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Susan Keller

Deakin University, susank@deakin.edu.au

Janet Owens

Deakin University, jowens@deakin.edu.au

Craig Parker

Deakin University, craig.parker@deakin.edu.au

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Improving Online Access for People with Disabilities

Susan Keller

School of Management Information
Systems
Deakin University
221 Burwood Highway
Burwood Victoria Australia 3125
susank@deakin.edu.au

Janet Owens

Institute of Disability Studies
Deakin University
221 Burwood Highway
Burwood Victoria Australia 3125
jowens@deakin.edu.au

Craig Parker

School of Management Information
Systems
Deakin University
221 Burwood Highway
Burwood Victoria Australia 3125
cparker@deakin.edu.au

Abstract - This paper reports on a consumer-focused research and development project aimed at investigating the online communication requirements of people with disabilities in Australia. Results are informing the development of an accessible email software package with word prediction.

I. INTRODUCTION

There is no doubt that the Internet is becoming increasingly pervasive in our everyday life. Internet shopping, Internet banking, Internet education, and even working from home through virtual offices have become common place.

Many of these developments offer the potential to vastly improve the quality of life for people with disabilities, offering increased independence and opportunities for participation in society [1]. These benefits are only realisable if individuals with disabilities have true access and equity in using the Internet. Access can be compromised by a range of factors including lack of information, lack of people or information sites to contact, literacy difficulties, and lack of support and training [2].

What is disability and impairment?

Disability has historically been viewed from a deficit perspective, as a medical issue, where 'the problem' lies within the person. More recent perspectives, however, view disabilities as "socially produced barriers that are the result of wider attitudes and structures that limits people's...participation" [3:9]. An impairment is defined as a limitation or difference such as that which results from a physical, sensory, or cognitive condition [3]. Impairment refers to the personal while disability refers to the social barriers that impact on a person's participation.

Impairments that may interfere with computer and on-line access can be broadly grouped into four areas:

- Visual;
Ranging from difficulties seeing text displayed in small fonts to complete blindness.
- Hearing;

- Problems can arise when sound cues and multimedia systems are used but the largest obstacle for many is unfamiliarity with languages other than sign language [4].
- Motor;
The most important issue for people with physical problems is difficulty using standard computer input devices such as keyboard or mouse. Many people are not able to speak easily, or at all, thus ruling out voice input.
- Cognitive and language;
The issues here are to do with difficulties understanding both the user interface and the message contained in the information or communication. There may also be issues in understanding the task and the sequence of activities required to successfully complete the task.
Many of these individuals have impairments that fall into more than one of the above groups.

Why is it important to understand the accessibility issues for people with disabilities?

Approximately 18% of the Australian population has or will have a disability during their lifetime [5] and it is estimated that there are 750 million people worldwide with disabilities. This alone makes research into the online access issues of people with disabilities an important area of research. However, there are other economic, regulatory and social equity motivations.

Economic motivations

Considering the total number of people worldwide with a disability there are obvious business opportunities for information services, software and hardware that meet the needs of individuals with a disability [6]. Designing services and products so that they are accessible for users with disabilities means concentrating on good design which should make products more desirable for everyone [7].

Regulatory motivations

People with disabilities are increasingly finding a voice and many countries are enacting legislation to ensure that the rights of people with disabilities are protected. Legislation

commonly involves ensuring the right to certain kinds of information, requiring that products and services procured by government agencies are accessible or ensuring the products and services sold within a country are accessible. Many governments around the world have legislation covering one or more of these areas (for example [8], [9]). In the United States this has propelled software houses, for example Microsoft [10] and Sun [11], to incorporate significant accessibility features into their software. Recently there have been efforts (in Portugal and Thailand) to directly legislate for accessible web content [12].

As more and more services go on-line policy makers are increasing concerned about the risks of a polarisation between the information rich and the information poor [13:3], [14] so it is reasonable to expect more legislation or wider interpretation of existing legislation.

