Bar to navigate through the menus.

Designed for the visually-impaired or those with disabilities that make reading difficult, **BookCourier** from Springer Design, Inc. is a portable, convenient, and economical tool for listening to electronic text, voice files, and music. BookCourier frees the user from cumbersome equipment such as cassette players and tapes, or bulky Braille transcriptions for your reading needs. Just by downloading files from your PC or the Internet using the supplied transfer software and the user is on their way. Book Courier includes a built-in MP3 player; a built-in voice recorder; fast forward and fast reverse controls; bookmarks, jumps, and other smart navigation controls; a built-in alarm, sleep timer, clock, and calendar; plus easy-to-use controls for adjusting volume, reading speed, and more. And if the user has a question about a feature, BookCourier's built-in talking help and talking user guide are immediately at the user's service.

**BrailleNote PK** is the world's smallest Braille and speech personal digital assistant. This 18-cell model combines a crisp, high definition Braille display with clear responsive speech output. It features Bluetooth technology so the user can talk to wireless devices including cell phones and keyboards plus have a wireless ActiveSync connection with your PC. It also features USB functionality so the user can connect effortlessly to the user's PC for ActiveSync. WiFi connectivity allows the user to surf the net wirelessly at high speed. Connect to a wireless hotspot or securely over a corporate wireless network when the user plug in a supported wireless network card sold separately. Internet Explorer v6 - KeyWeb works with many more Web pages, thanks to the latest browser technology. KeySoft media player allows the user to listen to music (in stereo) while working, with independent synthesized speech and music volumes.

The **Portset BrailleKey** provides an easy and simple solution for adding a Braille keyboard to a Personal Computer or Laptop. BrailleKey is connected to the USB port and is self registered by the operating system and makes it an ideal companion to both desk-top and portable systems The 9 keys are arranged in a group of 6 standard Braille input keys in a line, with space, backspace delete and new line keys ergonomically located below the Braille keys. Dot 7 is produced by the new line key providing a shifted character set. BrailleKey provides either Universal computer Braille or UK computer Braille as ASCII characters into any application as well as being a direct interface to Braille devices such as printers. A selector switch on the underside allows selection of either UK International or US Universal computer Braille. BrailleKey does not need any drivers or software to be installed onto the computer.

**BrailleKeyG2** is a revolutionary new solution from Portset to provide Grade 2 Braille input to a Personal Computer or Laptop. Not only are there the principal Braille keys but additional keys provide full cursor control, Ctrl and Alt functions. There are also corded functions such as TAB, ESC and Grade 1 Braille. BrailleKey G2 is connected to the USB port and is self registered by the operating system. The 6 Braille input keys are arranged in a standard Braille line, with space, backspace delete and new line keys ergonomically located below the Braille keys. A further lower line of keys provide on the left side, Ctrl and Alt, while on the right side is a cluster of 4 keys giving full cursor control. Corded functions are provided by incorporating the space bar with a key combination. For example letter A is produced by key 1 and space together. The ESC or Escape key is key 4,5,6 and space together. BrailleKey G2 when connected via the USB port provides the input of Grade 2 Braille to create text documents. BrailleKey G2 can act as a direct replacement for a normal keyboard in a Windows environment. Based on British Braille, BrailleKey G2 supports contractions, groupsigns, wordsigns and shortforms. The case has a sloped face and a compact size of 220mm (8.6ins) wide, 111mm (4.2ins) deep, 20mm (0.7ins) front height and 40mm (1.6ins) rear height. This makes it an ideal companion to both desk-top and portable systems. BrailleKey G2 does not need any drivers or software to be installed onto the computer.

**Aesop: The Talking Keyboard**. Aesop is a compact, light-weight unit that allows the user to practice touch typing anywhere at leisure. Just connect a standard computer keyboard and Aesop will speak each letter as the user types. Keystrokes

are spoken in a clear, digitised, (human quality) voice that helps a blind or visually impaired person learn touch typing without a computer or screen Reader.

The **PocketViewer** is a new compact, handheld, battery operated video magnifier. Designed to be truly portable the PocketViewer is the perfect portable solution enabling the user to see more of what they want, wherever they want. The portability of the PocketViewer means that the user can carry the PocketViewer at all times, its slimline design fits easily into a pocket or handbag. Pocketviewer can look at details and price labels in shops, sign credit card payments, read restaurant menus, theatre programs and timetables, check lottery results, television and radio programs, browse through magazines and read books while travelling. Using a special miniature video camera the PocketViewer is able to transfer and enlarge images from a page to its screen. Images appear in high contrast, black on white, or white on black depending on preference. By lifting or tilting the PocketViewer the user can reduce the magnification and see more of the objects the user is looking at. With a battery life of up to one and a half hours the PocketViewer is the ideal solution for people on the move.

The **Talking Checkbook** is an application designed to make account management and check writing accessible not only to people who have varying disabilities, but anyone who wants an easy way to write checks and balance accounts. The Talking Checkbook has a simple interface that makes managing any bank account easy. The user can use it to manage a checking, savings or even a retirement account. Select an account and press CTRL + B and instantly the user will hear the balance of that account. If the user wants detailed information about that account, they can go through the transactions one by one in descending order or the user can create a report. The reports are created in a MS Word document that gives the user full access to the information. The user can also export the information to a file that can be opened up in spreadsheet programs such as Excel or Lotus, where the user can create your own reports. Printing checks is completed by filling out the information just like writing a check. The user only has to enter the check information once. To make account management easier, a notes field and a search feature have been added. The note feature allows the user to record additional information about a check or a deposit. The search feature helps the user locate a check.

The **Ultimate Talking Dictionary** (UTD) is a comprehensive, unabridged dictionary. The UTD will read the definition of a word to the user and it will use the word in a sentence so that the user will get a true understanding of the word. The total dictionary that comes with the UTD contains over 250,000 words, including slang, jargon, and historic figures such as George Washington. The UTD also has a fully integrated thesaurus for referencing synonyms of all words. The UTD also includes sentences using each defined word in context, for every “sense (meaning)” of the word.

**Scan and Read Pro© V6.0** changes printed text into understandable sound. The program helps the user in reading and comprehension by highlighting each word as it is read aloud. Scan & Read Pro’s© voice can also be turned off if the user prefers to focus on the visual input only.

Its easy-to-use graphical interface lets the user change the appearance of the page to fit individual needs, using your strengths to overcome any reading weaknesses. If the user has trouble reading text on computer screens, Scan & Read Pro© can change the spacing between words, lines, or even characters so the user can see everything clearly. There is no limit to the amount of space the user may insert between words. Once the user is done reading your document, the original format is easily regained if so desired.

Scan & Read Pro© offers some unique and useful features such as supporting up to 12 different languages, advanced settings making customization easy, and support for automatic document feeders available on high-end scanners. Most voice synthesizers will read parts of words producing a somewhat choppy reading due to the fact that when a word is broken or hyphened across multiple lines, it does not produce continuous speech when reading each word segment separately. Scan & Read Pro© has a special technique for de-hyphenating words so that any speech syntheses will produce smooth vocalization.

**Text-to-Audio© V6.0** is an easy to use tool that converts documents to audio files. It can use available voice technologies (e.g. AT&T's Natural Voices™) to quickly and compactly convert documents into audio files. These award-winning voices provide clear, naturally sounding audio. Text-To-Audio© can turn E-books to "books on tape" or, more properly, "books on media" (including your PC or CD). With only a straightforward 5-step process, Text-to-Audio is easy to use for everyone. Text-To-Audio is another of Premier Assistive's leading products. It is an industry leader in converting electronic documents to audio files. AT&T's Natural Voices™ combined with our new Clear Audio technology provide the highest fidelity digital speech audio. Text-To-Audio can even be used to turn E-books to "audio books". With Text-to-Audio, the user are no longer tied to the user PC once the user create the audio files. The convenience of Text-to-Audio means that the user can now fit reading back into the users schedule, by turning that reading into portable compact audio files that the user can listen to while doing other activities like travelling or exercising. Text-To-Audio is fast. A 24 to 1 conversion time will allow the user to quickly convert any documents into audio files.

**Complete Reading System© 5.1** is an easy to use, self contained OCR/Reading program with full talking menus. The full talking menus mean the user won't need a screen reader to navigate through the settings. The system works equally well on desktops or laptops because it doesn't require an external keypad. Most major functions are single-key operated. Place your reading material on your scanner, and press F5 to scan and recognize the text. When it's finished, just press F6 to begin reading. Auto page orientation allows the user to place the document on the scanner at almost any angle and still be recognized by the system. The Complete Reading System© can also open and read existing documents. The default file format is Microsoft Word, but the program supports virtually every type of word processor. Since the Complete Reading System only requires basic technical skills, it is the ideal solution for anyone with special reading needs!!!! Most major functions are single-key operated. Place your reading material on your scanner, and press F5 to scan and recognize the text. When it's finished, just press F6 to begin reading. It's that easy! Our simple design ensures easy installation- you'll be

up and reading within 30 minutes. Auto page orientation allows the user to place the document on the scanner at almost any angle and still be recognized by the system. The Complete Reading System© can also open and read existing documents. The default file format is Microsoft Word, but the program supports virtually every type of word processor.

**Text Cloner Pro© 5.0** is a scanning package designed to work with your screen reader's own voice capabilities. It features a high-performance Optical Character Recognition (OCR) engine, as well as a built-in spell checker. One-touch functionality means all important tasks can be accomplished with a single keystroke. Text Cloner Pro© handles multiple columns automatically. It also recognizes and adjusts for pages inserted at an angle. Once your documents are scanned, Text Cloner Pro works to retain their original appearance. If words are bold, italicized, or different font formats are used, those formatting features will be retained. The user can also, if the user wish, change formatting and colours. Some of the newest advances in photocopy technology are available with Text Cloner Pro©. This includes an "image cleaner", which "cleans up" defects in the image prior to text recognition, increasing OCR accuracy to nearly 100%. It supports 12 languages, including English, French, Spanish, and German. Text Cloner Pro© is specially designed to work with your existing screen reader, so the user won't have to spend lots of time learning new commands or features.

**Scan and View© 5.0** turns a standard scanner into a CCTV. When loaded on a laptop with a portable scanner attached, the user will never be without a CCTV. With the push of a button, Scan and View© will grab an image from your scanner and display it on your screen in 24 million vibrant colours. Once displayed on your screen, the user can use the mouse or arrow keys to move around the image. The large icons make it very easy to navigate through the program. Scan and View© will do a few things standard CCTVs cannot do. It can rotate images 360 degrees, open and save images to your computer, and automatically straighten the images it scanned in.

**PDF Magic Pro** is a utility designed to convert normally "inaccessible" PDF Files into one of 11 different accessible formats. It can even support 155 languages. PDF Magic Pro 3.0 utilizes Premier Assistive's new "Exact Match" technology which will retain the format of the original PDF File document in the newly converted file. It supports colour graphics, tables and even forms. For example, the user can take any U.S. Government form in PDF Format and quickly and easily convert it to MS Word where the user can then fill it out.

