

# **Report on Assistive Technologies for Online Training Delivery (R012R)**

**Access and Equity in Online Learning**

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*An initiative within the Australian Flexible Learning Framework for the National Vocational  
Education and Training System 2000-2004*

*Managed by the Flexible Learning Advisory Group on behalf of the Commonwealth, all States  
and Territories in conjunction with ANTA*



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## Executive Summary

### Introduction

This paper provides information and advice on the use of assistive technology for online delivery of training to learners with disabilities. Specifically, the paper focuses on computer based assistive technology to support the participation in online learning of people who are blind or have a vision impairment and those people who are deaf or hard of hearing and people with a physical disability.

The paper has been produced for Stage 1 of *the National Access and Equity in Online Learning* Project which was conducted as part of the Australian National Training Authority (ANTA) endorsed *Flexible Learning for the Information Economy: A Framework for National Collaboration in Flexible Learning in Vocational Education and Training 2000-2004* now called the Australian Flexible Learning Framework which in turn supports the ANTA National Strategy for Vocational Education and Training. The Framework was developed by the Flexible Learning Advisory Group (FLAG) which represents all States, Territories, the Commonwealth and ANTA.

The aim of the research conducted for this paper was to:

- identify relevant policy and legislation;
- identify assistive technologies for online learning for people with disabilities;
- describe the hardware and software which supports online learning for people with disabilities;
- identify principles of inclusive design and relevant standards and guidelines; and
- develop recommendations to ANTA to assist in policy and planning for online learning for people with disabilities.

This paper has as its target group learners with disabilities and within this group those learners who are blind or vision impaired, those learners who are Deaf or hearing impaired and those learners with a physical disability. The circumstances, needs, concerns and aspirations of each group are different and each group has different and specific needs in relation to the use of Information and Communication Technology (ICT). To facilitate access to online learning individuals within each group require specific assistive technology.

In addition to the hardware and software required to support learners with disabilities this paper argues that the vocational education and training sector needs to adopt the concept of inclusive and universal design standards in the development of online products and services. The implementation of inclusive design standards would enable access to online learning without the need for adaptation or specially designed technology.

### Policy Context

The delivery of vocational education and training using Information and Communication Technologies (ICT) has the potential to increase access of learners with a disability. This potential is recognised in ANTA policy.

In 1999, ANTA CEOs endorsed the *Framework for National Collaboration in Flexible Learning in Vocational Education and Training 2000-2004*, now known as the *Australian Flexible Learning Framework for the National Vocational Education and Training System*.

This framework has five goals including Goal 3: World class online content development, applications and services. The Access and Equity in Online Learning Project is one of a number of projects which support the implementation of this goal.

In addition to the *Australian Flexible Learning Framework*, ANTA has published a number of papers and reports that support inclusive vocational education and training for people with a disability.

The ANTA report *Bridging Pathways: the Blueprint for Implementation* is a national blueprint for increasing opportunities for people with a disability in vocational education and training. This blueprint draws attention to the need both identify the learner supports and to increase the availability of such supports for people with a disability. *Eyes Wide Open - Vocational Education and Training in the Information Age* contains ANTA's proposal for increased focus on technology to enhance the delivery of vocational education and training.

The *Australian Flexible Learning Framework* has as Goal 2: Supportive technological infrastructure. In response to this goal a research has been undertaken to develop VET Preferred Standards. The aim of this research was to progress towards a nationally agreed standards based environment for the use of online training experiences. A set of preferred standards has been agreed to by ANTA CEOs for adoption in the VET sector. However, for people with a disability, there remain issues related to the cost of and access to technology, the cost and access to adaptive/ assistive technology and to technical support.

Access to online vocational education and training for people with a disability is set against the national anti discrimination legislative framework. Specifically, the Disability Discrimination Act 1992 (DDA) is Commonwealth legislation which makes it unlawful to discriminate on the grounds of disability.

These policies provide a framework that recognises the role that online learning plays in vocational education and training and the rights of people with disabilities to access online VET.

## **Assistive Technology**

Information and Communication Technologies have been developed primarily for what is defined as 'mainstream' users. As a consequence assistive technology has been developed to improve access to ICT by people with disabilities. However, because of the complex nature of computer systems and application design and the range of systems and applications it is often difficult to match these developments with hardware and software assistive technology that will enable access to ICT by people with disabilities. Furthermore, different types of assistive technologies are required by each of the target groups to enable access to online learning.

Assistive technology, particularly computer-based plays an important role in assisting students with a disability to access and successfully complete vocational education and training. Assistive technology is computerised equipment or software designed or modified to enable people with disabilities to access and use Information and Communication Technology.

The definition of assistive technology used in this paper is that which has been developed by the World Wide Web Consortium (W3C). The W3C is an international body responsible for managing the conduct and direction of the Internet. This consortium has undertaken policy development in relation to the accessibility of the Internet for people with disabilities.

Their definition of assistive technology is one which relates to the accessing of technology for daily activities and by extension to online learning. Their definition of assistive technology is 'Software or hardware that has been specifically designed to

assist people with disabilities in carrying out daily activities. Assistive technology includes wheelchairs, reading machines, devices for grasping etc. In the area of Web Accessibility, common software-based assistive technologies include screen readers, screen magnifiers, speech synthesisers, and voice input software that operate in conjunction with graphical desktop browsers (among other agents). Hardware assistive technologies include keyboards and pointing devices.

This definition includes hardware and software to support online learning for people with disabilities. In addition, W3C have developed Accessibility Guidelines for software developers which if applied by developers in the VET sector would facilitate access for the target group in this paper.

## **Disability**

The report *Planning Together: Collaborative Approaches to the Participation of People with a Disability in Vocational Education and Training* (1996) prepared by Kate Barnett and Associates for the Department for Employment, Training and Further Education notes that a consistent definition of the term 'people with a disability' is difficult to find in the literature and that categorisation and definition of people with disabilities is not simple.

The report *Flexibility: A strategic framework for people with disabilities in TAFE 1994-1996* (1993) that points out that people with disabilities are not an homogeneous group and that individual characteristics may influence the assistance required. This is the case in relation to the types of assistive technology required by people who fall within the categories that are the subject of this paper.

This paper has taken as its definition of learners with a disability the definition used in the Stage 1 of the National Access and Equity in Online Learning Project. The definition is from the University of British Columbia's Disability Resource Centre. (Penny and Associates Ltd (1996) *Internet Access for People with Disabilities: Final Report*) This definition describes persons with disabilities as persons who:

- a. have a significant and persistent mobility, sensory, learning or other physical or mental health impairment which may be permanent or temporary in nature;
- b. experience functional restrictions or limitations of their ability to perform the range of life's activities; and
- c. may experience attitudinal and/or environmental barriers which hamper their full and self directed participation.

## **Online Delivery**

The ANTA paper *Eyes Wide Open - Vocational Education and Training in the Information Age* presents the argument to support the use of learning technologies: 'Training delivered in new ways made possible by technology has the potential to address current inequities of access, so long as issues of infrastructure, costs, instructional design, learning support and cultural relevance are also addressed'.

Online services to students may include: course information, enrolment applications, access to lectures, seminars, E-mail communication with teachers, participation in online discussions which may be synchronous and/or asynchronous, on-campus access to the Internet for research, use of online learning environments such as TAFE VC in Victoria and TAFE SA Online, electronic submission of work and online access to learning materials.

Training providers will need an awareness of the access and equity implications for people with disabilities at each point in online delivery including the most appropriate assistive technology and inclusive web design and content.

The Best Practice Guidelines for California Community Colleges advise that where access to external Web sites is required for completion of a course, such sites must be accessible or the material provided by alternative accessible means.

Both teachers and learners using ICT in course delivery require computer literacy and fluency. For example, the use of computers requires knowledge of technical language, keyboard and navigational approaches. The ways in which computers operate may seem intuitive for many users.

This is not always the case for people who have a disability. Depending on the nature of the disability, the person may have to deal with the physical layout, a highly technical language, the visual nature of the computer screen and the complexity of navigational approaches.

In general terms, people with a disability may have difficulty in:

- receiving or interpreting output from the computer;
- giving commands or entering data into the computer; and
- comprehending the information as presented.

The term Blind refers to people whose vision is so severely impaired that they cannot receive any visual cues. They rely on auditory or tactile signals to access information. Braille is the primary literacy medium for people who are Blind. People who are Blind from birth or an early age typically learn Braille in school and prefer to receive material in this format. People who are Blind use screen readers with speech synthesisers or Braille displays. Blind people use keyboard navigation tools rather than a pointing device such as a mouse. While Blind people may use audio formats for many it is not the preferred format as spelling, layout and punctuation is difficult. Electronic text (e-text) such as the ASCII file is an accessible format for Blind people. The Round Table on Information for People with Print Disabilities has issued guidelines for the production of documents in accessible formats.

The term Vision Impaired includes people who are colour blind, people with peripheral vision only, people with tunnel vision, people who can only read large print. Many people with Vision Impairment use screen magnification hardware and software combinations including large monitors. Software programs enable the user to enlarge print and to focus on specific part of the display.