Social equity motivations

Information technology professionals are often unaware of the disproportionately adverse effect some of their practices have in barring access to information and services for users with a disability. For example, producing software that can not be used without a mouse can render a software package completely inaccessible for some people. From a social equity perspective it is incumbent upon information technology professionals to increase their awareness of the issues as well as the documented and emerging solutions to these challenges. With awareness and some simple changes to policy and practices many more people would have the opportunity to participate more fully in the information economy.

This paper describes part of an Australian government funded project completed by the Equity Access Research and Development group at Deakin University. This group comprises members from both the information systems discipline and the disability studies area. This collaborative effort allows the group's research and development to have outcomes that result in consumer-focused software development and recommendations that seek to improve policy, service delivery, and involvement of consumers with disabilities.

The purpose of the first stage of the project has been to explore the barriers that people with disabilities face when using on-line services, in particular electronic mail. The insights gained from this research will be used to drive the design and development of an electronic mail package. However, issues identified also have wider application for the development of other software and in particular on-line systems.

II. BACKGROUND

The Internet offers many potential benefits for users with a disability but to realise these benefits individuals need access to the Internet.

Although access needs to be considered in both technological and social terms [3], technological access has several dimensions including: availability, continuity, affordability, accessibility and awareness [15:7]. The accessibility dimension is concerned with designing information technology hardware, software and services in such a way that does not exclude people from their use [15:8].

Access can be direct or through the use of add-on assistive technologies. Direct access according to Vanderheiden [16] involves "adaptations to product designs that can significantly increase their accessibility...". An example of direct access is the built-in accessibility options in Windows 95 such as sticky keys (which allows people to use Alt, Shift Ctrl without needing to hold down keys simultaneously) and mouse keys (a keyboard alternative to the mouse). Such direct access features mean standard equipment can be used without modification by many more people than would otherwise be the case.

Add-on assistive technologies are hardware and software products that can be used in conjunction with standard software to provide specialist input and output capabilities. Some examples of assistive technologies include screen readers (used by people with vision impairments), voice input systems, and on-screen keyboards used with switch device systems to allow access for people who can not use standard input devices. At a very minimum, off the shelf software should be written in such a way as to seamlessly interact with these technologies. Using standard system controls, providing keyboard access to all parts of the program and ensuring that software works with the direct access features offered by the operating system is usually all that is required [17].

Bergman and Johnson [18:2] however argue that accessibility should mean more than just providing direct access and more than simply accommodating assistive technologies. Accessibility should be concerned with "designing application user interfaces that are easier to use for users with disabilities as well as users 'with out' disabilities by taking their needs into account when system and application software is designed". This encapsulates the idea of universal design, which is widely argued as a desirable goal for the design of all products [19], [20].

Email (or electronic mail) is the oldest and most popular Internet tool. It allows individuals anywhere in the world to write back and forth quickly and inexpensively. To send and receive an email message all that is required is an Internet connection, an email software package, and an email address.

As a means of communication electronic mail has many advantages. Email messages are cheaper and faster than paper based letters, less intrusive than phone calls and easier than faxes [21]. Email communication also overcomes time differences that can be a problem in long distance communication. For a user with a disability email may also have additional benefits including providing a means of

communicating with people without speech [22], and providing a 'level playing field' where a person's disability is not immediately apparent [23].

Issues surrounding access to the Internet such as accessible web content and browser software have been widely researched and have resulted in important guidelines and policies aimed at increasing the accessibility to on-line information. For example, the World Wide Web Consortium's Accessibility Initiatives have resulted in guidelines covering accessible web site design [24], authoring tools [25], and user agents [26](including browsers, multimedia players and plug-ins).

The broader barriers to on-line interactive communication, however, have not been as well researched. There is no known research into the specific access issues faced by people with disabilities in using electronic mail nor is there any known email application designed with the active participation of users with a disability. The current project has been designed to meet these research and development needs.

Within the broader project, users with disabilities are to be involved prior to software development so that consumer issues relating to use and design can be considered early.