The **E-Text Reader** is designed to be a reading tool. The user can use it for opening up and reading existing documents in your computer or the user can cut and paste from any program on your computer. The user can even insert pictures into the text. It is an "easy to use" reader that gives the user the ability to change voices, read at any speed, and even allows the user to make notes into the document the user are reading. Since the interface is actually a word processor, the user can select and highlight text just like the user would use a highlighter in a regular book. The user can also insert any number of "bookmarks". The user can save these bookmarks with the documents so the next time the user opens it. In addition to highlighting and bookmarks, the user can "underline" and "bold" text

so that they can be easily identified. Everything in the E-Text Reader can be controlled with hot keys or Icons on the toolbar, making it easy for everyone to use. We have also built-in the electronic manual so that the E-Text Reader can actually read its own manual to you.

The E-Text Reader is designed to help those who have trouble reading or comprehending the printed word. There are thousands of literature titles now available in electronic format. This reader will read (using digital voices) the electronic version of books ("E-Books, or E-Text") to you. The E-Text Reader can read any document in Standard Text, MS Word, RTF ("Rich Text Format") and HTML formats. The E-Text Reader goes beyond just reading. With E-Text Reader, the user can highlight text for notes or just for points of interest. The built-in highlighter let the user select the text the user want to highlight and then select the highlighter and the text will be highlighted. The multiple colours of highlighters allow the user to easily make notes in the document. E-Text Reader will also allow the user to type your own notes right in the document.

**E-Library – Volume 1**, is a robust compilation of literary works from authors covering a broad spectrum of seminal and classical subjects spanning 1000s of years from ancient to modern times. The E-Library from Premier Assistive is available in both single users and network able version. With in just a few minutes the network version can be integrated into a school Web site giving every one in that school equal access to the e library. Each copy of our E-library comes with our own award winning E-Text Reader.

**The Universal Reader 4©** is a very easy-to-use utility that reads and works with virtually any application. Use it to read your email, your WORD documents even Web pages. It is as simple as selecting what the user want it to read and then click on the floating toolbar and it starts to read. It takes about 2 minutes to install and even less time to learn how to use it. It reads to the user, and only when the user wants it to. It is not a "screen reader" that reads everything to the user and produces a constant chatter. The Universal Reader is silent until the user wants it to read. The handy floating window makes it easy to use. The user click on the Mouth icon to read, the Stop Light to stop, the Yellow Light to pause, and the rewind button to start over from the beginning.

The floating toolbar can be set so that it is "always on top" of other applications, it can be minimized onto the status bar or it can be running "behind" everything as the user perform other tasks. The Universal Reader has a view window, which will display what is being read. If the user only want to listen without the on-screen display, the user can close this window and still have the toolbar active. To make viewing easier, the user can change the text and background colour, select a font and even enlarge the font up to five times its original size. It even highlights the word as it is being read. The most useful part is that it works with virtually every application on your computer such as word processing, spreadsheets, email, Web pages, etc. If the users are in a window that has selectable text, then the Universal Reader can read it.

With the "Talking Pointer", all the users have to do is place your cursor over virtually any text, icon or picture and the description or text will be read to you.

The users even have selectable voices to choose from and the user can even control the speed of the voices. It comes with many voices to pick from. The AT&T Natural Voices™ are included when it is ordered on CD.

**Universal Reader Plus 4** contains all the great features of our Universal Reader plus the added benefit of the New Scanning Technology. Version 4 now has an adjustable View Window, and the option of large or small icons on the floating toolbar.

Optical Character Recognition "OCR" Technology utilizes new "Exact Match" technology, which retains scanned pages as close as possible to the original document, the document will not only be in full colour, but it also maintains the full-page layout of the original document for pictures, columns, tables and even forms.

Universal Reader Plus is great for: scanning and reading bills, scanning and filling out forms and test, getting any document into your computer quickly and easily.

The Universal Reader Plus is a very easy-to-use utility that reads to the user. The best part is that it works with virtually any application. Use it to read your email, your MS WORD documents, even Web pages. It is as simple as selecting what the user want it to read, click on the floating toolbar and it starts to read.

Universal Reader Plus reads to the user and only when they want it to. It is not a "screen reader" that reads everything to the user and produces a constant chatter. The Universal Reader Plus is silent until the user want it to read. The handy floating window makes it easy to use. The user click on the Mouth to read, the Stop Light to stop, the Yellow Light to pause and the Rewind button to start over from the beginning.

The floating toolbar can be set so (1) that it is always "on top", (2) it can be minimized onto the status bar or (3) it can be running behind everything as the user do other activities. The Universal Reader Plus has a view window, which will display what is being read. If the user only wants to listen without reading, the user can close this window and still have the toolbar active. To make viewing easier, the user can change the text and background colour, select a font and even enlarge the font up to five times its original size. It even highlights the word as it is being read. The most useful part is that it works with virtually every application from Microsoft Word to Microsoft Outlook. If the user is in a window that has selectable text, the Universal Reader Plus can read it.

The Talking Grammar Check does more than look for errors. When it finds an error, it will read to the user the grammatical rule and provide the user with suggestions. Most people can catch their errors when they hear them, which is why the Talking Grammar Check will read the suggestion to the user when the user clicks on it. When the user hear the correct suggestion, all the user need to do is select the change button. "It has never been easier to use your ears to proofread!" says Dr. Steve Timmer.

**Talking Word Processor©** is an easy-to-use word processing program designed to help people who have difficulty with reading and writing. We wanted to design a word processor that was easy to use as well as having speech capabilities.

Virtually any standard word processor file is compatible with Talking Word Processor©, including the latest versions of Microsoft Word, standard text, and rich text formats. With the press of a single key, the user can hear text as they type it. The "word repeat" feature repeats the word after it's been typed. This lets the user know immediately if the user misspells a word.

"Word Pause" is a new technology unique to Talking Word Processor©. This feature allows the user to slow down the reading of your words without distorting the way the words are spoken. The user can increase or decrease the time between each word. This lets the user hear the words at your own pace. It's a great feature if the user or your children are learning to read or studying a new language.

BRAILLEX 2 D Screen represents a completely new braille display concept. Its newest feature is the possibility to display the structure of the complete computer screen at one time. In addition to the conventional 80 character horizontal display, it features a vertical display with 4 dots per computer screen line, which show an extensive "status" of the complete screen. Within fractions of a second the user can fully appreciate the screen layout: the secondary display concentrates all this information in a length of only 3 ¼".

Methodically, BRAILLEX 2 D Screen allows blind people to access the computer screen in a way which is very similar to the approach sighted persons use. They first look at the data structure as a whole, then locate the place which attracts their interest, and then start reading.

On the vertical display, every screen line is represented by four dots. The user can program them to show the presence and location of characters on the screen, or of groups of characters (e.g. numbers or line drawing characters to identify windows on the screen), furthermore colours, the cursor position, the display position, etc.

This unique possibility to obtain a general view of the computer screen considerably increases the working speed. When the user deal with new programs or work with complex screen layouts the user need not scan the whole screen line by line in order to find the relevant information.

Next to each dot row in the vertical display the user can find a key which allows routing the Braille line to the corresponding screen line. The user can then read the contents in detail. This very easy, intuitive and fast screen access is complete with the intelligent cursor routing feature. After having scanned the screen (for example for proof-reading a text) the user can route the cursor to where the user want to modify their text.

The unequalled working comfort of BRAILLEX 2 D Screen is complete with its Integrated Access Strategy program that reflects Papenmeier's long experience in accessing computer screens with a Braille display.

The ideal platform for accessing Windows Together with Papenmeier's acclaimed WinDOTS program, BRAILLEX 2 D Screen is the ideal device for accessing the graphical user interface Microsoft Windows.

**Romeo Attaché** makes legendary Romeo Braille quality more transportable than ever. Romeo Attaché weighs only 16 pounds and is perfect for on-the-go teachers and students. The user can add their favourite notetaker and create a practical, space-saving home office with Braille capability.

**Romeo Attaché Pro** has all the features as the Romeo Attaché. However, Romeo Attaché Pro also comes with our Single Sheet Tractors and ET Speaks, our innovative speech system, as standard equipment. Romeo Attaché Pro weighs only 16 pounds and is perfect for on-the-go teachers and students. The user can add their favourite notetaker and create a practical, space-saving home office with Braille capability. Romeo Attaché Pro.

**ZoomText 8.0** provides full Internet accessibility magnifying and reading any Web page, in the proper reading order. The user can read automatically or manually navigate by word, line, sentence and paragraph. Size and colour enhancements make it easy to see the mouse pointer. Special locators make it easy to find and follow the text cursor. Mouse echo automatically reads text that the user points to. Words or complete lines can be spoken instantly or after hovering briefly. ZoomText automatically speaks all program controls, including menus, buttons, lists, and messages. A complete set of hotkeys let the user read and navigate while creating and editing documents. The new AppReader provides continuous reading and word highlighting of documents - from within the user's applications.

ZoomText 8.0 automatically smoothes all colours of text. Built in support for Word, Excel and Outlook allow the user to read and navigate with 100% accuracy. Tables, columns, and other objects are always read in the proper order. Constrained mouse movement allows the user to examine rows and columns, and keeps the user within the active window. Innovative colour controls improve screen clarity and reduce eyestrain. Special effects include colour dyes, two-colour modes and replacement of problem colours.

**INDEX Everest Braille Printer** uses single sheet cut paper is an easy and effective system for Braille production. With Everest the printed documents are ready for binding immediately after printing. Everest can be used in an efficient way with any paper similar to that used in other single sheet feeding systems. There is no need for hand separation, special cutting equipment for the paper, or even any special paper thus making it a useful alternative to continuous paper systems. Everest dot quality is one of the best on the market. It has equally formed dots that will last for a long time even if thin "copy paper" is used, and the design reduces the risk of holes or cracked dots. A cracked dot will have a limited life time. Using thinner paper is an important step in reducing costs and saving the global environment. The noise level of Everest is lower than that of most Braille printers on the market. Using Everest together with the optional Everest Acoustic Hood reduces the noise to a level below what is normally is acceptable in offices.

The optimised professional design makes maintenance accessible and easy all around the world.
The **Index 4X4 Professional** automatically produces braille magazines, books, and newspapers, in a saddle stitch format. This makes even low volume small editions cost effective. Format the text for printing, after printing collate the pages, staple and fold.

The **VisionBoard™** combines the bigger keys required by those with dexterity problems with large, high contrast letters on the keys for those who have trouble reading the little letters on most standard keyboards. Larger keys on a standard sized keyboard, of course, means fewer keys. For example, the seldom used function keys have been removed, as well as the number key pad used by accountants and others entering large volumes of numbers. Otherwise, all the most used keys are included making this keyboard the perfect solution.