The research for this paper has found that in Australia there are three groups of people who may be included in the classification of Deaf or Hearing Impaired. They are: Deaf people (signified with the word Deaf capitalised), deaf (or oral) people and hard of hearing people. Deaf people in Australia use Australian Sign Language or Auslan as their first language to communicate. Deaf people identify as a linguistic and cultural community rather than a disability group. The critical feature is the choice of language. English is a second language for Deaf people and as a result many have limited literacy in English. Whereas those people who developed their hearing impairment or hearing loss after the development of language will identify more with the mainstream community. Accordingly within this group the Deaf and the hearing impaired have different communication preferences, values and culture and different preferences and needs in terms of online learning and assistive technology.

Research conducted for the project *Deaf Australia Online* (1999) found that most online services cannot be used by Deaf people because the services are based on sound

and/or text. There is a preference for sign language and face-to-face communication among Deaf people. This preference together with English literacy issues often means that the Internet and online services are not used by Deaf people. To be effective for Deaf people online teaching and learning needs to take account of sign language, facial expressions and nuances of timing.

The report argues that visual (video) communication for sign language is fundamental to online services for Deaf people. However, there is a cost to the provision of high quality video conferencing services as well as standards and interoperability issues.

The research for this paper has found that the term physical disability includes a wide spectrum of 'disability'. Physical disability includes for example people who have arthritis, amputees, people with multiple sclerosis and people with cerebral palsy. The main issue for people with a physical disability is obtaining assistive technology that can be customised. The nature and extent of disability will be different for each individual. For example the type of assistive technology for a person with paraplegia is likely to be different to a person with arthritis.

The report published by the Australian Institute of Health and Welfare and titled *The Definition and Prevalence of Physical Disability in Australia* (1999) describes the issues relating to an operational definition of physical disability. It suggests that the terms physical disability and physical impairment are not clearly defined in the literature nor in Australian legislation and administrative documents.

The report argues that the difficulty of defining physical impairment generally is solved by compiling a list of impairments that are considered to be physical which includes a range of conditions such as multiple sclerosis, paraplegia, muscular dystrophy, arthritis. Accordingly, the nature a person's physical disability requires individual assessment in order to identify the most appropriate type of assistive technology.

For people with physical disabilities accessing online products and services there are issues related to navigation, the amount and complexity of information and web accessibility. As well, there are people with physical disabilities who also have learning disabilities. Most web sites and learning products are heavily text based. The State Library of Victoria and Monash University *Project Online Services for People with Disabilities in Australian Public Libraries* (1999) found that literacy is a major issue in the provision of online services to people with disabilities. The report argues that adaptive hardware and software is helpful but if a person is unable to read well online services are difficult or impossible to use.

## **Inclusive Design**

Inclusive design is defined by the Trace Centre (1996) as 'the process of creating products (devices, environments, systems and processes) which are useable by people with the widest possible range of abilities, operating within the widest possible range of situations (environments, conditions and circumstances)'.

There are two components to inclusive design in this definition. The first component is the design of products which are flexible enough, as is commercially practical, to be directly used by people with the widest range of abilities. The second component is the design of products and services so that they are compatible with the broadest range of assistive technologies for people who cannot use or efficiently access the products directly.

Increasingly, the principle of universal design is being accepted in the development of online services. Universal design is being defined as 'the design of products and environments to be useable by all people to the greatest extent possible, without the need for adaptation or specialised design'. (Technology Assessment Program, 1999) Universal design can be applied to policy-making, application development, equipment and software development, standards for inter-working and codes.

The Australian Human Rights and Equal Opportunity Commission (HREOC) argues that on the basis of available information, it appears that it is technically feasible to remove many Internet barriers to equal access for people with a disability in this area. This may be done in a way which does not detract from the usefulness or attractiveness to other users of Web pages, or in many cases actually benefits all users. The Commission argues that people with a disability have, on average, lower incomes than other member of the community and may not have access to state-of-the-art equipment and software.

HREOC recommends the W3C and AusInfo Guidelines. The AusInfo Guidelines provide advice on a wide range of issues in electronic publishing including access for people with disabilities. The Commission believes that integrating accessibility into general authoring a publishing advice is a way of bringing it into mainstream practice. The AusInfo Guidelines are intended to evolve to keep pace with best practice. The Commission believes that reasonable attempts to achieve current best practice will generally satisfy the access requirements of the DDA.

Examples of access are:

- People who are blind or have vision impairments can use appropriate equipment and software to gain access to electronic documents in Braille, audio or large print form.
- Deaf people or people with hearing impairments could have more ready access to captioning or transcription of sound material.
- Many people whose disability makes it difficult to handle or read paper pages can use a computer, for example with a modified keyboard or with voice control.
- Web publication may provide an effective means of access for people whose disability makes it difficult for them to travel to or enter premises where the paper form of a document is available.
- There is the need for more effort to encourage implementation of accessible design as building an inaccessible website can be avoided if people are given good information about inclusive design.

The World Wide Web Consortium (W3C) was created in October 1994 to 'lead the Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability'. W3C has more than 400 member organisations from around the world and has developed more than 20 technical specifications known as recommendations for the Web's infrastructure.

W3Cs long term goals for the Web include:

- Universal Access: To make the Web accessible to all by promoting technologies that take into account the vast differences in culture, education, ability, material resources, and physical limitations of users on all continents;
- Semantic Web: To develop a software environment that permits each user to make the best use of the resources available on the Web; and
- Web of Trust: To guide the Web's development with careful consideration for the novel legal, commercial, and social issues raised by this technology.

WAI or the Web Accessibility Initiative objectives are to ensure that all recommendations from W3C support principles of accessible design and to develop specific guidelines and application notes regarding designing web pages and Internet tools which are accessible.

## Conclusion

The research conducted for this paper on assistive technology that enables people with disabilities to access online vocational education and training has identified a number of issues.

Access to Information and Communication Technology and online learning requires access to computers, literacy and fluency in ICT and skills in a new way of reading online information and skills in the operation of assistive technology.

For many people with disabilities there are issues of the cost and interoperability of assistive technology. For those in the Deaf Community the technology is an aid rather than a substitute for face to face teacher facilitated learning. For people with a physical disability one piece of equipment may work well and be suitable for one student but not for another depending on the nature of the disability. Access to the Web requires a new way of understanding information to be useful. Users need to know about Web addresses, modes of access and the organisation and construction of web sites.

In summary the issues for learners with disabilities are the:

- cost of computer equipment and assistive technology;
- compatibility of equipment;
- match between learning preferences and online delivery; and
- ways in which web pages may be designed.

The research has identified strategies which if implemented would enhance online learning for people with disabilities.

The first strategy involves the inclusive or universal design of web pages, computer hardware and software. The Trace Centre in America argues that there are low cost modifications to standard computers that would increase accessibility and be of benefit to mainstream users as well. The Trace Centre research has found that engineers and designers in major computer companies have indicated that design modifications could have been included in the original design process if the developers had been made aware of the need for such modifications. The design issues are being addressed in Australia through the AusInfo Guidelines and internationally through the W3C Web Accessibility Initiative. In turn, web design and interoperability issues also need to be considered by ANTA.

W3C has developed Web content Accessibility Guidelines. The Guidelines are as follows.

1. Provide equivalent alternatives to auditory and visual content.
2. Don't rely on colour alone.
3. Use markup and style sheets and do so properly.
4. Clarify natural language use.
5. Create tables that transform gracefully.
6. Ensure that pages featuring new technologies transform gracefully.
7. Ensure user control of time sensitive content.

8. Ensure direct accessibility of embedded user interfaces.
9. Design for device independence.
10. Use interim solutions.
11. Use W3C technologies and guidelines.
12. Provide context and orientation information.
13. Provide clear navigation mechanisms.
14. Ensure that documents are clear and simple.

ANTA has endorsed the findings of the report Preferred Standards to Support National Cooperation in Applying technology to VET. However, these standards are preferred and not intended to be mandatory. This paper argues for an awareness of the importance of inclusive standards for Web design and content based on the W3C Accessibility Guidelines by ANTA and is a first step towards accessible online learning for people with disabilities.

In addition, the accessibility Guidelines are for use by software developers can also be used by content developers in the vocational education and training sector. Accordingly, professional development for online developers should include WC3 Guidelines for Accessibility.

The second strategy involves RTOs making reasonable adjustments to ensure that online services may be accessed by people with disabilities. This would involve consideration of the design and construction of RTO web pages, online information, enrolment, teaching and learning strategies, access to technologically based information and the identification of appropriate assistive technology.

The research suggests there are issues in relation to the development and provision of assistive technology for online learning for people with disabilities that can be addressed at a system level. Accordingly, the following recommendations are proposed.

## **Recommendations**

It is recommended that:

The Flexible Learning Advisory Group undertake a review of the preferred standards in the light of the identified needs of people with disabilities to incorporate W3C guidelines for Inclusive/universal web design and content.

The Flexible Learning Advisory Group and ANTA develop an awareness strategy that targets computer hardware and software companies to encourage inclusive design.

The Flexible Learning Advisory Group develop a set of online benchmarks and a range of product exemplars to demonstrate ways in which to meet the needs of users with disabilities.

The Flexible Learning Advisory Group implements a strategy to distribute the Guidelines for Online Product Development produced for the Access and Equity in Online Learning Project.

The Flexible Learning Advisory Group Professional Development initiatives such as LearnScope and Toolbox include consideration of the online learning needs of people with disabilities when developing online products and W3C Guidelines for Accessibility.