Using an email package involves both reading and text production tasks. Reading can be problematic for users with vision impairment (with or without hearing problems) as well as those with literacy problems. However text production is a still larger problem for users with poor literacy skills and for individuals who can not use keyboard or voice input. The only viable option for this last group of people is an on-screen keyboard activated by an on-off switch device. Switch devices can be activated in many ways (for example by foot, finger or mouth) and activation of the switch device acts like a single mouse click. Although design and operation of on-screen keyboards differ many work on a row column scanning metaphor. Each row is highlighted in sequence and when the highlight reaches the row with the desired letter the user activates the switch device and highlighting then commences letter by letter in that row. In these situations word prediction, where a list of words is produced after initial letter(s) are input, is an important strategy to increase text production and reduce fatigue. Consumer feedback will therefore also be sought for the design of a word prediction facility within the email program.

III. METHODOLOGY

Participants

Participants in the study consisted of Internet users, potential Internet users, and representatives from responding Australian government funded disability groups and agencies in the states of Victoria, New South Wales, and South Australia. These organisations included advocacy services,

competitive employment, training and placement agencies, and supported employment agencies.

Executive officers of organisations were asked to bring the project to the attention of individuals in their agency and to direct interested people to participate in a focus group or fill in the on-line survey hosted on the project web site [27]. Additionally, where an agency was a provider of computer Internet access and served a variety of disability groups then that agency was invited to be a possible host of a focus group. Letters of invitation were mailed to 644 agencies, six to seven weeks prior to focus group meetings. Ten agencies responded as possible candidates for focus group participation. One agency for each of the three participating states was randomly selected from these ten agencies. The other agencies were invited to participate in the on-line questionnaire. This option was also available to internet users visiting the project web site.

Questionnaire and Focus Groups

Both quantitative and qualitative methods of data collection were used in the project. Qualitative methods included open ended survey questions and focus groups which were used to identify and explore broad issues around on-line accessibility. Focus groups are also well-suited to research geared to the development of technology because they promote discussion and foster a problem-solving approach in which difficulties are raised and may be resolved in the context of information shared by participants [28].

The survey questionnaire was developed in six sections and was available on-line on our web site [27]. Participants were asked about themselves, their use of the computer and the Internet, and their needs in relation to email and word prediction software. Individuals were also asked to comment on their current use of email (if any), difficulties experienced, suggestions to overcome difficulties, and potential use of email and to make any further suggestions for the development of an email package.

The questionnaire also included closed option questions on nominal and ordinal/Likert scales which were used as a means of obtaining background information about participants, their use of the Internet, and the importance of a number of email and word prediction/completion features. Focus group participants discussed open ended questions while on-line participants individually completed their questionnaires.

Data Analysis

Quantitative data was analysed descriptively. Qualitative data was analysed using standard inductive techniques and thematic analysis. Specific comments made by individuals were also included in the analysis as these highlighted the individual differences and needs of consumers with disabilities.

IV. RESULTS AND DISCUSSION

Focus group participants included consumers with disabilities, carers or assistants, sign language interpreters, agency representatives, and project team members. The twelve active focus group participants were computer users or potential computer users and the majority were users with a disability. Participants ranged in age from 18 to 51 years with the majority under 40 years of age. Experience in using the Internet ranged from none to very experienced. Consumers reported that their disabilities included learning difficulties, profound deafness, cerebral palsy and/or cognitive impairment. Agency representatives reported on behalf of clients with cerebral palsy, spina bifida, spinal/brain injury, or degenerative neurological condition such as Motor Neuron Disease. In addition to the focus group sample, ten individuals (all agency representatives responding on behalf of clients) responded to the on-line questionnaire.

The response rate to the invitation to participate was poor; only 10 groups out of 644 responded as possible focus group candidates and 10 individuals completed the on-line survey. Executive officers of agencies were relied upon to share the letter of invitation with relevant staff and individuals with disabilities. Lack of participation could have been related to a breakdown within agency communication, lack of agency consumers who had access to the Internet, lack of Internet skills among staff, or a perception on the part of agencies that their consumers lacked the cognitive or literacy skills required to use the Internet. Even where agencies were able to help a consumer to fill in the survey there may have been problems in interesting staff or unskilled computer users to become involved.