New Options Design and Technologies for the Visually Impaired are now working together to create **Accessible Web Site** solutions. These sites are created to be fully accessible to the visually impaired. Visually impaired individuals, groups, organizations, even companies wanting to reach the visually impaired community may benefit from the expertise in accessible Web sites by **Accessible Web Site Design & Development.**

## Appendix 9: Annotated bibliography

**Alty, J. (1998). Communicating graphical information to blind users using music: the role of context in design. *Proceedings of CHI 98 Conference on Human Factors in Computing Systems*, Los Angeles, CA, April 18–23, ACM Press, ISBN 0-201-30987-4.**

Audiograph is a tool for investigating the use of music in the communication of graphical information to blind and partially sighted users. The system is used to communicate complex diagrams and gives some examples of user out put. Performance is not as good as expected and it is postulated that context will play an important part in the perception of diagrams communicated using music. A set of experiments indicate that context does indeed seem to play an important role in assisting meaningful understanding of the diagrams communicated. The implications for using music in auditory interface design highlight the fact that this technological development is only the beginning in assisting visually impaired persons forging a career in the music industry.

**Arch, A., & Burmeister, O. (2001). Australian Experiences with Accessibility Policies Post the Sydney Olympic Games.**

This paper reviews current online accessibility policies and guidelines of federal and state governments in Australia and contrasts these positions with the high levels of accessibility expected in the future in the banking, education, legal and multimedia sectors as a result of recent industry policies declarations.

In Australia accessibility policy is the adoption of “best practice” defined through the Australian Human Rights and Equal Opportunity Commission (HREOC) “Notes’ (HREOC, 2002a) which show application of the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI) Web Content Accessibility Guidelines (WCAG) to Australian Guidelines.

In Australia it may not be illegal to have an inaccessible Web site, it is illegal to discriminate; thus an inaccessible Web site may not be discriminatory if alternative, equivalent, access to the information or service is provided.

Non-government sectors are leading the way in accessibility. The Australian Bankers Association (ABA) “Disability Action Plan” (DAP) urges banks to improve accessibility of Automatic Teller Machines (ATMs), Electronic Funds Transfer at Point of Sale (EFTPOS), Automated Telephone Banking and Internet Banking.

The “Accessible Web Action Plan” from the Internet Industry Association and the Australian Interactive Media Industry Association (IIA/AIMIA, 2002) was developed to provide a best practice model for their members and assist them to eliminate, as far as possible, barriers for people with disabilities in the provision of Internet, or online-based goods, services and facilities.

*The Australian Disability Discrimination Act*

The Australian DDA (1992) relies on a complaints based system and requires an individual to lodge a complaint with HREOC who will then attempt to conciliate between the person or organisation providing the discriminatory service and the complainant. If the complaint cannot be resolved by the conciliation does a person have the option to take their complaint to the Federal Court for an enforceable ruling.

*Litigation against the Sydney Organising Committee for the Sydney Olympic Games*

A significant influence on the development of accessibility policy in Australia has been the litigation against the Sydney Organising Committee for the Olympic Games (SOCOG). Inaccessibility of some Sydney Olympics' Web designs and the lack of alternative provision of information and services that accessibility has been bought to public attention. The original complaint was that the Web site was not accessible to people using screen readers:

1. lack of ALT text associated with images;
2. lack of alternative text for image maps;
3. use of JavaScript for navigation.

The result was that some vision impaired users could not access ticketing information, event schedules or postings of event results.

*Specific Accessibility Policies*

- *Electronic Banking in Australia*

On April 15th 2002 the Australian Bankers' Association (ABA) released new voluntary Industry Standards aimed at improving the accessibility of electronic banking. As the standards are voluntary, banking customers rely on the banking institution's goodwill to adopt the standards and addressing any complaints or breaches that arise. Banks are free top differentiate their products , meaning that one bank might cater generally to all disability groups, whilst specifically targeting people with one type of impairment, such as visual impairments.

- *E-Banking Technologies*

The four main areas of e-banking addressed by the ABA standards are ATMs, EFTPOS, telephone banking and Internet banking.

- *Automated Teller Machines (ATMs)*

In 2002 Australians with visual impairments were introduced to audio-enabled ATMs. This initiative proved successful and the NAB adopted a policy whereby all their new ATMs from January 2003 have been voice enabled.

A problem for users with a disability is the difference in ATM design. Some individuals who are blind do learn to operate non-speech enabled ATMs by memorising sequences in keystrokes, however, a machine that can be learned in this way does not mean that it is accessible if it is not possible for the individual to discover how it works through trial and error experimentation. Devices that can be learned are significantly less accessible that devices whose operation can be discovered.

- *Electronic Funds Transfer at the Point of Sale (EFTPOS)*

One advantage of the EFTPOS terminal is that there is another person present in the transaction process to assist in the pressing of correct keys.

- *Automated Telephone Banking [also known as Interactive Voice Response (IVR)]*

There is an option available to speak to an operator and to be transferred to an operator without financial penalty. This satisfies the requirements that people with disabilities, or other disadvantages are not discriminated against as a result of an inability to use a particular interface.

- *Internet Banking*

Adoption of the ABA Standards

There is a register of over 180 Disability Action Plans online (HREOC, 2003), but only three banks are represented among the 35 business plans listed. The NAB and Commonwealth Bank of Australia (CBA), specifically address accessibility for vision impaired.

All Australian banks have committed to the ABA Disability Action Plan and the associated banking standards, however, each bank is setting its own implementation priorities and timetables.

- *Accessibility in the Australian Government*
  - Web Accessibility
  - Online Council of Ministers
  - Federal Government
  - State Governments
  - ICT Procurement Policies
  - Accessibility In Australian Educational Organisations and Institutions
  - Educational Policies and Guidelines
  - Higher Education

While all Universities provide access for students and staff with disabilities, this has not been transferred to access information. In 2002, Alexander and Steele surveyed eighteen of Australia's 39 universities and found that only 10 had Web accessibility policies in place and another four had them in development. Another study by Alexander (2003) involving 45 tertiary institutions, Ninety-eight percent failed to meet WCAG 1.0 Single-An accessibility conformance.

Policy and practice do not match the Australian tertiary education sector. It is hoped that the implementation of the Disability Standards for Education will help remedy this situation by raising awareness in the sector.

**Asakawa, C., & Itoh, T. (1998). User interface of a Home Page Reader. *Proceedings of the third international ACM conference on Assistive technologies*, pp. 149-156, April 15-17, 1998, Marina del Rey, California, United States.**

The World Wide Web is a new information resource for the blind through non-visual Web access. The newly designed system has special characteristics; a numeric keypad for surfing the Net, with a key assignment designed for intuitive operation; a fast-forward key for quick reading. Hyperlinks are read in a female voice and HTML tags are converted into voice data, and the system can be synchronized with Netscape Navigator.

**Augusto, C. & Schroeder, P. (1995). Ensuring equal access to information for people who are blind or visually impaired. *Journal of Visual Impairment & Blindness, 89*(4), 9.**

Obstacles to full access to electronic information-based technology and assistive devices for people who are blind or visually impaired include: high costs and limited financial assistance sources for assistive technology, insufficient resources for providing instruction in the use of new technology, and developments such as the graphical user interface.

**Ballabio, E. (1997). Inclusion of disabled and elderly people in telematics is a support action in the Telematics Applications Programme of the European Commission. *Communication on Equality of Opportunity for People with Disabilities, COM (96)406.***

Design for All is the process of creating products, services and systems which are usable by people with the widest possible range of abilities, operating within the widest possible range of situations. *Design for All* is the designing of products, services and systems so that they are flexible enough to be directly used, without assistive devices or modifications, by people with the widest range of abilities and circumstances as is commercially practical given current materials, technologies and knowledge; and compatible with the assistive technology products that might be used by those who cannot efficiently access and use the products directly.

The objective of the INCLUDE project is to provide the necessary support for the Telematics Application Programme and other relevant actors in ensuring that telematics equipment and services are designed and implemented in ways that make them accessible for disabled and elderly people.

INCLUDE recognizes *Design for All* as a key approach for improved accessibility to new products and services. Furthermore, taking the needs of disabled and elderly people into account in the design process adds value to products, services and systems by accommodating the broadest range of users possible.

Examples of Design for All
*Kerb cuts, volume amplification control in telephones, speech recognition software, captioning of native language in TV-programs, adaptation of keyboard features*

Other examples:

- interfaces which are usable by individuals without fine pointing control would also be usable by individuals wearing heavy winter gloves
- portable communication or information systems that can be operated by people who are blind can also be suitable for people driving a car.

*What are the benefits of Design for All?*
As products, services and environments are designed to accommodate the greatest range of users, there will be less need to make adaptations for people who function differently because of physical, sensory, or cognitive ability, age or size.

The elimination of special, duplicative, and more costly elements to accommodate the needs of people with disabilities. For example, incorporating access features into voice-mail services could eliminate the need for deaf persons to purchase expensive text telephone answering machines.

*For industry:*
Increasing ease of use and convenience for the broadest possible range of individuals will expand the potential pool of users, multiply marketability and reduce expenditures for assistive technology. Profitability is enhanced, and cost is contained.

Europe's ICT industry must incorporate accessibility features in their products and services in order to be competitive with US industry on the world market. US companies are obliged by law to ensure that their products and services are accessible for people with disabilities.

Incorporating disability standards at the design stage is cheap - amending products and standards or making specialist provision is expensive, time consuming and ultimately discriminatory. A recent Commission study on transport for example estimated that incorporating access features at the design stage added as little as 2% of the overall cost and that any additional costs were offset by increases in passenger revenue. It makes economic sense to ensure full accessibility of products.

It is recognized at the political level, States should develop strategies to make information services and documentation accessible for different groups of people with disabilities. Braille, tape services, large print and other appropriate technologies should be used to provide access to written information and documentation for persons with visual impairments. Similarly, appropriate technologies should be used to provide access to spoken information for persons with auditory impairments or comprehension difficulties. Consideration should also be given to the needs of people with other communication disabilities.

*United Nations Standard Rules on the Equalization of Opportunities for Persons with Disabilities*
Although significant technological breakthroughs have been made in the field of communications, more could be done to optimise the liberating potential of technology and to ensure that future developments take full account of the needs of

people with disabilities. The principle of "design for all" and universal access have, of course, cross-sectoral benefits for many more groups.

Viewing access issues in the light of the principle of equality of opportunity and the right to participate: This can be done by progressively removing existing architectural, communications and transport barriers and by developing detailed and enforceable guidelines on accessibility. It can also be done by ensuring a barrier-free environment in the design and construction of new facilities and in the development of new communications technologies. Special consideration is required of the need to harness positive developments in the field of information and communication technologies.

**Barlow, J., Bentzen, B., & Bond, T. (2005). Blind pedestrians and the changing technology and geometry of signalized intersections: Safety, orientation, and independence. *Journal of Visual Impairment & Blindness, 99*, 587-599.**

This study documented that blind pedestrians have considerable difficulty locating crosswalks, aligning to cross, determining the onset of the walk interval, maintaining a straight crossing path, and completing crossings before the onset of perpendicular traffic at complex signalized intersections. Revised techniques and strategies are suggested for alleviating these difficulties.