## Chapter 1: Introduction

### Background to the paper

This paper provides information and advice on the use of assistive technology for online delivery of training to learners with disabilities. Specifically, the paper focuses on computer based assistive technology to support the participation in online learning of people who are blind or have a vision impairment and those people who are deaf or hard of hearing and people with a disability.

The paper has been produced for Stage 1 of *the National Access and Equity in Online Learning Project* which was conducted as part of the Australian National Training Authority (ANTA) endorsed *Flexible Learning for the Information Economy: A Framework for National Collaboration in Flexible Learning in Vocational Education and Training 2000-2004* which in turn supports the ANTA *National Strategy for Vocational Education and Training*. The Framework was developed by the Flexible Learning Advisory Group (FLAG) which represents all States, Territories, the commonwealth and ANTA.

The national *Access and Equity in Online Learning Project Stage 1* was co-ordinated through FLAG. Its purpose was to examine the relevance of online technologies to the needs of Aboriginal and Torres Strait Islander learners, learners with disabilities and learners with low literacy levels. An outcome of this project is a set of Guidelines for the development of online products for people with disabilities. The guidelines can be viewed at the following web site: [www.flexiblelearning.net.au/accessequity](http://www.flexiblelearning.net.au/accessequity).

This paper has as its target group learners with disabilities and within this group those learners who are blind or vision impaired, those learners who are deaf or hearing impaired and those learners with a physical disability. The circumstances, needs, concerns and aspirations of each group are different and each group has different and specific needs in relation to the use of Information and Communication Technology (ICT). To enable their inclusion in online learning each group requires access to specific assistive technology. In addition to the hardware and software required to support learners with disabilities it is argued that there is a need to adopt the concept of inclusive and universal design standards in the development of online products and services. The implementation of inclusive design standards would enable access without the need for adaption or special design.

Specifically, the aim of the research conducted for this paper was to:

- identify relevant policy and legislation;
- identify assistive technologies for online learning for people with disabilities;
- describe the hardware and software which supports online learning for people with disabilities;
- identify principles of inclusive design and relevant standards and guidelines; and
- develop recommendations to FLAG to assist in policy and planning for online learning for people with disabilities.

## Overview of the Paper

The paper is organised into four chapters with a Bibliography and a Glossary. The key findings and recommendations are in the Executive Summary.

The chapters cover policy and legislation, online delivery, assistive technology for the target groups, the concept of inclusive design, standards and guidelines and a conclusion.

The methodology included a review of relevant policy and legislation and an Australian and international literature search.

## Definitions

This paper uses a number of terms to describe assistive technologies and learners with disabilities. Key terms are defined in the paper and are included in the glossary.

## Assistive Technology

Assistive technology, particularly computer based plays an important role in assisting students with a disability to access and successfully complete vocational education and training. Assistive technology is computerised equipment or software designed or modified to enable people with disabilities to access and use Information and Communication Technology.

The definition of assistive technology used in this paper is that which has been developed by the World Wide Web Consortium (W3C). The W3C is an international body responsible for managing the conduct and direction of the Internet. This consortium has undertaken policy development in relation to the accessibility of the Internet for people with disabilities.

Their definition of assistive technology is one that relates to the accessing of technology for daily activities and by extension to online learning. Their definition of assistive technology is 'Software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities. Assistive technology includes wheelchairs, reading machines, devices for grasping etc. In the area of Web Accessibility, common software-based assistive technologies include screen readers, screen magnifiers, speech synthesisers, and voice input software that operate in conjunction with graphical desktop browsers (among other agents). Hardware assistive technologies include keyboards and pointing devices'.

This definition includes hardware and software to support online learning for people with disabilities. In addition, W3C have developed Accessibility Guidelines for software developers which if applied by developers in the VET sector may facilitate access for the target group in this paper.

## Disability

The report *Planning Together: Collaborative Approaches to the Participation of People with a Disability in Vocational Education and Training* (1996) prepared by Kate Barnett and Associates for the Department for Employment, Training and Further Education notes that a consistent definition of the term 'people with a disability' is difficult to find in the literature and that categorisation and definition of people with disabilities is not simple.

The report *Flexibility: A strategic framework for people with disabilities in TAFE 1994-1996* (1993) that points out that people with disabilities are not an homogeneous group and that individual characteristics may influence the assistance required. This is the case in relation to the types of assistive technology required by people who fall within the categories that are the subject of this paper.

The 1992 Disability Discrimination Act (DDA) defines disability as including physical, intellectual, psychiatric, sensory, neurological and learning impairments. A disability group is in this definition a broad categorisation of disabilities on the basis of an underlying impairment. The Commonwealth Disability Discrimination Act (1992) provides protection against discrimination on the grounds of disability and includes direct and indirect discrimination. In practical terms vocational education and training providers must make changes to practices or procedures that discriminate including making changes to buildings and the provision of information and services.

This paper has taken as its definition of learners with a disability the definition used in the Stage 1 report. The definition is from the University of British Columbia's Disability Resource Centre. (Penny and Associates Ltd. (1996) *Internet Access for People with disabilities: Final Report*) This definition describes persons with disabilities as persons who:

- a. have a significant and persistent mobility, sensory, learning or other physical or mental health impairment which may be permanent or temporary in nature;
- b. experience functional restrictions or limitations of their ability to perform the range of life's activities; and
- c. may experience attitudinal and/or environmental barriers which hamper their full and self directed participation.

In addition to describing the nature of disability, the definition includes a statement on the consequences of disability. The consequences are that people with a disability experience 'functional restrictions or limitations' and 'attitudinal and/or environmental barriers'.

It is important to recognise the variety and complexity of disability generally and in relation to the target group of this paper. Disability is increasingly viewed as one aspect of the diverse human condition rather than as a deficit. However, because of the way in which computer hardware and software has been designed people with disabilities may require assistive technology to operate computers and to access the Internet.

The groups in this paper are:

- people who are Blind or Vision Impaired;
- people who are Deaf or Hard of Hearing; and
- people with a Physical Disability.

Chapter 2 provides definitions for each group, as there are important distinctions within each group of which providers of online learning need to be aware. For example, Deaf people in Australia identify as a linguistic minority who use Australian Sign Language (Auslan). This group does not identify as a disability group. There are important differences between people who are Blind and those who are Vision Impaired. Physical disability encompasses a range of conditions including cerebral palsy, muscular dystrophy, paraplegia and multiple sclerosis.

## Policy Context

The delivery of vocational education and training using Information and Communication Technologies (ICT) has the potential to increase access of learners with a disability. This potential is recognised in ANTA policy.

In 1999, ANTA CEOs endorsed the *Framework for National Collaboration in Flexible Learning in Vocational Education and Training 2000-2004*, now known as the *Australian Flexible Learning Framework for the National Vocational Education and Training System*. This framework has five goals including Goal 3: World class online content development, applications and services. The Access and Equity in Online Learning Project is one of a number of projects which support the implementation of this goal.

In addition to the *Australian Flexible Learning Framework*, ANTA has published a number of papers and reports that support inclusive vocational education and training for people with a disability.

The ANTA report *Bridging Pathways: the Blueprint for Implementation* is a national blueprint for increasing opportunities for people with a disability in vocational education and training. This blueprint draws attention to the need both identify the learner supports and to increase the availability of such supports for people with a disability. *Eyes Wide Open - Vocational Education and Training in the Information Age* contains ANTA's proposal for increased focus on technology to enhance the delivery of vocational education and training.

It is important to note from a teaching and learning perspective that the report argues that while changes need to be made to maximise the use to technology to facilitate learning, the technologies themselves cannot replace human interaction between the teacher and the learner. For learners with a disability this is important because while learners with a disability may require assistive technology to access online learning for many the preferred learning style is one which includes human interaction.

The *Australian Flexible Learning Framework* has as Goal 2: Supportive technological infrastructure. In response to this goal a research has been undertake to develop VET Preferred Standards. The aim of this research was to progress towards a nationally agreed standards based environment for the use of online training experiences. A set of preferred standards has been agreed to by ANTA CEOs for adoption in the VET sector.

However, for people with a disability, there remain issues related to the cost of and access to technology, the cost and access to adaptive/ assistive technology and to technical support.

Access to online vocational education and training for people with a disability is set against the national anti discrimination legislative framework. Specifically, the Disability Discrimination Act 1992 (DDA) is Commonwealth legislation which makes it unlawful to discriminate on the grounds of disability.

Provision of information and other material on the Internet is covered by the DDA and equal access for people with a disability is required by the DDA where it can reasonably be provided. This requirement applies to an individual or organisation developing Web pages in Australia or maintaining a page on an Australian server.

These policies provide a framework that recognises the role that online learning plays in vocational education and training and the rights of people with disabilities to access online VET.

The development of this paper has taken account of international legislation such as the Americans with Disabilities Act which prohibits discrimination against people with disabilities. There is some evidence to suggest that this is leading to an increased availability of accessible multimedia materials for learners with disabilities. In addition, section 508 of the Rehabilitation Act (USA) requires all procurements of hardware and software by Federal Agencies to be accessible to people with disabilities.

Information and Communication Technologies have been developed for primarily for what is defined as 'mainstream' users. As a consequence assistive technology has been developed to improve access to ICT by people with disabilities. The development of this paper has been informed by the understanding that there may be similar issues for each group in relation to cost of and access to assistive technology. However, there are different enhancements developed for learners within each of the disability groups that work to make learning more accessible. Because of the complex nature of computer systems and application design and the range of systems and applications it is often difficult to match these developments with hardware and software assistive technology that will enable access to ICT by people with disabilities. Furthermore, different types of assistive technologies are required by each of the target groups to enable access to online learning.