During focus group participation, some participants with little or no speech had difficulties in producing lengthy responses. Communication via alphabet boards was necessarily slow and tiring and this limited the exchange of information for some. This impacted on the richness of data which could be given within the restricted time frame of a focus group meeting.

Nevertheless, information shared by focus group and on-line participants yielded important insights into the inhibitors of on-line communication as well as important recommendations for the development of an email package including word prediction. From analysis of the data the following themes emerged:

Lack of basic information

Most participants who had not used the Internet were not aware of its potential benefits including the possibilities offered by email.

The importance of basic awareness raising is reflected in the awareness dimension of access as described by the European Commission [13]. The usefulness of basic awareness raising was demonstrated in a small study by Sinks and King [29] where almost all participants reported an

interest in learning more after a short oral and video presentation explaining the Internet.

Lack of contacts

Lack of initial contacts was another concern, as expressed by one participant, "If somebody's very computer literate, then you're likely to have a bit of a network to use the email with. People that aren't (computer literate) have got nowhere to go with their email until they've actually set up some communication channel." Participants suggested the inclusion of some email addresses to relevant list servers, email newsletters and pen pals be incorporated into the proposed email package. People were interested in information about disability and "the fun stuff" such as jokes and social opportunities offered by pen pals.

Literacy Problems

Many participants highlighted literacy problems as a major obstacle to the use of email. Having the software read out the email was considered important in helping with reading difficulties. Word prediction and spell checking were considered important for helping people with some word and phonics recognition. Another suggestion was to include a thesaurus.

Participants also suggested that some basic pro-forma email messages be provided in the software. These messages could range from basic greetings to more complex documents like job applications. Users could then select an appropriate ready made email message and make changes if necessary.

Participants also wanted to be able to save drafts of email messages because some people could not finish an email message in one sitting. Some wanted to save completed email messages as drafts so they could reuse them for subsequent email. It was considered very important that draft messages were easy to save and retrieve.

A need for simplicity

New users wanted a very simple email package with only the most basic operations such as reading, writing and sending.

Potential email users with cognitive impairments also require operations to be completed with as few steps as possible. The complexity of standard email package screen design and the number of steps required was reported as major obstacle for these users.

Simple program instructions with as much information in pictures and graphic symbols as possible was also considered very important.

Support of the support person

Many people with disabilities rely on carers to introduce them to information technology and the Internet. This is problematic when carers themselves do not have the skills.

This problem is exacerbated by frequent staff turnover within some disability agencies.

As one participant commented: "Part of our problem is supporting the support person because amazingly a lot of people don't necessarily have experience in using the Internet and email. If the support person isn't trained up then they can't actually support the consumer. That's one of our difficulties especially when staff turn over is huge here, absolutely huge. You might have someone who is working in one of our community access services who is right into computers and they get everyone set up, they leave, and no one knows how to switch the computer on."

As a partial solution to this problem participants suggested including a 'getting started' section that provides simple, basic instructions and that could be used to train users and their support people. There was much discussion on the importance of this feature being immediately noticeable.

Other difficulties with on-line systems

Experienced users reported difficulties surfing the Internet that were not addressed by browser software or assistive technologies. Problems arose because of the small size of icons and menus. People had difficulty seeing icons and difficulties clicking on icons and menu bars if they had poor mouse skills.

Other problems included: difficulty scrolling because of the small size of scroll bars; the speed and accuracy needed when using a mouse; and text that was too small and could not be enlarged. The Internet was described as slow and "not user friendly" with comments covering the difficulty in finding information and poor or inaccessible web site design.