**Blind Citizens Australia submission to the Productivity Commission Inquiry into the Disability Discrimination Act (2003). Retrieved November 28, 2006, from www.pc.gov.au/inquiry/dda/subs/sub122.pdf**

*Summary of Recommendations*

- That the Disability Discrimination Act (DDA) (2003) be amended to remove the reference to "other reasonable factors". The purpose of this amendment is to oblige insurance companies to obtain actuarial and statistical data to support exclusion or higher premiums.
- That the DDA be amended along with necessary sections of the Migration Act 1958 to ensure that where a person is eligible for migration to Australia, the fact that a person has a disability or has a dependent family member or spouse with a disability, should not operate to prevent migration.
- That the DDA be amended to make it clear that only prescribed laws are exempt from the operation of the DDA. The DDA should be amended or a new section added to ensure that discriminatory provisions in laws can be challenged with the Commonwealth named as the appropriate Respondent.
- That there be a review of the comparator definition of disability discrimination to evaluate its usefulness in meeting the objects of the DDA.
- That the DDA be amended to include a positive obligation to make reasonable accommodations.
- That the Productivity Commission recommend that prisons be required to develop Action Plans outlining how prisoners with disabilities can expect to access rehabilitation and education opportunities.
- That the Productivity Commission recommend that mandatory Disability Standards be developed in all areas listed in the DDA.

- That the Human Rights and Equal Opportunity Commission Act 1986 and/or other relevant legislation be amended to clarify that the costs are only to be awarded against a complainant when a complaint is judged to be frivolous or vexatious.
- That the Productivity Commission recognise that systemic discrimination in employment is the most important factor which affects the participation of people with disabilities in the labour market.

This submission draws on the experience of Blind Citizens Australia in using the DDA to address discrimination encountered by blind people in their daily lives. Blind Citizens Australia advocacy service supports people from all over Australia, in the making and pursuit of complaints under the DDA and informs broader policy development and group advocacy activities, so that Blind Citizens Australia use the two streams of advocacy together in assisting members to overcome discrimination on account of blindness.

Blind Citizens Australia has also made a substantial contribution to the development of DDA Standards both through the provision of input from blind people and the co-ordination of the DDA Standards Project. Blind Citizens Australia also contributed to the HREOC public inquiry process and other initiatives which have sprung from the legislation, such as the Commonwealth Disability Strategy and worked with government authorities and private sector organisations to develop collaborative strategies to address discrimination against blind people.

**Blind Citizens Australia: Submission to the Productivity Commission Review Reform of Building Regulation (2004). Retrieved November 26, 2006, from bilbo.indcom.gov.au/study/building/subs/sub020.rtf**

Blind Citizens Australia is the peak national organisation of people who are blind or vision impaired with fifteen branches across Australia and 3,600 (approximate) members. Members gain opportunities for peer support and social interaction and access to blindness-specific information and advocacy support. Community expectations of access and amenity require explicit incorporation of dignity into the definition of amenity is particularly vital in the context of a “least-cost” approach to building regulation. A recommendation is that the definition of amenity explicitly includes dignified access to premises for people with disabilities.

Efficiency and effectiveness through consistency of the building industry and the Building Code can be maximised through greater commitment to training in disability access and improved national consistency. This will improve efficiency and promote economies of scale reductions in costs. A recommendation is that the Building Code be amended such that premises are only assessed as being compliant with it if tactile ground surface indicators are installed according to the deemed-to-satisfy provisions. Efficiency & effectiveness can also be improved through early consultation with a broad range of people with disabilities. A recommendation is that the building industry seek the input of people with disabilities at an early stage in the planning and design process. People with disabilities urgently need access to affordable and accessible training in Australian

Standards, the Building Code, the Premises Standard and the Accessible Public Transport Standards, as well as relevant state and local regulations. A recommendation is that training courses for people with disabilities serving on disability advisory committees be developed and widely provided.

Minimum Standards versus Best Practice need to be addressed and recommendation is that state, territory and local governments continue to have the capacity to regulate for improved access for people with disabilities and that these improvements be based on the relevant Australian Standard.

Blind Citizens Australia is a member of the Standards Australia Committee which develops the suite of standards related to access for people with disabilities. The current Standards process could be improved in three ways:

- greater coordination of input from government and industry;
- increased responsiveness of Standards Australia to feedback; and,
- a greater commitment to using the Standards process by government and industry.

A recommendation is that the disability sector, government, industry and professional associations review the consultation and reporting processes used by their representatives on Standards Australia committees.

Increased responsiveness of Standards Australia to feedback as Standards Australia does not make sufficient use of this capacity to update Standards relatively quickly and thereby keep the Standards relevant. A recommendation is that Standards Australia makes greater use of the amendment process to ensure that Standards remain relevant.

Greater commitment to using the Standards process by government and industry is required. A recommendation is that government and industry recommit to using the Standards Australia standards development process to ensure consistency and best practice are achieved.

Alignment with international standards so that Australia's position as a world leader in the development of disability access remains. Achieving uniformity and consistency so that disability awareness training forms a greater part of building industry professions' training and ongoing professional development is a priority.

Current compliance sees building certifiers are not able to accurately assess a building's compliance with the Building Code in relation to access for people with disabilities. A subsequent recommendation is that people with disabilities and their representative organisations be consulted at the early stages of building design to ensure that their needs have been considered.

Many projects employ access consultants to make sure that the project meets Standards for access for people with disabilities although the quality of these consultants varies considerably; many consultants are expert in access for people with physical disabilities but know little about the needs of people who are blind or vision impaired. A recommendation is that a registration process be introduced to

ensure that access consultants have a wide range of experience and knowledge about all disabilities.

DDA Standards on Access to Premises do not include instructions for how to provide:

- braille, raised tactile or audible maps;
- braille, raised tactile or audible signs for finding services or facilities in a premises; or
- safe and detectable paths to a building from a street.

Blind Citizens Australia has identified three issues of concern related to the proposed Administrative Protocol. These are the role of third parties, the selection of access experts and the voluntary nature of the protocol. Blind Citizens Australia is extremely concerned that people with disabilities do not have standing under the Administrative Protocol to refer a matter to an Access Panel.

The lack of standing decreases the accountability and transparency of the process and is not consistent with the right generally conferred on members of the public to make complaints about perceived breaches of the Building Code. Under the proposed Protocol, which is designed to specifically deal with disability access issues, people with disabilities have less capacity to raise concerns than under most general building review and dispute schemes. This could result in the absurd situation that whereas a person may have had the right to make a complaint under existing processes, because the matter has been referred to an Access Panel, the person does not have a voice.

People with disabilities should have standing to both refer a matter to an Access Panel and make submissions to an Access Panel. The disability sector contains significant expertise and its involvement will improve the access outcomes for people with disabilities. Notice should be given to the public that a matter has been referred to an Access Panel. There should be a requirement that an Access Panel consult with relevant disability organisations or people with disabilities likely to be directly affected by the decision of the Panel.

That people with disabilities should have standing to both refer a matter to an Access Panel and make submissions to an Access Panel. A recommendation is that Access Panels should consult with relevant disability organisations or people with disabilities likely to be directly affected by the decision of the Panels. The access of experts could come through the recommendation that all members of an Access Panel should have extensive and compulsory training in disability access issues. A voluntary process recommendation that an alternative solution or decision that unjustifiable hardship exists must be referred to an Access Panel during the first two years of operation of the Protocol and Access to Premises Standard.

Draft Premises Standards do not contain provisions for emergency egress for people with disabilities. We understand that the ABCB plans to address this in the near future, however, in the mean time people with a disability are left vulnerable in emergency situations. That emergency egress provisions for people with disabilities be addressed as a matter of urgency.

Blind Citizens Australia's experiences of working with the Australian Building Codes Board have been positive. We have found them to be responsive to concerns and skilled at communicating complex technical issues in clear language. To contribute effectively to the development of the Building Code, people who are blind or vision impaired need access to information about proposed changes in accessible formats. This information should be provided at no cost and should include as much detail from the Building Code as is required to competently comment on the proposed changes.

A recommendation is that information about proposed changes to the Building Code be provided in accessible formats.

*Awareness and research*

Comparatively little research has been done in Australia or internationally on ways to ensure that people with disabilities have equal access to buildings. With the exception of research into the effectiveness of tactile ground surface indicators, the research that has been done in the area of blindness has tended to concentrate on high-tech solutions, at the expense of more simple measures that might improve access. As a consequence, people with a disability have been disadvantaged in relation to the development of the Building Code and the Premises Standard because we have often been unable to point to specific research to back suggestions for changes and have not had the resources or expertise to pursue these research projects independently.

There has been improvement in this area. In 2002, a research project aimed at helping people who are blind navigate the built environment commenced, funded by the Co-operative Research Centre for Construction Innovation. It is hoped that this project will lead to further research projects.

In the view of BCA there is an unexplored potential for more effective research to be undertaken through trials undertaken at the local level. The Australian Building Codes Board and other organisations should work with local councils and people with disabilities to identify small-scale research projects into disability access. State and territory governments are well placed to incorporate practical trials of access measures through their public premises such as railway stations, hospitals and galleries. People with disabilities cannot contribute financially to research, but we can contribute our time and energy. The few trials of access measures in the area of blindness have attracted significant interest from people who are blind. Such an approach would benefit people with disabilities and would foster innovation. To maximise its effectiveness, information about the trials should be collated and reported to people with disabilities on a regular basis.

A recommendation is that more funding be allocated to research in the area of disability access with the Australian Building Code Board working cooperatively with state, territory and local governments and people with disabilities to identify opportunities to conduct small-scale research projects into disability access. Information about these trials should be collated and reported to people with disabilities on a regular basis.

**Brewster, S. (2002). Visualization tools for blind people using multiple modalities. *Disability and Rehabilitation, 24*(11-12), 613-621.**

There are many problems when blind people need to access visualizations such as graphs and tables. Current speech or raised-paper technology does not provide a good solution. One approach is to use non-speech sounds and haptics to allow a richer and more flexible form of access to graphs and tables. Two experiments are reported that test out designs for both sound and haptic graph solutions. In the audio case a standard speech interface is compared to one with non-speech sounds added. The haptic experiment compares two different graph designs to see which was the most effective. Results for the sound graphs showed a significant decrease in subjective workload, reduced time taken to complete tasks and reduced errors as compared to a standard speech interface. For the haptic graphs reductions in workload and some of the problems that can occur when using such graphs are shown. Using non-speech sound and haptics can significantly improve interaction with visualizations such as graphs. This multimodal approach makes the most of the senses users have to provide access to information in more flexible ways.

**Colford, M. (2000). AccessWorld: Technology for consumers with visual impairments. *Library Journal, 125*(15), 122.**

"AccessWorld: Technology for Consumers with Visual Impairments" provides the latest information on assistive technology for the visually impaired, including evaluations of the latest products available and news on technologies being developed. The journal is published by the American Foundation for the Blind and is available in several formats including online, large print, audiocassette and Braille.