Some examples illustrate this point:

- People who are blind or vision impaired require information in textual form which is then enlarged or translated into Braille or synthetic speech.
- People who are Deaf or Hearing Impaired may require a teletypewriter (TTY) consisting of a keyboard, a visual display and modem.
- People with a physical disability may require modifications to the keyboard or specialist devices to enable commands to be issued.

In addition, there are other issues identified by the research that include:

- access to online services that use sound that cannot be accessed by those people who are Deaf;
- access to online services which is text based may not be accessed by those people with low levels of English literacy; and
- access to online services may not be the preferred learning style of people who are Deaf.

The research for this paper has identified the need for the adoption of the principle of inclusive or universal design. There is now recognition in Australia and internationally of the importance of inclusive or universal design as a way in which to support access to online services for people with a disability. The concept of inclusive or universal design is described in Chapter 3 of this paper.

## Chapter 2: Online Delivery and Assistive Technology

The purposes of Chapter 2 are to provide an overview of the key elements of online delivery, to discuss the learning needs in relation to ICT and to identify the types of assistive technology that may be used by people who are Blind or vision impaired, people who are Deaf or hearing impaired or people with disabilities.

The *Australian Flexible Learning Framework* has been developed to support increased use of Information and Communication Technologies in flexible delivery. The policy is to encourage the use of online delivery where possible and where appropriate to the needs of the learner.

The ANTA paper *Eyes Wide Open - Vocational Education and Training in the Information Age* presents the argument to support the use of learning technologies: 'Training delivered in new ways made possible by technology has the potential to address current inequities of access, so long as issues of infrastructure, costs, instructional design, learning support and cultural relevance are also addressed'.

At each point in online delivery training providers will need an awareness of the access and equity implications for people with disabilities including the most appropriate assistive technology and inclusive web design and content.

In addition, the Guidelines advise that where access to external Web sites is required for completion of a course, such sites must be accessible or the material provided by alternative accessible means.

Both teachers and learners using ICT in course delivery require computer literacy and fluency. For example, the use of computers requires knowledge of technical language, keyboard and navigational approaches. The ways in which computers operate may seem intuitive for many users. This is not always the case for people who have a disability. Depending on the nature of the disability, the person may have to deal with the physical layout, a highly technical language, the visual nature of the computer screen and the complexity of navigational approaches.

In general terms, people with a disability may have difficulty in:

- receiving or interpreting output from the computer;
- giving commands or entering data into the computer; and
- comprehending the information as presented.

For people who have difficulty with computer screen output hardware and software assistive technologies have been developed such as synthetic speech and large clear text. People with a physical disability may not be able to operate the commonly used keyboard and speech input devices have been developed. The issues for Deaf people for whom Auslan is a first language in many cases may be similar to those whose first language is not English.

### People who are Blind or Vision Impaired

The term Blind refers to people whose vision is so severely impaired that they cannot receive any visual cues. They rely on auditory or tactile signals to access information. Braille is the primary literacy medium for people who are Blind. People who are Blind from birth or an early age typically learn Braille in school and prefer to receive material in this format. People who are Blind use screen readers with speech synthesisers or Braille displays. Blind people use keyboard navigation tools rather than a pointing device such as a mouse. While Blind people may use audio formats for many it is not the preferred format as spelling, layout and punctuation is difficult. Electronic text (e-text) such as the

ASCII file is an accessible format for Blind people. The Round Table on Information for People with Print Disabilities has issued guidelines for the production of documents in accessible formats.

The term Vision Impaired includes people who are colour blind, people with peripheral vision only, people with tunnel vision, people who can only read large print. Many people with a vision impairment use screen magnification hardware and software combinations including large monitors. Software programs enable the user to enlarge print and to focus on specific part of the display.

The Round Table on Information Access for people with Print Disabilities uses the following definition of 'print disability'. 'People with print disabilities are those who cannot independently obtain access to information in a standard print form because they: are blind or vision impaired; or have physical disabilities which limit their ability to hold or manipulate information in a standard print form; or have perceptual or other disabilities which limit their ability to follow a line of print or which affect their concentration'. In summary, people who are Blind or are Vision Impaired require material in either Braille, large print, audio and/or electronic text.

## **People who are Deaf or Hearing Impaired**

The research for this paper has found that in Australia there are three groups of people who may be included in the classification of Deaf or Hearing Impaired. They are: Deaf people (signified with the word Deaf capitalised), deaf (or oral) people and hard of hearing people. Deaf people in Australia use Australian Sign Language or Auslan as their first language to communicate. Deaf people identify as a linguistic and cultural community rather than a disability group. The critical feature is the choice of language. English is a second language for Deaf people and as a result many may have limited literacy in English. Hearing impaired and hearing loss has developed after the development of language and they identify with the mainstream community. Accordingly within this group the Deaf and the hearing impaired have different communication preferences, values and culture and different preferences and needs in terms of online learning and assistive technology.

Research conducted for the project *Deaf Australia Online* (1999) found that most online services cannot be used by Deaf people because the services are based on sound and/or text. As well Auslan as a sign language relies on visual communication which means that Information and Communication Technology needs to be designed or adapted to meet the needs of people who are Deaf.

According to *Deaf Australia Online*, Deaf Australians are not as aware of online services as hearing Australians. Their access to vocational education and training is restricted because of the shortage of qualified interpreters and levels of English literacy vary widely. There is a low level of awareness in post secondary providers of education and training of the linguistic and cultural needs of Deaf people.

There is a preference for sign language and face to face communication among Deaf people. This preference together with English literacy issues often means that the Internet and online services are not used by Deaf people. To be effective for Deaf people online teaching and learning needs to take account of sign language, facial expressions and nuances of timing.

Currently Telephone-typewriters (TTYs) and the National Relay Service (NRS) provides voice and text-based access to the telephone or modem for people who are Deaf or hearing impaired.

The report proposes what is defined as 'an ideal model'. This ideal model incorporates the concept of inclusive design of products and services to meet the needs of all people without the need for specialised design. The design and development of online services would include the cultural preferences of Deaf people. In addition the report proposes a range of communication facilities to enable access to online services for Deaf people. The services include a multi-functional fixed communications unit that would include E-mail, fax Web access, TTY and video display. This unit would allow communication through one or more of text, image, moving pictures. The report notes that a prototype unit is being developed in Sweden. Other services include a mobile unit that combines e-mail, messaging, fax and TTY (currently expensive) and video relay interpreting services.

The report argues that visual (video) communication for sign language is fundamental to online services for Deaf people. However, there is a cost to the provision of high quality video conferencing services as well as standards and interoperability issues.

The report argues for the development of universal design standards for online products and services along side models of delivery that incorporate a sense of connection to the teacher.

## **People who are Physically Disabled**

The research for this paper has found that term physical disability includes a wide spectrum of 'disability'. Physical disability includes for example people who have arthritis, amputees, people with multiple sclerosis and people with cerebral palsy. The issue for people with a physical disability is obtaining assistive technology that can be customised for the particular disability as the nature and extent of disability will be different for each individual. For example the type of assistive technology for a person with paraplegia is likely to be different to a person with arthritis or multiple sclerosis.

The report published by the Australian Institute of Health and Welfare and titled *The Definition and Prevalence of Physical Disability in Australia* (1999) describes the issues relating to an operational definition of physical disability. It suggests that the terms physical disability and physical impairment are not clearly defined in the literature nor in Australian legislation and administrative documents. The report argues that the concept of a disability group implies similar activity limitations and common needs related to underlying impairments or disabling conditions.

Disability can be identified at the level of body impairment, activity or participation in society. The identification of an activity limitation may focus on the basics of daily living while the identification of a participation limitation may focus on paid employment.

However, the report argues that the difficulty of defining physical impairment generally is solved by compiling a list of impairments that are considered to be physical which includes a range of conditions such as multiple sclerosis, paraplegia, muscular dystrophy, arthritis. Accordingly, the nature a person's physical disability requires individual assessment in order to identify the most appropriate type of assistive technology.

For people with physical disabilities accessing online products and services there are issues related to navigation, the amount and complexity of information and web accessibility. As well, there are people with physical disabilities who also have learning disabilities. Most web sites and learning products are heavily text based. The State Library of Victoria and Monash University *Project Online Services for People with Disabilities in Australian Public Libraries* (1999) found that literacy is a major issue in the provision of online services to people with disabilities. The report argues that adaptive hardware and software is helpful but that if a person is unable to read well online services are difficult or impossible to use.

## **Assistive Technology**

The following is an overview of the assistive technology available to assist people with disabilities to access online learning. The overview does not provide full technical details. Specific products are mentioned as examples of assistive technology and not as recommendations of one product over another.

### **Braille Systems**

There are broadly two alternatives for computer access for people who are blind; Braille and synthetic speech. There a range of Braille input systems available:

#### **Braille Note Takers/Writers**

These systems support speech synthesisers enabling the user a choice to review documents by audio output. They are also compatible with many Braille and ink printers, making it quite simple to convert Braille documents into printed text.

#### **Braille Printers (also known as embossers)**

These utilise pins to emboss Braille dots on special heavyweight paper and many Braille printers can be easily attached through standard serial ports to personal computers.