It is interesting to note that all experienced computer users in the study were using Window 95 or greater and some of the problems mentioned could be rectified by applying settings within the operating system. For example, the speed of the mouse can be adjusted through the mouse settings in the Control Panel and the size of the scroll bars and menus (but not icons) can be increased by selecting the high contrast option under Accessibility Options in the Control Panel.

This points to the importance of awareness of the available accessibility options; more could be done in bringing these features to the attention of consumers.

In the future, systems may adapt automatically to the requirements of individual users but until that time more effort needs to be done to educate consumers to the available options and to design products in such a way that these features are more obvious.

Comments about email

Of the participants who used email the main purpose was for employment, followed closely by social and then educational use.

Participants were also asked to comment on the most important features they required in an email application. This was not as useful as hoped because responses related to the

level of experience of users. Generally, the more experienced the user the more features they felt were important. However, this does highlight the conflicting needs of consumers; what is helpful to some is a hindrance to others. This was also evident in the comments about word prediction.

Comments about word prediction

Some users felt word prediction would be very useful in helping them to communicate and to increase their functional literacy while other users felt that word prediction would be confusing or irritating.

Focus group participants agreed that the ability to turn off the feature was important. Participants also agreed that the word prediction should start with a base dictionary but allow users to add their own words, although they did not want to save incorrectly spelled words.

Abbreviation expansion was also considered important for some. Individuals wanted to be able to assign their own abbreviations to phrases and after typing the abbreviation have the full text appear in the message.

Participants felt that the most frequently used words should appear in the list, and that such frequencies should adapt over time to the individual's own writing style. However, participants had different needs in relation to how the words were presented in the word list. Some felt that the words should appear in order of relative frequency and some wanted words to appear in alphabetical order.

Participants did agree that while words should always be selected from the dictionary based on frequency of use, consumers should have a choice of how words are presented in the list and of how many words appear in the list.

V. CONCLUSIONS AND FURTHER RESEARCH

People with disabilities have rights to full participation in the on-line community. If the key to understanding the problem of accessibility is to understand the needs of users [18:20] then this initial investigation of the on-line communication requirements of users with disabilities has yielded useful findings. These findings have been used to inform the development of a prototype email application with word prediction. Evaluation and refinements to the design will be made in full consultation with users with a disability.

The prototype is customisable and includes a simple interface, simple email procedures, pro-forma messages and clear and simple explanations. These features aim to address the problem of literacy difficulties experienced by many users with disabilities which become a greater barrier when on-line programs are complex.

A customisable word prediction facility has also been included. This is aimed at reducing literacy barriers and facilitating faster composition of messages for users who rely

on indirect access means, such as switch devices, for typing messages.

All participants in our study had some basic literacy but the requirements of people without basic literacy need to be investigated.

As some individuals with disabilities have difficulty making initial links with other on-line users the email prototype incorporates the email addresses of list services and email newspapers to give these individuals access to other users and facilitate new and rewarding social interactions.

Consumer feedback from the focus groups clearly pointed to the idiosyncratic nature of the abilities of users. Therefore, it was clear that any software design needs to allow considerable flexibility for customising the user interface. However, such customisation is not without difficulties, as working out the best settings for a particular person can be time consuming and again requires awareness of what options are available.

A significant barrier that potential users face is lack of awareness of the opportunities that on-line communication can offer. Further research needs to be undertaken to determine the best method of addressing this problem for users with a disability.

Participants in this study mentioned they wanted to access disability specific information and the 'fun stuff' but the online information requirements of users with disabilities is largely unexplored [30].

One of the most urgent challenges facing the Information Systems profession is lack of awareness of the issues surrounding accessibility. Ideally this needs to be tackled at an undergraduate level when students are learning how to develop web sites and software. Tools that automatically support the development of accessible web content and application software are also needed.

More research is also needed into the information technology service requirements of users with disabilities and indeed the best ways of eliciting these requirements.

Most information systems and services are created without the input (or even consideration) of users with disabilities. By considering, at the design stage, the requirements of users with disabilities there is the real potential to create products and services that are not only more useable by more people with disabilities, but are also more useable for everyone.

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