AccessWorld provides the latest information on assistive technology for the visually impaired, including evaluations of the latest products available and news on technologies being developed. Published by the American Foundation for the Blind, each issue includes two in-depth product evaluations and other features including product announcements, a question-and answer column, a calendar of events, book and video reviews, and reports on newsworthy developments in the field. The journal is available in several formats including online, large print, audiocassette, and Braille. The issues examined include evaluations of several different text magnifiers and speech synthesizers. Reviews are extensive and reader-friendly. In addition, an interview with Deane Blazie (who introduced the Braille 'n Speak personal organizer), an article on why AOL is problematic for visually impaired users, and a book review on Internet use for the blind are included. This is a very important resource for a specialized audience, but it also will help inform librarians concerned with making their materials accessible to all local patrons.

**Connell, B., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M. & Vanderheiden, G. (2001). What is universal design? *The Center for Universal Design.* Retrieved November 22, 2006, from www.design.ncsu.edu:8120/cud/univ_design/princ_overview.htm**

Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. A working group of architects, product designers, engineers

and environmental design researchers, collaborated to establish the following Principles of Universal Design to guide a wide range of design disciplines including environments, products, and communications. These seven principles may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments.

The Principles of Universal Design presented in the following format: name of the principle, are intended to be a concise and easily remembered statement of the key concept embodied in the principle; definition of the principle, a brief description of the principle's primary directive for design; and guidelines, a list of the key elements that should be present in a design which adheres to the principle. (Note: all guidelines may not be relevant to all designs.)

**PRINCIPLE ONE: Equitable Use**
The design is useful and marketable to people with diverse abilities.

**PRINCIPLE TWO: Flexibility in Use**
The design accommodates a wide range of individual preferences and abilities.

**PRINCIPLE THREE: Simple and Intuitive Use**
Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

**PRINCIPLE FOUR: Perceptible Information**
The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

**PRINCIPLE FIVE: Tolerance for Error**
The design minimizes hazards and the adverse consequences of accidental or unintended actions.

**PRINCIPLE SIX: Low Physical Effort**
The design can be used efficiently and comfortably and with a minimum of fatigue.

**PRINCIPLE SEVEN: Size and Space for Approach and Use**
Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Principles of Universal Design address only universally usable design, while the practice of design involves more than consideration for usability. Designers must also incorporate other considerations such as economic, engineering, cultural, gender, and environmental concerns in their design processes. These Principles offer designers guidance to better integrate features that meet the needs of as many users as possible.

**D'Amour, D. (2004). Technology upgrade boosts access for blind Canadians. *Reading Today*, *21*(5), 23.**

The Canadian National Institute for the Blind (CNIB) launched All May Read, a CAN$33 million campaign designed to replace obsolete technology in the production and delivery of print materials to provide visually impaired people, and the CNIB Digital Library, a one-stop shopping Internet portal for readers, who cannot read in print, where they can fully access library services like online audio, talking books, electronic text, and newspapers, among others.

**Digital Conversion Laboratories. (2005). Visually impaired students no longer have to wait six months or longer accessible textbooks, thanks to XML and Data Conversion Laboratory. *XML Educational for Blind & Visually Impaired.***

For the blind and visually impaired new technology has opened doors to education. They can listen to a textbook on a computer or read using refreshable braille. Yet students with print disabilities needed to wait six months or longer for an accessible textbook to be made available. This will change with the reauthorization of the Individuals with Disabilities Educational Act (IDEA). The act, signed December 3 by President Bush, gives students with print disabilities equal access to educational materials as their sighted peers.

Key to the act is requiring a standard file format for each textbook, making conversion into accessible formats such as braille, large print or digital text much faster. “An historic milestone,” says Mark Gross, president of Data Conversion Laboratory (DCL), a New York-based technology firm and a supporter of the new standard. “Like Eli Whitney’s invention of interchangeable parts leading to the industrial revolution, an accepted standard will revolutionize document preparation for the blind and visually impaired.”

Based on an ANSI NISO standard, the text portions are called Digital Talking Book (DTBook), an XML standard coordinated by the DAISY Consortium and the Library of Congress. “Publishers can help libraries serving persons with disabilities by providing XML files in DTBook or other XML vocabularies that can be transformed to this standard,” says George Kerscher, secretary general for the DAISY Consortium.

Data Conversion Laboratory now provides conversion to DTBook, as part of its “Books2Bytes” service (www.books2bytes.com). “The new service allows authorized organizations to easily produce materials without capital investment and without long term commitments,” says Gross.

**Dobelle, W. (2000). Artificial vision for the blind by connecting a television camera to the visual cortex. *ASAIO Journal*, *46*(1), 3-9.**

Blindness is more feared by the public than any ailment with the exception of cancer and AIDS. We report the development of the first visual prosthesis providing useful “artificial vision” to a blind volunteer by connecting a digital video camera, computer, and associated electronics to the visual cortex of his brain. This device has been the objective of a development effort begun by our group in 1968 and represents realization of the prediction of an artificial vision

system made by Benjamin Franklin in his report on the “kite and key” experiment, with which he discovered electricity in 1751.

**Dobbs, M. (1999). Who's leading the blind? *K Training, 36*(10), 96-104.**

70% of America’s working-age blind who want jobs cannot find them, and 30% of those who are working are underemployed in relation to their qualifications. Advocates blame discrimination, a drop in Braille literacy and a lack of training and rehabilitation. The level of joblessness among the blind has remained stagnant for decades. Too often, blind and visually impaired children languish in school because they are not held to the same standards as their sighted peers. The education system is increasingly letting blind kids down. The news, however, is not all grim. Technology has drastically altered the typical workplace, and it can make many jobs easier for blind people to perform. Some 90% of blind people who have jobs use computers. Computers are probably more important for the blind than for anyone else. Employment training centers like Blind Inc. are opening doors for the working blind.

**Ebert, J. (2005). Scientists with disabilities: Access all areas. *Nature*, 552-554.**

Vision impaired scientists are building their own customized technological solutions to overcome problems. Software that translates and reads out mathematical equations has helped Aqil Sajjad pursue his studies. A gadget known as IVEO — one of the newest assistive technologies for the blind. IVEO is the brainchild of John Gardner, a solid-state physicist turned entrepreneur who is also blind. It is the latest in a long line of products that he has invented to remove barriers that prevent the visually impaired from fully appreciating maths and science. Like many researchers with disabilities, Gardner had to develop his own technologies for doing science and communicating his work because commercial solutions were seldom available.

The colours on the map of the upper atmosphere can be turned into musical notes for blind students. Universal access to the products of scientific research — from public-health information to data on environmental pollutants — is just one aspect of assistive technology. But for students with disabilities, having access to the right technology can determine whether they choose to enter science at all. That was true for Aqil Sajjad, a physics student from Pakistan, who says that the specialized software WinTriangle, which helps the visually impaired read and write mathematics, was a lifeline.

WinTriangle, which was produced by the Science Access Project, allows a blind user to write mathematical equations, perform calculations and hear mathematical text. In its simplest form it is a scientific word processor with a specialized set of fonts representing symbols and operations that can be read by a speech synthesizer. WinTriangle is “open-source” software, which lets users adapt and rewrite it to meet their needs. It is fairly common for assistive technologies to be modified or enhanced by their users. Gardner recently teamed up with Victor Wong, James Ferwerda and Ankur Moitra at Cornell University in Ithaca, New York, who have developed software that translates colour pixels on a computer screen into piano notes. The group hopes to combine the audio software with IVEO’s tactile technology to solve a particularly challenging information problem.

Wong, who lost his sight in an accident when he was seven, works with a team that studies the ionosphere, the layer of the atmosphere between Earth and space. Part of Wong's work involves reading maps of the ionosphere in which colours represent variables such as electron density and light intensity. With the Cornell system, Wong uses a touch-sensitive tablet to explore three-dimensional images with a "wireless" electronic pen. "When you move the pen around on the tablet it's the same as looking around on the screen," explains Wong. When using the tablet, Wong finds the pen is almost too sensitive — it is actually better than the naked eye and gives too much detail. In addition, there is no easy way to uncover the major features of an image without tedious, pixel-by-pixel exploration. By combining IVEO's ability to display tactile maps with the Cornell team's software for converting colour into sound, users will be able to determine the boundaries of a map or graph more easily. "This is about finding a way to make graphical information accessible to the blind and those with print disabilities," says Gardner. But not all of the barriers are technological he says. "The latter is the hardest to achieve."

Stern agrees. "Counsellors and teachers at all levels, from preschool through to the very critical high-school years, do not believe that students with disabilities can persist and excel in science and engineering fields," she says. "One reason is there aren't enough role models." In addition, she says, few students, counsellors, teachers or employers know about assistive technologies. And for some people, such technology doesn't yet go quite far enough. This may be reflected in the low number of disabled researchers. In 2000, the NSF estimated that 365,500 people with disabilities were employed in science, technology, engineering and mathematics (STEM) in the United States — about 7% of the science workforce. But there are more people with disabilities in the general workforce (13%), and even the college-educated workforce (9%). "There is a strong under-representation of persons with disabilities in STEM fields, especially at the PhD level," says Ted Conway, director of an NSF programme researching disabilities education.

Jesse Leaman has devised an electronic "rear-view mirror" for wheelchair users.
Gardner is optimistic about the future, but sees change happening slowly. "I don't want to be too negative," he says. "I am optimistic about public awareness and new technologies. I believe that things are getting better, but it would be dishonest to say that things are already better."

**Fiore, S., & Edwards, A. (2005). *Agency, interaction and disability: Making sense through autobiographical accounts*. Retrieved November 21, 2006, from www.hhrc.rca.ac.uk/events/include/2005/proceedings/pdf/fiores.pdf**

An approach to Interaction Design emphasising the emotional-volitional construction of experiences with technology as sensual, emotional and embodied, can lead to a better understanding of how to support blind people's experiences with interactive technologies in a meaningful way. Understanding and interpretation of autobiographical accounts by people with vision loss, has provided opportunity for reflection over how people build meaningful experiences without sight. Such critical reflection emphasises the significance of emotion and agency in making artefacts meaningful, rather than just usable, for blind users. An interpretive approach to the texts, supports a notion of the designer(s) as creative,

empathic subject(s). The research forms a part of a larger project exploring the means and dynamics suggested by a pragmatist aesthetics approach to creating artefacts that help designers understand the world in different ways.

**Glenn, J. (1989). Conscious technology: The co-evolution of the mind and machine. *The Futurist, 123*(5), 15-21.**

The 21st century will usher in the age of "conscious technology," in which human beings will use technologies to enhance their bodies and minds and in which technologies will increasingly assume human qualities. Cyborg technology is the internalization of technology into humans. This technology will become one of the critical factors in the merger of consciousness and technology. Some of the near-future developments that herald the evolution of humans toward cyborganization include: 1. Recombinant DNA, or gene splicing, has made possible a biodegradable plastic called Biopol that can be inserted into damaged bone; the needed bone then grows in where the biodegradable plastic is absorbed by the body. 2. A grid of nerve microcircuits attached to nerve cells will replace rods and cones in the eyes of individuals with certain forms of blindness. Computers are evolving into self-programming, mobile robots with perception and controlled responses.