#### **Braille Translation Software and Hardware**

This enables learners working with desktop personal computers, including networked systems, to translate printed documents into Braille. Braille translation software programs convert standard ASCII text files into Grade 2 Braille. Many programs are available for both IBM and Macintosh computers.

### **Voice Synthesisers**

Voice Synthesisers involve the use of computer software and a sound card to read to the user what they are typing or what is on the screen.

Computer software has been developed which enables users to access information contained on Internet sites. There are a range of systems available. The more commonly used is JAWS™ (Job Access With Speech).

JAWS™ allows access to the computer for persons who are blind by speaking text that is displayed on the screen. This software program allows individuals to customise its performance to meet their specific needs.

JAWS™ uses the numerical keypad on the keyboard to accomplish many of the screen reading tasks. Macros are used extensively with the program to accomplish many tasks. This screen reading software gives its user the ability to re-format complex web pages, including graphics, columns and frames, and list links alphabetically in list boxes.

### **Optical Character Recognition Systems**

Optical character recognition (OCR) is a process by which printed text in books, magazines or newspapers is converted directly to speech or digitised information. When a speech synthesiser is used with an OCR system, it is possible for people with visual disabilities to gain almost instantaneous access to virtually any printed material.

An OCR system consists of a scanner, the recognition component and OCR software. A variety of OCR products providing a range of features are available. Generally, they work

as an external device with the user's existing assistive technology, however, some products have adaptive devices built in and are referred to as stand-alone reading machines.

## Closed Circuit TV Systems

Closed Circuit TV Systems (CCTV) allow the user to enlarge text in the form of documents, books into a computer or TV screen. Some systems allow the user to switch between CCTV image and word processing software. CCTVs assist learners have a visual impairment. CCTVs are customised to an individuals needs and are available as:

- a fixed camera over a movable table on which the document is placed or a movable camera which can be rolled over the document. Some versions of this type can be interfaced with the computer allowing the user to work with computer programmes and view the enlarged CCTV image on the same screen; and
- a mobile unit which can be used to enlarge text in libraries, shops or the workplace.

## Text Enlargement Software

A range of computer software is available which will enlarge the text and image on a computer screen. This assists learners who have a visual impairment. One of the most commonly used programs with a MS Windows environment is *ZTWin*<sup>™</sup> or *ZoomText*<sup>™</sup> for Windows which allows the user to vary magnification, colours, specific parts of the screen, scroll and set 'target' areas of the document. *CloseView*<sup>™</sup> and *InLarge*<sup>™</sup> are examples of two programs used in a Macintosh environment.

## Voice Recognition Software

Voice Recognition systems enable the learner to speak to a computer and have works appear on the screen. It assists learners with a physical disability. System capabilities differ from program to program but with many products it is now possible to not only dictate text to the computer but also to completely operate associated software such a spreadsheets, Web browsers and e-mail, by voice. *Dragon NaturallySpeaking*<sup>™</sup> is an IBM compatible voice recognition program. It is a word processor that can be largely controlled using only the voice. *NaturallySpeaking*<sup>™</sup> is a continuous-speech dictation system, meaning that it can interpret words spoken at a normal pace that is without pauses between words. The text editing and formatting capabilities allow users to bold, italicise and change the font by voice commands.

## Computer Software

There is a range of computer software available that assists students who experience difficulties either accessing, processing or delivering information.

The following are examples of some commonly used products:

- Read and Write<sup>™</sup> (formerly textHELP<sup>™</sup>);
- Write Outloud<sup>™</sup>;
- Co Writer<sup>™</sup>; and
- WYNN<sup>™</sup>.

The features of specialised software products include:

- Speech feedback letter-by-letter, word-by-word, sentence-by-sentence, marked block and proof-reading;
- Word-by-word spell checking to catch errors as they occur;
- Word Completion and Suggestion (predictive typing) which saves very slow typists having to type the whole word; and
- Page modification to suit individual needs and also to enable, space, highlight and mask specific text.

## Keyboard and Mouse Alternatives

There are adaptive computer accessories available to assist people who have difficulties in using a computer mouse or standard keyboard. There are ranges of examples of computer software programs that are designed to assist the keyboard user. The following are examples of some of the access features included in generic Microsoft Windows packages:

- *StickyKeys* are for people who type with a single finger or mouth stick, commands that require the simultaneous pressing of two or more keys (eg. ALT+TAB) are a problem. With StickyKeys users can press one key at a time and instruct Windows to respond as if the keys had been pressed simultaneously.
- *FilterKeys* assists users who brush against unintended keys. FilterKeys instructs Windows to disregard keystrokes that are not held down for a minimum period of time.
- *MouseKeys* enable users to control the mouse pointer using the keyboard, including clicking, double-clicking, and dragging and dropping with both mouse buttons.
- Specific typing tutoring assistance for one handed typists may also assist eg. Five-Finger-Typist.

## Mouse Alternatives

Mouse alternatives may be used by people who have difficulty using the standard mouse. Hardware available includes:

Trackballs	A trackball is an upside-down mouse. Instead of moving the whole device, only the ball moves leaving the body stationary and reducing physical movements.
Mouse Pen	This device is shaped like a pen that can be gripped and pointed at the screen.
Foot Mouse	This is a modified mouse which is larger and designed to be manipulated by the feet.
Mouse Pad	This usually contains a series of switches that can be programmed to perform a variety of functions.

Head Mouse	This is a head-controlled pointing device that replaces the standard mouse for people who cannot use their hands. They use infra-red receptors and, in some models, clicks are carried out by blowing or using pneumatic buttons.
Joystick	This is an adaptive mouse where all functions are controlled by buttons; click, double click, drag, horizontal/vertical only, and speed.
Mouth Joystick	This is operated/controlled by mouth with mouse button clicks activated by sip and puff movements.
Membrane Keyboard	This can be used by people who do not have the physical ability to depress individual keys on a standard keyboard, and they also help vision impaired persons who need a larger typeface key than commercial large-print key-tops provide. The keys require various degrees of downward pressure to activate. Some will activate with 20 grams of pressure, enabling persons who have co-ordination but lack strength.

## Switches

Switches are a radically different format used to input information. They are used by people with severe physical disabilities. When used in conjunction with hardware or software devices, they provide input to the computer that is identical to typing in the information using a conventional keyboard. The device switches the input language of the user to keyboard language that the computer recognizes.

There are a wide variety of signalling devices or switches being marketed which, when interfaced with software programs such as Morse code or on-screen scanners enable computer access. Morse code interface programs are available with various features, but the user needs to know Morse code. Several Morse code interfaces are available which will work with most switches.

There are two types of scanning applications that, when interfaced with switches, can access computers and information: direct scanning, in which a user points to the target item using a single action, and indirect scanning, in which the cursor moves from one character to the next until it is at the spot where the user wants input made.

Sip-and-puff switches are used by individuals to emulate the physical action of using the keyboard or mouse. The person who uses the sip-and-puff switch may not have the manual dexterity needed to accurately tap in commands on one of the alternate keyboards and relies on the ability to apply pressure (puffing) and suction (sipping) through straws to dictate the direction the cursor will move. The switches may interface with either an on-screen keyboard or Morse code.

A person using an on-screen keyboard moves the cursor by puffing until the cursor is on the desired letter or command, and then sips to tell the computer to choose the letter or command indicated. For persons knowledgeable in the use of Morse code, actual letters may be entered using puff and sip to emulate the dots and dashes of the code.

For people with arm control, arm-control-switching units can be used. The user's arm rests in a cradle of slots, with each slot representing a different movement. The person moves the arm from slot to slot to simulate the arrow keys of the keyboard. A slot also acts as the <ENTER> key. The arm-control switches must use Morse code software or an on-screen keyboard display.

## On-Screen Keyboards

On-screen keyboards allow persons using switches, trackballs, or mouse emulators to use computers and the Internet. Several on-screen keyboard packages allow users to point to the keys rather than press them.

## Teletypewriter (TTY)

The National Relay Service operated by the Australian Communications Exchange under a Federal Government contract, facilitates communication between persons who are Deaf or speech impaired using a Teletypewriter (TTY) and persons using speech.

The principal telecommunications device for people who are Deaf is a text-telephone, commonly known as a TTY. TTYs in Australia use the Baudot code, originating from the 5-bit telex code, so they are not compatible with ASCII devices. A TTY enables a person who is Deaf or speech impaired to communicate with another person over the telephone. Text is typed into the TTY, the information is transmitted over the telephone network, and the text is received and printed out on another TTY.

People who are both deaf and blind (deafblind) require TTY access. Such equipment needs to interface with Braille technology.

Telstra has an extensive range of telephone equipment which can assist people who are Deaf or speech impaired, or who are hearing impaired, in using the telephone network.

## Resources

The publication *Adaptive Technology for the Internet: Making Electronic Resources Accessible* by Barbara Mates, Doug Wakefield and Judy Dixon, published in January 2000 by the American Library Association provides an overview of assistive technology. The material was prepared from the perspective of making public libraries accessible for online access by the provision of accessible workstations.

The book gives detailed examples of assistive technology such as:

- Enlarging hardware and software to assist people with vision impairment;
- Synthetic speech and Braille computer access software and hardware for people who are blind;
- Advice on making online materials accessible to people who are Deaf or hearing impaired;
- Software accessibility features and input devices, ranging from keyboards to switches for people with physical disabilities; and
- Optical Character Recognition equipment for people with print disabilities.