**Golledge, R. (2005). Reflections on procedures for learning environments without the use of sight. *The Journal of Geography, 104*(3), 95-104.**

The Americans with Disabilities Act (1990) can be interpreted as civil rights legislation for disabled people. Equal opportunity, equal environmental accessibility, and equal education opportunities are presumed to be by-products of this legislation. Geography must face questions about how to achieve these goals. In the profession where visualization is dominant in terms of representation and display, one group of disabled people is the most disadvantaged-people who are visually impaired. In this paper, a variety of ways to help visually impaired people access and learn geospatial material are offered. To be consistent with today's electronic high-tech environment, suggestions are made that can be implemented now or in the near future to allow the learning of geography without the use of vision.

**Hackett, S. (2006). Usability of AcceSS for web site accessibility. *Journal of Visual Impairment & Blindness, 100*, 173-182.**

With the Internet affecting so many aspects of life, the ability to access the Web has become of critical importance, but despite the existence of screen readers and efforts to spread information about how to create accessible Web sites, this everyday experience is still difficult for many people who are blind or visually impaired. Here, Hackett and Parmanto describe the development of AcceSS (Accessibility through Simplification and Summarization), a technology for transforming a Web page into a format that is accessible. The AcceSS transcoding gateway is a Web intermediary that adapts or transforms the content of a Web page into a format that is accessible to persons with disabilities.

**Hunt, H. (1992).** ***New Technologies and the Employment of Disabled Persons*****. Switzerland: ILO Publications.**

This report focuses on technology training programs for disabled persons, the contributions of access technology to the employment of disabled persons, the ability of traditional rehabilitation centers to train disabled persons for advanced technology occupations, and the placement and employment of disabled persons trained in new technologies. The impact of new technology on the employment of disabled persons and describes the project, conducted by Rehabilitation International and sponsored by the International Labour Office, resulted in this collection of papers. Subsequent chapters are as follows: "New Technology Training Programs for Disabled Persons in Great Britain" (Paul Cornes and others); "The Effect of New Technology on the Employment of Blind and Visually Impaired Persons in Four Western European Countries" (Lawrence A. Scadden); "Factors Associated with the Traditional Rehabilitation Centre's Ability To Train Disabled Persons for Advanced Technology Occupations" (Michael J. Leahy and Robert Leneway); "Computer-Based Technology for Disabled Persons in Working Life: A Holistic Approach" (Jan Breding and Ulf Keijer); "The Contributions of New Access Technology to the Employment of Disabled Persons in Japan" (Shinichi Okada and Takeshi Yatougo); "New Technologies and the Employment of Disabled Persons in Israel" (Emanuel) Chigier); "New Technologies and the Employment of Disabled Persons in Four Developed Countries" (Jacques Dawans); and "New Technology in Rehabilitation: A Hungarian Perspective" (Gyorgy Konczei).

**Kieninger, T. (1996). The "Growing Up" of HyperBraille -an office workspace for blind people. Retrieved November 29, 2006, from wotan.liu.edu/docis/show?doc=dbl/uistui/1996__67_T_UOH-.htm&query= - 4k**

Due to their intuitive usage especially for novice users, graphical user interfaces (GUI) are a widespread user front end for almost any kind of application. The advantages to sighted users hide strong drawbacks for the community of blind people. Their special needs are not very well catered for the common software design. The control over GUI applications with their overlapping windows and buttons are no analog to the way blind people "see" their environment as it is for sighted people. The competitiveness of these people is drastically reduced. The basic goal of HyperBraille is to enable blind or visually impaired people to participate as fully competitive members in today's information technology oriented office worlds. The aim was not to create another tool to access graphical user interfaces but rather decided to realize a text screen-oriented application especially for blind people which integrates tools to retrieve, create and exchange printed as well as electronic documents. The hypertext and formatting features of the Hypertext Markup Language HTML, conversely, the adapted GUI concept of the pull-dot.vn menus can be customized on a Braille display. As for the sighted user, pull-down menus allow the novice user to immediately operate any application like word-processors or WWW-browsers without knowing the various key bindings.

The development of HyperBraille started three years ago with the construction of a World Wide Web client that allowed easy access to all the documents of the Web.

The new features of HyperBraille are mostly driven by user feedback and by the needs for individual configurations of potential users.

**Kim-Rupnow, W., & Burgstahler, S. (2004). Perceptions of students with disabilities regarding the value of technology-based support activities on postsecondary education and employment. *Journal of Special Education Technology, 19*(2).**

Transitioning from high school to employment or postsecondary education is a critical juncture for students with disabilities. The complexities associated with such pivotal decisions are compounded, increasing the need for transition preparation and ongoing support to develop self-determination, social, academic, and career skills. Although many programs have offered services to students during transition periods, there is little empirical research on the long-term impact of specific support activities, including those that employ computers and the Internet. The results of a retrospective survey of participants in a technology-based exemplary transition program for college-bound youth reports how participants perceive the impact of key components, including technology-enriched summer study and year-round computer and Internet activities, on their self-determination, social, college, and career skills. Recommendations for applications to transition programs include the use of multiple technologies in the bridge between school and vocational employment.

**King, A., Blenkhorn, P., Crombie, D., Dijkstra, S., Evans, G., & Wood, J. (2004). Presenting UML Software Engineering Diagrams to Blind People. *Lecture notes in computer science*. Retrieved November 27, 2006, from cat.inist.fr/?aModele=afficheN&cpsidt=15971821**

The TeDUB system delivers a UML diagram tool accessible to blind software engineers. The system uses a number of different interfaces and representation techniques to overcome the challenges of making diagrams created with the Unified Modelling Language usable for blind people. The system is entirely automated and does not require special preparation of UML diagrams by a sighted user. The results of evaluation of the system with 36 users were positive. The system was well received and the participants were able to complete set UML tasks.

**Linley, R. (2000). *Public Libraries, Disability and Social Exclusion, Working Paper 11*. Retrieved November 29, 2006, from www.seapn.org.uk/workingpapers/vol3wp11.rtf**

Disabled people are excluded in society by barriers, including prejudice and discrimination. Current legislation and Government policy, including the impact of the Disability Discrimination Act 1995 impact access and independence; information provision; specialism and integration; tackling discrimination; and local and national partnerships. Good practice has been emphasised on providing access for disabled people, rather than the actual use they make of public libraries. A policy approach recognising the civil rights of disabled people is recommended.

**Lockerby, C., Breau, R., & Zuvela, B. (2006). Enhancing digital access to learning materials for Canadians with perceptual disabilities: A pilot study. *Journal of Visual Impairment & Blindness, 100*(8), 477-483.**

Digital Talking Books created with the DAISY standard have the capacity to combine human or synthetic voice narration with digitized text, offering the advantages of electronic publishing and improved navigation capabilities. To address this dearth of research, the Canadian National Institute for the Blind (CNIB) Library for the Blind secured funding from the Office of Learning Technologies, Human Resources and Skills Development, Canada, to carry out a three-year study of user preferences and needs regarding DAISY Talking Books on CD.

In general, participants found DAISY books fairly easy to use, especially "with training," as mentioned by some. While the "easier" tasks that allowed users to move through the audio, such as "Fast forward" and "Rewind," were completed without problems, some participants had difficulty grasping the concept of a book being structured into levels comprised of chapter headings, subsections, paragraphs, and phrases. Part of the confusion may rest with the terms used to describe the levels. One participant commented on this during her test, saying she found some terms, including element and levels, to be "too confusing." Another point that participants made concerned the amount of electronic text, in addition to the amount of audio, featured in the different types of DAISY books. While participants who were blind were not able to see the text on the screen when using Victor Reader Soft, they could still make use of the "Find text" feature that would allow them, for example, to locate a specific word in the book. Some participants indicated that full textbooks, with the most extensive navigation capabilities, were the most beneficial.

The feedback concerning the quality and operability of the Victor Reader Pro playback device showed that more than half of participants (52%) assessed it as being easy to use and indicated that the device is of good quality. Nearly 40% of participants found the Victor Reader Soft software to be of good quality and easy to use. About 33% of participants indicated that training is necessary to help explain the levels of a book, and that operating the software on a computer requires more practice time for remembering controls.

Participants generally had a positive view of the social, educational, and economic impact of the new reading technology. In particular, one participant remarked that DAISY allowed "easier and faster access to different sources of information," including current events. Other comments suggested that the system's improved navigational capabilities would be of particular benefit to students. However, many participants had reservations about the cost of the players and indicated that this might prohibit them from acquiring the technology. Participants also mentioned the advantage of the fact that more than one book can be recorded onto a single CD.

Participants demonstrated that although they were able to navigate DAISY books, they had some difficulty understanding the structure and levels inherent in the DAISY format. This finding is consistent with those of the earlier DAISY usability studies (Morley, 1998; Recording for the Blind & Dyslexic, 2001), in which

subjects also expressed some confusion about the terminology used in the navigation of a DAISY book.

Preferences of participants for using the player rather than using the software on a computer was indicated by the small percentage (4.1%) who indicated that their expectations of the software were not met. This finding could be based on some participants' familiarity with the use of a stand-alone player, rather than using software to read books on a computer.

By exploring the experiences of participants with DAISY Talking Books, this study not only discovered how people who are blind, visually impaired, and/or print-disabled read DAISY books, but also identified participants' perceptions of DAISY as being particularly useful in their educational, professional, and social lives. Specifically, participants noted the usefulness of DAISY technology with regard to educational and work-related materials, as it allows students and working-age adults to move more easily within a textbook or reference manual, and gives them the option of placing bookmarks throughout a document. Participants saw advantages, as well, in the fact that more than one book can be recorded onto a single CD, and in the digital media's superior navigation and sound quality when compared to analog cassettes. Many participants mentioned that, as a result of this project, they will continue to use DAISY books to ensure better access to the information they require.

**Maynard, N., & Riccobono, M. (2004).** ***Reaching for the Stars: A New NASA-National Federation of the Blind Initiative*****. Retrieved November 29, 2006, from http://adsabs.harvard.edu/cgi-bin/nph-bib_query?bibcode=2004AGUFMED43C..06M&db_key=PHY&data_type=HTML&format=**

The National Aeronautics and Space Administration (NASA) and the National Federation of the Blind (NFB) recently launched a unique new partnership which will inspire and empower blind youth to consider opportunities in science, technologies, engineering, and math related careers from which they have typically been excluded. This partnership presents a framework for successful cultivation of the next generation of scientists. By partnering with the NFB Jernigan Institute, a research and training facility developed and directed by blind people, NASA has engaged the most powerful tool for tapping the potential of blind youth. By teaming NASA scientists and engineers with successful blind adults within a national organization, the NFB, the partnership has established an unparalleled pipeline of talent and imagination. The NASA/NFB partnership seeks to facilitate the means that will lead to increased science and technology employment opportunities for the blind, and particularly within NASA. The initiative is facilitating the development of education programs and products that will stimulate better educational opportunities and supports for blind youth in the STEM areas and better preparing them to enter the NASA employment path. The partnership brings the unique perspective of the blind to the continuing effort to develop improved space technologies, which may be applied for navigation and way finding, technologies for education and outreach, and technologies for improving access to information using non-visual techniques. Some of the activities accomplished in the first year of the partnership include the establishment of the first NFB Science Academy for Blind Youth, which included two summer science

camps supported by NASA. During the first camp session, twelve middle school age blind youth explored earth science concepts such as identification and characterization of soils, weather parameters, plants, and the independent dissection of a dog fish shark. During the second camp, twelve high school aged blind youth prepared a science payload for a one half size patriot rocket fuelled by a hybrid rocket motor and successfully completed the procedures necessary to launch the rocket from the Wallops Flight Facility. These and other activities are highlighted to demonstrate the effectiveness of partnership, imagination, and innovation that has come from the collaboration between these two organizations.

**Miles, M. (2003). CBR works best the way local people see it and build it.** ***Asia Pacific Disability Rehabilitation Journal, 86*****(14), 1.**

In the following paper the growth in availability of practical information which people may manage visual impairment disability in home and local community, and some problems of transmission and cultural adaptation, are reviewed. There is a growing menace of simplistic globalised packages, promoted by deeply confused "flying experts", ignoring or dismissing the indigenous concepts, knowledge and skills that are essential to success in disability service innovation. It is recommended that consultation with the broader community members is conducted to bridge the identified gap in goals and objectives of the visually impaired community and the support providers in both the public and private sector.

**Newell, A., & Gregor, P. (2000). "User Sensitive Inclusive Design" - in search of a new paradigm.** ***CUU 2000 First ACM Conference on Universal Usability*** **(USA 2000) (Ed. J. Scholtz & J. Thomas), pp. 39-44.**

This paper considers appropriate research methodologies for the development of Universal Usability. It is written from the viewpoint of research which has the long term objective of developing technological systems for everyone, including people with disabilities and considers whether new research paradigms are appropriate and how they are different from those used within traditional technological research. It suggests the development of a new paradigm of "User Sensitive Inclusive Design" which includes people with disabilities within a User Centred Design methodology, and recommends a collaborative approach to the development of such a methodology.

Universal usability requires that researchers and designers consider all potential user groups of systems, including minority groups such as people with disabilities. This means, however, that the user groups have too broad a set of functionalities and characteristics to be encompassed within traditional user centre design methodologies, and there are additional ethical and other challenges in dealing with this user group. Rather than produce a whole new paradigm, however, it is suggested that the methodologies of User Centred Design be extended to form a paradigm which could be called User Sensitive Inclusive Design. This should include not only experimental techniques but also methods for communicating the results of the research effectively to mainstream researchers and product developers.

This could be an international endeavour and thus combine the research strengths of European and American research. European research tends to be more holistic,

qualitative and socially sensitive, whereas North American research is much stronger in its quantitative techniques and formalism. In addition, there are different legislative frameworks for providing access for people with disabilities, and different timing of legislation, which has affected the situation in the two counties. The different research methodologies and cultures of North America and Europe, can offer a synergy that will provide a design methodology that is better than the sum of the two separate methodologies in this exciting field of User Sensitive Inclusive Design.

The development of the concept of, and a methodology for, User Sensitive Inclusive Design will facilitate researchers in the field to develop better specialised equipment, and also provide mainstream engineers with an effective and efficient way of including people with disabilities within the potential user groups for their projects. If we can do both of these, we will have achieved a great deal towards providing appropriate technological support for people with disabilities in the future. It should be noted that, although this paper exclusively considers people with disabilities within the concept of Universal Usability, many of the ideas contained in it apply equally to other minority groups.

**Noonan, T. (1999). Accessible e-commerce in Australia, *A Discussion Paper About The Effects Of Electronic Commerce Developments On People With Disabilities*. Blind Citizens Australia, www.bca.org.au/ecrep.htm**

*"AccessAbility Grants Program" now part of "Networking the Nation"*
The Commonwealth Government's "AccessAbility Grants Program" research project investigates the impact of electronic commerce on people in Australia with disabilities - particularly people who are blind or vision-impaired.

The research introduces E-Commerce concepts and developments; current and potential barriers that these technologies may present for people with disabilities in Australia; as well as providing pointers to products, services, research, guidelines and standards that are all working to improve access in the area. The report is aimed at E-Commerce professionals, Government, hardware and software developers, disability professionals, as well as people with disabilities.

Two very major barriers to accessible E-Commerce in Australia are the huge lack of disability research in the E-Commerce area; and an unexpected general lack of awareness by the E-Commerce industry regarding disability and accessibility issues and research.

A variety of day-to-day activities from an E-Commerce and accessibility perspective include shopping (including selecting goods, accessing catalogues, paying for goods, barcodes, home delivery options etc);banking and finance (including selecting a bank, ATM issues, telephone and Internet banking, access to brochures and statements); Internet access (including getting online, selecting a browser, training issues, Web design issues, buying on the Internet etc);government information and transactions (including stated Information Economy priorities, Government E-Commerce developments, Telstra and the Government, Centrelink developments etc); participation in employment; implications of electronic publishing; and emerging technologies including Java,

Windows CE, Information Kiosks, screen and Web phones, smart appliances, XML etc.

**O'Donoghue, P. (1977).** ***Accessible Workplaces - A Best Practice Resource for the Employment of People with Disabilities in Local Government.*** **Retrieved November 27, 2006, from www.alga.asn.au/publications/accessible_workplaces.rtf**

Accessible Workplaces is the latest in a series of ALGA publications aimed at resourcing Councils to meet their responsibilities under the Federal Disability Discrimination Act (1992). The publication highlights the many issues related to the recruitment and employment of staff with disabilities. It also highlights the need, in the current Local Government environment, to ensure that contractors employed by Councils are aware of their legislative obligations of Equal Employment Opportunity (EEO).

The publication is based on research, conducted by ALGA, into Local Governments' performance as an employer of people with a wide variety of disabilities. This research clearly demonstrates that people with a disability are employed at all levels of Local Government organizations, however, it also shows that people with a disability are having problems accessing employment opportunities in the Local Government field, indicated by a significant under representation in workforce statistics.

The "how to" approach of Accessible Workplaces provides a practical framework for addressing these issues within mainstream Human Resource Management (HRM) practice. This framework has deliberately been developed in a flexible form to ensure it is applicable to the diverse range of organisations operating within the Local Government sector.

The framework centres on the work of best practice Councils. This practical approach should provide a sound foundation from which all Councils can address these important issues. Critically, this approach minimises duplication and the wasting of valuable, and limited, Council resources.

Accessible Workplaces should be read in conjunction with the other publications in this series:

- Disability Discrimination Act: A Guide to Best Practice in Local Government
- Disability Discrimination Act Action Plans: A Guide for Local Government
- Accessible Communities (which collates best practice in the disability area from across the Local Government sector)

These publications will help Councils to locate disability related employment issues within the broader activities of their organisations.

**Sajka, J., & Kerscher, G. (2000). Surpassing Gutenberg -Access to Published Information for Blind Readers, A Historic Opportunity in Access to Published Information for Blind Readers. *American Foundation for the Blind,* Retrieved November 21, 2006, from www.sensus.dk/ICEVI2000.htm**

The examination of some reasons to explain why electronic book publishing will become a versatile medium comprising 10% of all consumer book sales in the U.S. by 2005, estimated by Anderson Consulting at $2.3 billion. The Association of American Publishers (AAP) and the Open Electronic Book Forum (OEBF) both pin this expectation on open standards—any book, anytime, anywhere, for anyone. Electronic books will succeed, we argue, in part because they provide communicative opportunities not available in traditional, static print media. But, they will also succeed because of developments in technology for blind readers, which will benefit all readers regardless of ability or disability. As evidence the paper offers among other points, Microsoft Corporation's licensing of technology developed to benefit blind people for use in Microsoft Reader and mainstream publishing applications. The paper demonstrates, further, that technology transfer from disability to mainstream use has solid historic precedent.
The following subheadings are offered:

- A Historical Perspective
- Better Information Access for Everyone
- Aren't Braille and Traditional Talking Books Enough?
- Work on Digital Talking Books
- Open Electronic Book Forum
- A Test of Viability
- E-book Japan Initiative
- Converging Standards at OEBF
- Conclusion

**Smith, D., & Wild, T. (2006). Least-restrictive environment for students with visual impairments. *Journal of Visual Impairment & Blindness, 100*(10), 592-594.**

The concept of the least-restrictive environment was developed by federal mandates that are contained in the Individuals with Disabilities Education Act of 1975 (IDEA 1975). This law

- requires children with disabilities to be educated with their peers without disabilities to the maximum extent possible,
- ensures a continuum of alternative placements (for example, regular education classrooms, resource classrooms, or special schools for students who are visually impaired),
- provides for supplementary aids and services (resource room or itinerant instruction) in conjunction with general education,
- specifies that a student's educational placement is to be reviewed annually, and
- requires that placement is to be determined by a student's Individualized Education Program team, which includes the parents and educators who are involved in the student's life (Smith, 2006).

The overriding principle in decisions on educational placements is that each student's placement must be determined on an individual basis, according to the needs of the child, and that less restrictive environments should be considered before more restrictive environments.

Despite these mandates, decisions on educational placement are not always made on the basis of what is appropriate for a student. Rather, decisions are sometimes based solely on such factors as the category of the disability, the significance of the disability, the availability of special education and related services, the availability of space, the configuration of the service delivery system, or the convenience of administrators (Will, 1986). Kim and Corn (1998) found that a teacher's current job placement affected the teacher's recommendation for a student's placement. For example, they found that teachers of students with visual impairments in urban areas were more likely to place students with visual impairments in local schools than were teachers in rural areas. Kim and Corn surmised that such placement decisions were based on the perceived availability of resources. "In some cases, children attend residential schools because the local public high schools are unable or unwilling to provide educational supports [that are] needed for success" (Ferrell, 2003). "In other cases, tried public schools but found them deficient and decided that residential schools do a better job at providing the necessary adaptations that support students to teach their potential" (Ferrell, 2003). Ferrell and Corn (2003) found that 34% of the students in their study attended a special school for students who are visually impaired because their local school systems were not equipped to meet their unique needs. The students listed the lack of necessary trained personnel, technology, and resources as reasons why they left their local schools to attend the special schools.

- All members of Congress are urged to express a strong commitment in their respective states to uphold the mandates of a least-restrictive environment that are specified by IDEA 1975.
- All members of Congress are asked to ensure that each state has a state vision consultant who will monitor the implementation of IDEA and its mandated least restrictive environment.
- All members of Congress are asked to hold their respective districts accountable for all placement decisions for students with visual impairments.