The Tiresias database developed and managed by Dr John Gill, Chief Scientist at the Royal National Institute for the Blind in London has a comprehensive non-commercial listing of assistive technology for people who are blind or vision impaired.

ABLEDATA is an extensive online database covering the full range of assistive technology. It is sponsored by the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education.

In Australia there are Independent Living Centres in all States. These give information about a broad range of assistive technology. In particular, the Independent Living Centre of South Australia maintains an excellent online database of assistive technology ([www.ilc.asn.au/](http://www.ilc.asn.au/)).

There are product distributors in Australia specializing in particular market segments such as blindness and vision impairment or physical disability, which have their own catalogues with product descriptions.

## Chapter 3: Inclusive Design, Standards and Guidelines

The purpose of this chapter is to outline Australian and international initiatives for increasing the access of all people including people with disabilities to the Internet.

### Inclusive Design

Inclusive design is defined by the Trace Centre (1996) as ‘the process of creating products (devices, environments, systems and processes) which are usable by people with the widest possible range of abilities, operating within the widest possible range of situations (environments, conditions and circumstances)’.

There are two components to inclusive design in this definition. The first component is the design of products which are flexible enough, as is commercially practical, to be directly used by people with the widest range of abilities. The second component is the design of products and services so that they are compatible with the broadest range of assistive technologies for people who cannot use or efficiently access the products directly.

The Center for Universal Design in North Carolina, USA has devised seven principles of inclusive design. They are:

- Equitable use.
- Flexibility in use.
- Simple and intuitive use.
- Perceptible information.
- Tolerance for error.
- Low physical effort.
- Size and space for approach and use.

The Center for Applied Special Technology (CAST) in USA has developed approaches for the development of curricula based inclusive design principles. For example, a key approach is a distribution network of learning materials based on a variety of content and available in different media. CAST is involved in the National Consortium on Universal Design for Learning which is a partnership of schools, educators and experts working towards improved access to the general curriculum.

CAST has developed the eReader, a software program to provide easier access to documents of the web for people with language disabilities, reading disabilities and vision impairments. Based on inclusive design principles, it is flexible enough to assist learners with a wide range of abilities to gain access to electronic text while at the same time working towards improved literacy skills. It does this by adding speech, visual highlighting, document and page navigation to the electronic text.

To assist product developers in creating inclusive products the Trace Center is developing an online universal design evaluation tool. This is a tool where designers can answer questions about their product development processes. To support this, designers will be given information about particular features that may create barriers. Illustration, resource materials and experts to contact will also be provided. Currently, a product design ideas browser is available which offers an immense amount of suggestions on making particular products more accessible.

## Universal Design

Increasingly, the principle of universal design is being accepted in the development of online services. Universal design is being defined in the literature as 'the design of products and environments to be usable by all people to the greatest extent possible, without the need for adaptation or specialised design'. (Technology Assessment Program, 1999) Universal design can be applied to policy-making, application development, equipment and software development, standards for inter-working and codes.

The Australian Human Right and Equal Opportunity Commission (HREOC) has provided the following information on its website at [www.hreoc.gov.au/disability\\_rights/standard/www\\_3](http://www.hreoc.gov.au/disability_rights/standard/www_3). The HREOC has drawn attention to resources that will help authors and designers make their World Wide Web documents accessible to the broadest possible audience.

The Commission argues that availability of information and services in electronic form through the World Wide Web has the potential to provide equal access for people with a disability, and to provide access more broadly, more cheaply and more quickly than is otherwise possible using other formats.

However, current text readers and Braille output devices are not able to deal with information or links presented only in graphics or photographic format. Material provided only in audio format will not be accessible to Deaf people or some people with hearing impairments unless an alternative is provided. Although users can determine many aspects of colour, size and print font of output for themselves, some approaches to text form or colour will render access difficult or impossible for users with impaired vision.

Further, the Commission argues that people with a disability have, on average, lower incomes than other members of the community and may not have access to state-of-the-art equipment and software.

HREOC argues that on the basis of available information, it appears that it is technically feasible to remove many Internet barriers to equal access for people with a disability in this area. This may be done in a way that does not detract from the usefulness or attractiveness to other users of Web pages, or in many cases actually benefits all users.

HREOC recommends the W3C and AusInfo Guidelines. The AusInfo Guidelines provide advice on a wide range of issues in electronic publishing including access for people with disabilities. The Commission believes that integrating accessibility into general authoring a publishing advice is a way of bringing it into mainstream practice. The AusInfo Guidelines are intended to evolve to keep pace with best practice. The Commission believes that reasonable attempts to achieve current best practice will generally satisfy the access requirements of the DDA.

In March 1999 and revised in January 2000 AusInfo, formerly the Australian Government Publishing Service, issued Guidelines for Commonwealth Information Published in Electronic Formats. The rationale is that government information is being issued electronically, either over the Internet or on CD. The Guidelines are provided for people in government who manage publishing programs and oversee the development of their agency's electronic information, who maintain or create web sites, or who write, design or create material for electronic documents. It is recognised that others in the community may find the information in the document useful to their electronic publishing needs.

According to AusInfo, the application of guidelines for publishing Commonwealth information in electronic formats contributes to:

- improved efficiency, quality, production, management, distribution and accessibility of government information
- consistent presentation
- standardized use of logos, national symbols and other graphics
- the satisfactory addressing of legal aspects of government electronic publishing
- management and preservation of electronic government publications to ensure future access

The Guidelines were endorsed by the Human Rights and Equal Opportunity Commission in March 1999, with respect to their consistency with the Objects of the Disability Discrimination Act. The HREOC now uses the AusInfo Guidelines as its primary reference point for good web design; in lieu of HREOC's own advisory notes on World Wide Web access previously issued by the Disability Discrimination Commissioner under section 67(1)(k) of the DDA which provides for HREOC to issue guidelines for the purpose of avoiding discrimination.

The Guidelines state:

'Availability of information and services in electronic form via the web has the potential to provide equal access for people with a disability; and to provide access more broadly, more cheaply and more quickly than is otherwise possible using other formats.' Examples of access are:

- People who are blind or have vision impairments can use appropriate equipment and software to gain access to electronic documents in Braille, audio or large print form.
- Deaf people or people with hearing impairments could have more ready access to captioning or transcription of sound material
- Many people whose disability makes it difficult to handle or read paper pages can use a computer, for example with a modified keyboard or with voice control
- Web publication may provide an effective means of access for people whose disability makes it difficult for them to travel to or enter premises where the paper form of a document is available

The issues that have determined HREOC's policy include the following.

- The WWW is by its very nature a global activity. Wide accessibility will be assisted by a universal performance standard and could be hindered by proliferation of a multitude of standards.
- The development of industry standards in this area is proceeding rapidly and a high level of expertise is involved. HREOC wants to encourage web designers to use expert information that is kept up-to-date with WWW publishing and access challenges and solutions.
- It is important that people with disabilities be closely involved in initiatives aimed at avoiding disability discrimination.
- There is the need for more effort to encourage implementation of accessible design as building an inaccessible website can be avoided if people are given good information about inclusive design.

A complaint of disability discrimination is unlikely to succeed if accessibility has been considered at the design stage and reasonable steps have been taken to provide access. As a general rule, it would be unreasonable to require features that would exceed the best current standards or features that would impose unjustifiable hardship on the provider. In considering a disability discrimination complaint about WWW access, HREOC would take into consideration the extent to which the best available advice on accessibility had been followed.

## **World Wide Web Consortium**

The World Wide Web Consortium (W3C) was created in October 1994 to 'lead the Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability'. W3C has more than 400 member organisations from around the world and has developed more than 20 technical specifications known as recommendations for the Web's infrastructure.

W3C's long term goals for the Web include:

Universal Access: To make the Web accessible to all by promoting technologies that take into account the vast differences in culture, education, ability, material resources, and physical limitations of users on all continents;

- Semantic Web: To develop a software environment that permits each user to make the best use of the resources available on the Web.

Web of Trust: To guide the Web's development with careful consideration for the novel legal, commercial, and social issues raised by this technology.

W3C Activities are generally organised into groups: Working Groups (for technical developments), Interest Groups (for more general work), and Coordination Groups (for communication among related groups). These groups also ensure coordination with other standards bodies and technical communities. There are currently over thirty W3C Working Groups. W3C Activities and other work are organised into four domains:

- Architecture Domain: develops the underlying technologies of the Web.
- User Interface Domain: seeks to improve user interaction with the Web. This includes work on formats and languages that will present information to users with more accuracy and a higher level of control.
- Technology and Society Domain: seeks to develop Web infrastructure to address social, legal, and public policy concerns.

Web Accessibility Initiative (WAI): W3C's commitment to lead the Web to its full potential includes promoting a high degree of usability for people with disabilities. WAI is pursuing accessibility of the Web through five primary areas of work: technology, guidelines, tools, education and outreach, and research and development.

## **Web Accessibility Initiative**

WAI or the Web Accessibility Initiative objectives are to ensure that all recommendations from W3C support principles of accessible design and to develop specific guidelines and application notes regarding designing web pages and Internet tools which are accessible.

The Web Accessibility Initiative has published two recommendations to promote access to the Web for people with disabilities. The principles of these guidelines also benefit all users and are very similar to guidelines for mobile access.

The Web Content Accessibility Guidelines 1.0 (1999), explains how to author accessible Web pages and sites.

The Web Content Accessibility Guidelines are being extensively updated to take account of recent developments in web technologies and to make the guidelines and accompanying techniques easier to read and understand for a wider range of potential audiences.

A variety of automated tools exist to test the potential accessibility of websites. Bobby - online at [www.cast.org/bobby](http://www.cast.org/bobby) - developed by CAST is probably the most well-known but a variety of other validation and repair tools are also available from the WAI home page at [www.w3.org/WAI](http://www.w3.org/WAI).

The Authoring Tool Accessibility Guidelines 1.0, explains how to build authoring tools that produce accessible content and are accessible to users with disabilities, was published in February 2000.

A third set of guidelines (dealing with User Agents) will suggest ways for software developers to directly implement accessibility capabilities or add hooks directly into web browsers, file viewers, multimedia players etc to make accessibility of the web easier and more reliable.

## Round Table Guidelines

The Round Table on Information Access for People with Print Disabilities is an industry association of non-profit community agencies, alternative format producers and libraries which are concerned with the production, distribution or use of materials in accessible formats for people with print disabilities. The formats are Braille, large print, audio and electronic text. The Round Table has had various sub-committees and working parties have considered issues for the various formats. There have been sub-committees on library services and education. An important Round Table sub-committee is the Australian Braille Authority (ABA). It takes responsibility for standards and guidelines concerning the code rules and formatting of Braille produced in Australia.

The Round Table has developed guidelines for materials production in Australia:

- *Guidelines for Production of Large Print* gives information on producing large print – font size and style, the use of white space and enhancements like bolding, what to do and some things not to do.
- *ABA Formatting Guidelines* specifies how documents should be formatted in Braille.
- *ABA Chemistry Notation* specifies the Braille code to be used in Australia for chemistry.
- *Examination Guidelines for Students with Vision Impairments* gives guidelines for the presentation of examination papers for students who are blind or vision impaired. This guidelines document was produced by the Round Table's Education sub-committee.
- *Sound Advice* gives detailed guidelines for the production of documents in the audio format. The guidelines were written for analogue production using the cassette as the distribution medium.
- *Guidelines on Narration of Visual Material* gives advice on how to read or describe tables, charts, diagrams and other graphical information as part of an audio book. These guidelines are mainly applicable for the production of education material.
- *Guidelines for the Preparation of Text Material on Computer Disk* specify codes to be used for structuring cues and give other advice for the preparation of electronic text documents.

## California Community Colleges Guidelines

In August 1999 Access Guidelines were issued for distance education through California Community Colleges. The *Distance Education: Access Guidelines for Students with Disabilities* was developed by the High Tech Center Training Unit in collaboration with the Distance Education Accessibility Workgroup.

The Guidelines cover:

- Legal Requirements
- Basic Requirements For Providing Access
- Access Guidelines for Specific Modes of Distance Education Instructional Delivery
- Print Media
- Audio Conferencing
- Video Conferencing/Video Transmission (Live)
- Video Transmission (Pre Recorded)
- World Wide Web
- Instructional Software, Laser Video Disc, CD-ROM, DVD
- Trace Research & Development Center Accessibility Guidelines (now subsumed in the Web Content Accessibility Guidelines version 1.0)

## Microsoft Accessibility Check List

These guidelines are applicable when Windows-based applications are being developed or commissioned in order to make them compliant with assistive technologies. These guidelines have been issued by Microsoft Corporation to promote accessibility. They also include general software design guidelines prepared by the Trace Centre.

## IBM Guidelines

IBM has developed three brief sets of guidelines that includes software, hardware and web accessibility.

## **DAISY/NISO Standard**

The DAISY Consortium started in Europe less than five years ago, and has members in the United States, Australasia and Japan. DAISY denotes Digital Audio-Based Information System. The member organizations are talking book libraries and audio production agencies with a common interest to develop a new paradigm for Digital Talking Books (DTBs) for people with print disabilities. The DAISY Consortium is developing standards for the production, exchange and use of the next-generation DTB.

The DAISY Consortium has adopted open standards as the basis for the DAISY Standard and to facilitate the use of mainstream technology for the production and playback of Digital Talking Books.

The DAISY/NISO 3.0 specification, due for release as a consultative draft in the fourth quarter of 2000, will include a world-wide standard for multimedia Digital Talking Books.

A major mainstream development is the creation of Open EBook Specifications. The Open EBook Forum was formed in January 2000 out of the Open EBook Initiative which had started at the first World EBOOK Conference in October 1998. The Open EBook Initiative brought together a number of large software and hardware companies to consider the development of standards for electronic books, including Microsoft and IBM.

In September 1999 the Open EBook Publication Structure specification 1.0 was released. This specification defines the format that content takes when it is converted from print to electronic form. Its purpose is to provide a specification for representing the content of electronic books.

## Chapter 4: Conclusion

The research conducted for this paper on assistive technology has identified a number of issues. For people with disabilities the use of Information and Communication Technology to access online learning requires computers, literacy and fluency in ICT and skills in reading and understanding online information as well as skills in the operation of assistive technology.

Computer hardware and software has generally been developed for mainstream users requiring people with disabilities and or training providers to purchase assistive technology that matches their learners needs. The cost of assistive technology for training providers and for individuals is an issue. In turn, access to online learning requires access to the Internet and this raises issues of inclusive or universal design of Web pages to ensure access by people with disabilities.

For many people with disabilities there are issues of the cost and interoperability of assistive technology. For those in the Deaf Community computer technology is seen as an aid rather than a substitute for face to face teacher facilitated learning. For people with physical a disability one piece of equipment may work well and be suitable for one person but not for another. Access to the Web requires a new way of understanding information to be useful. Users need to know about Web addresses, modes of access, the organisation and construction of web sites.

In summary the issues for learners with disabilities are the:

- cost of computer equipment and assistive technology;
- compatibility of equipment;
- match between learning preferences and online delivery training; and
- ways in which web pages are designed.

The research has identified strategies which if implemented would enhance online learning for people with disabilities. The first strategy involves the inclusive or universal design of web pages, computer hardware and software. The Trace Centre in America argues that there are low cost modifications to standard computers that would increase accessibility and be of benefit to mainstream users as well. The Trace Centre research has found that engineers and designers in major computer companies have indicated that design modifications could have been included in the original design process if the developers had been made aware of the need for such modifications. The design issues are being addressed in Australia through the AusInfo Guidelines and internationally through the W3C Web Accessibility Initiative. In turn, design and interoperability issues also need to be considered by ANTA.

W3C has developed Web content Accessibility Guidelines. The Guidelines are as follows.

- Provide equivalent alternatives to auditory and visual content.
- Don't rely on colour alone.
- Use markup and style sheets and do so properly.
- Clarify natural language use.
- Create tables that transform gracefully.
- Ensure that pages featuring new technologies transform gracefully.

- Ensure user control of time sensitive content.
- Ensure direct accessibility of embedded user interfaces.
- Design for device independence.
- Use interim solutions.
- Use W3C technologies and guidelines.
- Provide context and orientation information.
- Provide clear navigation mechanisms.
- Ensure that documents are clear and simple.

ANTA has endorsed the findings of the *report Preferred Standards to Support National Cooperation in Applying technology to VET*. However, these standards are preferred and not intended to be mandatory. This paper argues for an awareness of the importance of inclusive standards for Web design and content based on the W3C Accessibility Guidelines by ANTA is a first step towards accessible online learning for people with disabilities.

In addition, the Accessibility Guidelines are for use by software developers they can also be used by content developers in the vocational education and training sector. Accordingly, professional development for online developers should include WC3 Guidelines for Accessibility.

The second strategy involves RTOs making reasonable adjustments to ensure that online services may be accessed by people with disabilities. This would involve consideration of the design and construction of RTO web pages, online information, enrolment, teaching and learning strategies, access to technologically based information and the identification of appropriate assistive technology.

The key questions for RTOs to consider include:

- Is the organisation's web site accessible to people with disabilities?
- Can information and application forms be down loaded by people with disabilities?
- Are conversions available for PDF formats?
- Is information provided in alternative formats preferred by students? (eg. sign language, Braille etc)
- Is the content of online material accessible by people with disabilities?
- Are the materials in Plain English and have the language and literacy levels been checked?
- Is there a match between the delivery of online learning and learner preferences?
- Are students with disabilities assessed in relation to their assistive technology requirements?
- Are E-mail messages in plain text rather than HTML?

- Are online materials and web pages designed in accord with the W3C Accessibility Guidelines?
- Is the IT infrastructure compatible with industry standard for assistive technology?
- Are teaching staff trained to organise access to assistive technology?
- Do people with disabilities have access to technology-based information including CD-ROM and learning materials?
- Are materials available in alternative formats?
- Are the online teaching and learning strategies inclusive of people with disabilities?

The research suggests there are issues in relation to the development and provision of assistive technology for online learning for people with disabilities that can be addressed at a system level. Accordingly, the following recommendations are proposed.

## **Recommendations**

It is recommended that:

The Flexible Learning Advisory Group undertake a review of the preferred standards in the light of the identified needs of people with disabilities to incorporate W3C guidelines for Inclusive/universal web design and content.

The Flexible Learning Advisory Group develop an awareness strategy that targets computer hardware and software companies to encourage inclusive design.

The Flexible Learning Advisory Group develop a set of online benchmarks and a range of product exemplars to demonstrate ways in which to meet the needs of users with disabilities.