**Smith, T. (2002).** ***Diversity and Disability: Exploring the Experiences of Vision Impaired People in the Workplace,*** **21(8). Retrieved November 28, 2006, from alia.org.au/publishing/alj/54.2/full.text/johnstone.html**

Over the past decade managing diversity has emerged as a popular topic for analysis, however, much of the discussion concerning diversity has tended to focus on gender and race. Only limited attention has been centred on disabled people as a minority group in the workplace. One of the biggest challenges faced by disabled people is in obtaining and maintaining employment, particularly for those individuals with a vision impairment. Some of the issues faced by vision impaired people in the workplace in Australia, with certain accommodations to the workplace, vision impaired employees can be just as capable and efficient as their sighted counterparts. Moreover the major barrier still faced by disabled workers is overcoming the negative attitudes and misconceptions of colleagues and employers.

**Submission from Women with Disabilities Australia (WWDA) to the HREOC request for comments on the possible public inquiry on employment and disability issues. (2004). Retrieved November 21, 2006, from www.hreoc.gov.au/disability_rights/employment/rfc/wwda.doc**

Income support is a basic human right and essential for social and economic development (WHO 1997). Paid employment is a critical component in enabling women with disabilities to support themselves financially and to build self-esteem and achieve social recognition. It is clear that in order to enable women with disabilities to increase their independence, capacity building and take up paid employment, as well as participate fully in their communities, any reform which is designed to increase participation in paid employment and *'build a simpler system to help jobless families and individuals'*, must address the structural and systemic barriers women with disabilities currently face.

**Taylor, J. (2004). Serving blind readers in a digital age. *American Libraries, 35*(11), 49-52.**

The National Library Service for the Blind and Physically Handicapped is on its way to developing the next-generation talking-book system through LC Technologies. Among other things, the Digital Talking Book, the Web-Braille system, Web magazines, and the Web book pilot are the latest steps to assure that all may read.

Digital audio technology offers improvements at every level-better sound quality, the ability to read an entire book without manipulating the equipment, and improved ability to skim text and insert bookmarks. After more than a decade of research, NLS has begun to implement this technology as the framework of the future system.

Replacing some 740,000 cassette playback machines with digital players and approximately 23 million audio cassettes with digital media is a daunting prospect that will affect almost every aspect of the program. NLS has been working to develop a digital talking-book (DTB) system that can be set up with limited public funds and minimum disruption to users, but that is still shaped by four core concepts: 1) Service must remain free and accessible to every eligible user; 2) consumer involvement is critical; 3) access to recorded books and magazines must be restricted to eligible users; and 4) the focus must remain on patrons' recreational and informational reading needs.

This new standard is significant for many reasons: It creates an open, non-proprietary specification that can be used by any agency serving blind and physically handicapped people; it permits the creation of DTBs ranging in complexity from novels to technically sophisticated reference works; and it gives users flexibility in how they use talking books. Some may want a straightforward recreational reading experience while others require the more complex capabilities of setting bookmarks, highlighting portions of text, and conducting keyword searches. Digital books and machines for any delivery system implemented by NLS will be compatible with this standard.

*Web-Braille and beyond*
NLS's braille program has also moved into the digital age. The idea for the Web-Braille system was first proposed by NLS staff in 1997 when the obvious advantages of offering braille materials through the Internet came within reach. Now users needing immediate access to an online braille book can obtain it in a matter of minutes, without waiting for the mail or dealing with bulky volumes. Patrons can browse by using refreshable braille displays, download material for future use, or print hardcopy braille. Some 7,000 magazines and books are now available, with around 40 new titles added every month.

Additionally, NLS has begun a pilot program with a small group of eligible readers to test Internet delivery of digital audio magazines presented in human speech. A similar project testing delivery of audio books is planned in 2005.

The massive commitment of public resources to a project as complex as the DTB transition requires rigorous planning and scrupulously attentive execution. The fundamental strategy, therefore, is to carry out all necessary steps in planning and implementation with due diligence and judicious deliberation.

Detailed narrative and graphic representations of the implementation plan can be found in Current Strategic Business Plan for the Implementation of Digital Systems, available on the NLS website at www.loc.gov/nls/businessplan2003.html

Systems to assist blind people have made tremendous strides since Louis Braille devised his 43-symbol tactile code early in the 19th century. The DTB, the Web-Braille system, Web magazines, and the Web book pilot are the latest stens to assure that all may read.

Amazing advances in computing and communications have created tools and techniques to access information that were beyond imagining just a few years ago.

Technology offers improvements at every level-better sound quality, the ability to read an entire book without manipulating the equipment and improved ability to skim text and insert bookmarks.

***Design for All principles*. Retrieved November 26, 2006, from www.stakes.fi/include**

*Basic Design for All principles*
The goal for Design for All is to design products, services and systems that enable everyone, as much as possible, to use them.

Any product can not be absolutely accessible, although, you can make it more accessible, however, there will always be people who can not use it. You should go as far as you can in making the design accessible. There are, however, no magic numbers to tell you that you have gone far enough and nothing more will help anyone. In general, accessibility guidelines raise the awareness and understanding of designers and help them ask the right questions rather than to provide specific answers or numbers. Nevertheless, wherever specific design ideas or recommended values exist, they are provided. When they do not, guidance is provided to help designers identify areas where attention can increase accessibility.

*Make the whole product accessible!*
In most cases it is possible with careful design to create products that are simultaneously accessible to people with different impairments. However, where this is not possible, care should be taken to be sure that the *entire* product is accessible to those disability populations that you are able to address. Giving half a product to one disability group and the other half of the product to another is not helpful to or desired by anyone of the groups.

Often, initial attempts at accessible design are done piecemeal. Accessibility features are added where they are obvious rather than as a result of looking at the product's overall accessibility. The result can be a design which has accessible parts, but is not as a whole accessible or usable. Access to half a product when the rest is inaccessible is of little practical use.

*Conflicts exist, but that's life - and they can be solved!*
Accessibility guidelines often presuppose that basic qualities, needed by all users, are expressed in other documents, either explicitly or by referring to regulations, standards or other reference documents. There may be overlaps, gaps and contradictions between accessibility requirements and other system requirements. Such differences should be treated in the same way as differences between any requirements. Accessibility can not be added afterwards, like paint, when all other requirements have been considered. Accessibility requirements should be considered at the same level as security, durability, low power consumption etc.

One feature of a system that is advantageous to one disability may be the opposite to another disability. Generally, redundancy is a key to the solution of this problem. For example, graphical user interfaces are of great advantage to most users, but are in many cases inaccessible to blind people. Therefore, an information kiosk should allow the user to choose between different kinds of presentation forms - visual graphics, visual text, tactile (Braille) or voice.

**The Seven Commandments, *Center for Universal Design.* Retrieved November 25, 2006, from www.design.ncsu.edu/cud/**

- *Equitable use*: The design is useful and marketable to any group of users.
- *Flexibility in use*: The design accommodates a wide range of individual preferences and abilities. The user's pace.
- *Simple and intuitive use*: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level.
- *Perceivable information*: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
- *Tolerance for error*: The design minimizes hazards and the adverse consequences of accidental or unintended actions.
- *Low physical effort*: The design can be used efficiently and comfortably and with a minimum of fatigue.
- *Size and space for approach and use*: Appropriate size and space is provided for approach, reach, manipulation and use regardless of the user's body size, posture or mobility.

*Remember also that*

- multi-cultural and multi-lingual aspects need to be considered when developing a product, service or system.
- the status of a system (e.g., waiting for input, checking, transferring data etc.) should always be available for the user.
- as part of a user centred design, the terminology used in user interfaces (including brochures, user instructions and information presented by the system) should be based on the language of the intended user.
- in situations where personal services are replaced by technical systems, manned alternatives (i.e., human intermediaries) should always be available to those who have difficulty using a technical system.

*Accessibility by means of assistive devices*

Although direct accessibility to products, services and systems is by far the best solution, the type or severity of some persons' impairments preclude their ability to use a product even if it has been designed to include as many access features as practically possible. In these cases, special assistive devices, consisting of hardware, software or both, are required in order to make it possible for the user to access and use the product. Examples are speech synthesizers, enlarged keyboards and software for screen magnification. In many cases, these devices replace standard input and output devices. The standard hardware and software should therefore be designed to facilitate the connection of, interaction with and use of assistive devices.

**Trief, E., & Feeney, R. (2003). Guidelines for a pre-college curriculum for students with blindness and visual impairments. *RE:view, 35*(3), 137.**

This paper identifies the components of a pre-college curriculum needed by learners who are blind and visually impaired, and discuss the importance of acquiring competencies in predicting whether students with visual impairments and blindness successfully complete a four-year college degree. The findings suggest that students need to learn keyboarding skills and how to use the computer, read and write, and do math continuously, and that college curriculum must concentrate on assistive technology as well as social, communicational, organizational, and daily living.

In the summary the participants clarified the differences among: (a) subjects that are very important as part of pre-college preparation, (b) subjects that are very important in general, and (c) subjects that are very important for a student's success in college. We had sought only to determine what subjects were important to include in pre-college preparation. We never asked if these particular areas of instruction were important in general.

Many participants considered that keyboarding instruction was important for success in college but that it should be acquired before entering college and before participating in a pre-college program. Using computers in high school would help to build speed and accuracy, which would improve as the student progressed through school.

Braille literacy was another important area of instruction for the respondents. Most felt that acquiring Braille reading and writing skills early in their education was essential; unless the instruction began at an early age, they could not possibly acquire speed and accuracy. Keyboarding and Braille literacy instruction take years to perfect and are considered career and life skills vital to a student's success in college.

Participants felt similarly about writing skills, math skills, counselling, and orientation and mobility: such large, more time-consuming areas of instruction should be integrated into a student's entire education and then receive strong reinforcement in high school. If a pre-college curriculum were to address any of these broader topics it should be only as directly related to college, for example, orientation and mobility instruction specific to the college the student will attend. Participants felt that a pre-college curriculum should focus on smaller topics that could be taught and mastered in a short period of time (such as note taking skills, organizational skills, or study techniques). They were concerned that students' skill levels in the broader topics would be so varied that their inclusion in a pre-college program would not be feasible. Many students learn keyboarding and the use of computers as early as grade school, while others might not start using computers until much later in life. Therefore, by focusing on such topics as college-level test taking procedures, note taking skills for college-level courses, instruction in the use of newly created technological aids and equipment, and study techniques for college students, the pre-college curriculum would truly be geared specifically toward the students' upcoming college experience and could be mastered in a short period of time.

It is apparent that the effectiveness of a pre-college preparation curriculum depends on its ability to teach specific areas that students need to work on before entering college and that can be taught over a relatively short period.

All students should learn keyboarding skills and how to use a computer and to read, write, and do math continuously throughout their entire education. The pre-college curriculum should build on and supplement existing basic skills. The scope of its focus should be narrowed to concentrate on college-specific skills and techniques that students with visual impairments need before entering college.

With a proper curriculum in place, students can, in a short time, learn, embellish, and sharpen their skills to ensure successful completion of college. On the basis of the results of the two open-ended questions, the authors will embark on designing a pre-college curriculum that concentrates on assistive technology and social, communication, organizational, daily living, note taking, study, library, research, and time management skills as they directly affect college success.

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