The Flexible Learning Advisory Group implements a strategy to distribute the Guidelines for Online Product Development produced for the Access and Equity in Online Learning Project.

The Flexible Learning Advisory Group Professional Development initiatives such as LearnScope and Toolbox include consideration of the online learning needs of people with disabilities when developing online products and W3C Guidelines for Accessibility.

## Glossary

ABS	Australian Bureau of Statistics.
Alternative Keyboards	Alternative keyboard layouts and other enhancements allow people who experience difficulty with conventional keyboard designs to use computers. The products available range from keyguards that prevent two keys from being pressed simultaneously, to alternative keyboards with different layouts and sizes for people who have specific needs, to alternative input systems which require other means/methods of getting information into a computer.
Alternative Mouse Systems	Alternative mouse systems allow people who experience difficulty with conventional mouse designs to use computers.
ANTA	Australian National Training Authority.
Assistive Technology	Software or hardware that has been specifically designed to assist people with disabilities in carrying out daily activities. Assistive technology includes wheelchairs, reading machines, devices for grasping etc. In the area of Web Accessibility, common software-based assistive technologies include screen readers, screen magnifiers, speech synthesizers, and voice input software that operate in conjunction with graphical desktop browsers (among other agents). Hardware assistive technologies include keyboards and pointing devices.
Auslan	Australian sign language as used by Deaf people in Australia.
DDA	Disability Discrimination Act.
Deaf	A person who has a hearing loss, identifies with the Deaf community and is fluent in Auslan. Can have any degree of loss from mild to profound.
deaf	A person with a severe/profound loss of hearing but who does not identify with the Deaf community nor is fluent in Auslan. Commonly will use speech and lipreading to communicate.
External Speech Synthesiser	External voice synthesizers are used with older computer systems that have no sound card, or for users who require two speech synthesizers.
Hard of Hearing	A person with a mild/moderate degree of hearing loss. People who are hard of hearing may use speech and lipreading to communicate and may identify with other hard of hearing people, but not with the Deaf Community.
Hearing Impaired	A medical/educational term used to describe all people with a hearing loss. This term is not accepted by the World Federation of the Deaf.
Internet Relay Chat/IRC	IRC is like e-mail, but allows someone at a PC to type messages that instantly appear on another's screen and facilitating two-way communication.
Interpreter	A person who is fluent in Auslan and spoken language and who interprets a spoken language to a sign language and vice versa.
Optical Character Recognition (OCE)	Optical character recognition is the process of converting an image of text, such as a scanned paper document or electronic fax file, into computer-editable text. The text in an image is not editable; the letters are made of tiny dots (pixels) that together form a picture of text.
Screen Reader	Screen reader is the commonly-used name for Voice Output Technology. Hardware and software produce synthesized voice output for text displayed on the computer screen, as well as for keystrokes entered on the keyboard.
Sign Language	A non-verbal form of communication used by Deaf people throughout the world consisting of hand-signs, fingerspelling (letters of the alphabet shown

	on the hands) and other grammatical features such as role shifts and classifiers. It does not follow the grammar of a spoken language and there is no written form of this language. Sign languages are recognised as true and complete languages in many countries of the world.
TTY/Teletypewriter	A TTY consists of a keyboard, a visual display and a modem. By dialing the required number, another TTY can be contacted, and by typing on the keyboard and reading the visual display, communication can take place via the normal Public Telephone Network (PTN).
VCO/Voice Carry Over	The capacity for hearing impaired people to use spoken voice rather than typing to communicate through the ACE-NRS, and to receive responses in typed form.
VET	Vocational Education and Training.
Video Conferencing	Video conferencing describes the holding of a conference among people at remote locations by means of transmitted audio and video signals.
Videoconferencing (Videotelephony)	This is a generic term referring to the use of any video equipment used by videoconferencing.
Video Relay Interpreting (VRI)	VRI is a specific aspect of video interpreting, which refers to the use of a video telephone to relay information between a Deaf Auslan user and a hearing person who does not understand Auslan via a qualified Auslan interpreter.
Voice Output Communication Aids	Voice output communication aids (VOCA) are electronic devices that are able to generate printed and/or spoken text and are an aid individuals who are unable to use natural speech to meet all of their communication needs.
Voice Recognition System	Voice recognition is a technology which allows a user to use his/her voice as an input device. Voice recognition may be used to dictate text into the computer or give commands to the computer (such as opening application programs, pulling down menus, or saving work).

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## Web Resources on Assistive Technology

### Australia

Ability Research Centre

<http://www.abilitycorp.com.au/>

Australian Communication Exchange - National Relay Service

<http://www.aceinfo.net.au/>

Australian National University - Assistive Technology sites

<http://www.anu.edu.au/disabilities/tech.html>

Australian Rehabilitation & Assistive Technology Assoc. (ARATA)

<http://members.iinet.net.au/~sharono/arata/>

Disability Equipment Information Service

<http://deis.vic.gov.au/>

Independent Living Centre of South Australia

<http://www.ilc.asn.au/>

Quantum Technology

<http://www.quantech.com.au/>

Regency Park Rehabilitation Engineering

<http://regencyrehab.cca.org.au/>

RSB Adaptive Technology Centre

<http://www.at.rsb.org.au/>

Sensory Tools

<http://www.sensorytools.com/>

Technical Solutions Australia Pty Ltd

<http://www.tecsol.com.au/>

Virtual Assistive Technology Centre

<http://www.at-center.com/>

### International

ABLEDATA

<http://www.abledata.com>

Assistive Technology Viewer

<http://peabody.vanderbilt.edu/>

Center for Applied Special Technology (CAST) eReader

<http://www.cast.org/tools/teachingtoolsreader.html>

Closing The Gap - Essential Bookmark Collection for AT Coordinators

<http://www.closingthegap.com/>

Royal National Institute of the Blind - Accessing Technology

<http://www.rnib.org.uk/technology/>

Labyrinthen

<http://www.labyrinthen.com>

Plextor Inc.

<http://plextor.com>

The Productivity Works

<http://www.prodworks.com>

Tiresias - International Information on Visual Disability - Equipment

<http://www.tiresias.org/equipment/equipmentcontents.htm>

University of Toronto Adaptive Technology Resource Center - Technology Glossary

<http://www.utoronto.ca/atrc/reference/tech/techgloss.html>

VisuAide

<http://www.visuaide.com>

Web Resources on Projects, Guidelines and Resources

Bobby

<http://www.cast.org/bobby/>

CAST - "Mind, Media and Instructional Design:" A Book and Web Site on Universal Design for Learning

[http://www.cast.org/initiatives/book\\_web.html](http://www.cast.org/initiatives/book_web.html)

Center for Applied Special Technology (CAST)

<http://www.cast.org/>

Center for Applied Special Technology - National Consortium on Universal Design for Learning

[http://www.cast.org/initiatives/national\\_consortium.html](http://www.cast.org/initiatives/national_consortium.html)

DAISY Consortium

<http://www.daisy.org/>

DAISY/NISO developments

<http://www.loc.gov/nls/niso>

Disability and Technology - A Resource Collection

<http://www.netaccess.on.ca/~galambos/tech.htm>

Disabilities, Opportunities, Internetworking and Opportunities (DO-IT)

<http://www.washington.edu/doi/>

Equal Access to Software and Information (EASI)

<http://www.rit.edu/~easi/>

HTML Writers Guild - AWARE Center

<http://aware.hwg.org/>

IBM Accessibility Center – Guidelines

<http://www-3.ibm.com/able/access.html>

Matching Persons and Technology

<http://members.aol.com/IMPT97/MPT.html>

Microsoft Accessibility

<http://www.microsoft.com/enable/>

National Clearinghouse on Education and Training for people with disabilities (NCET)

<http://www.deakin.edu.au/tedca/ncet/>

National Library Service for the Blind and Physically Handicapped (NLS)

<http://www.loc.gov/nls/>

NCAM Universal Access Project

<http://www.wgbh.org/wgbh/pages/ncam/archives/uap.html>

Open EBook Forum

<http://www.openebook.org/>

Open Learning Australia

<http://www.opennet.net.au/>

Recording For the Blind & Dyslexic (RFB&D)

<http://www.rfb.org>

Sensory Access Foundation - Access Review

<http://www.sensoryaccess.com/access-review/>

Special Needs Opportunity Windows (SNOW) - Learning Technology

[http://snow.utoronto.ca/learn\\_tech.html](http://snow.utoronto.ca/learn_tech.html)

Trace Center - Designing more usable computers and software

[http://trace.wisc.edu/world/computer\\_access/index.html](http://trace.wisc.edu/world/computer_access/index.html)

Trace Center - Product Design Ideas Browser

<http://www.trace.wisc.edu/docs/browser/>

United States Distance Learning Association

<http://www.usdla.org/>

University of Newcastle - Accessible Web

<http://www.newcastle.edu.au/accessweb/>

U.S. Department of Education - Requirements for accessible software design

<http://ed.gov/>

World Wide Web Consortium (W3C) - Web Accessibility Initiative

<http://www.w3.org/WAI>

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**For more information contact:**

**Phone: (07) 3247 5511**

**Fax: (07) 3237 0419**

**Email: [enquiries@flexiblelearning.net.au](mailto:enquiries@flexiblelearning.net.au)**

**Web: [flexiblelearning.net.au](http://flexiblelearning.net.au)**