Recommendations Based on Empirical Data: Computer Information and Adaptive Technologies in Postsecondary Education

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Executive Summary of the Research Which Forms the Basis for the Recommendations

Computer and information technologies have the potential both to enhance the lives of people with disabilities as well as to deny them equality of access to education, jobs, and community life. In particular, these new technologies have the potential to enable or to create difficulties for students with disabilities in the new Canadian knowledge based economy. Concerns about these technologies and their accessibility for people with disabilities are evolving issues for the next decade.

Objectives

The goal of our research was to provide empirically based information to assist in decision making that ensures that new policies, software and hardware reflect the needs and concerns of a variety of individuals: postsecondary students with disabilities, their professors, and college and university personnel who make technological, adaptive, and other supports available to the higher education community.

Specific goals for the present investigation were to evaluate the use and utility of computer and information technologies in the postsecondary education of students with disabilities. Equally important was to make available empirical data to better advise: students, college and university personnel responsible for providing services to students with disabilities, planners, policy makers from both government and academic milieux, as well as developers and suppliers of mainstream and adaptive technologies. Specific objectives were:

- Explore what aspects of computer, information and adaptive technologies students with various disabilities find particularly useful
- Look at what educational and social goals are met by computer technologies.
- Explore the question of whether there are students who could benefit from computer technologies but fail to use them and, if so, why
- Identify how systemic variables, such as the availability of government subsidy programs and training, interact with individual differences, such as sex and specific disability, to help or hinder students in using computer technologies
- Evaluate existing trends in adapting software and hardware to the needs of people with disabilities in the postsecondary education community

Methodology

Between the fall of 1997 and the spring of 1999 we conducted a series of three investigations where the focus was on evaluating the computer, information, learning and adaptive technology needs and concerns of postsecondary students with disabilities.

To obtain an overview of issues and concerns, in Phase I (fall 1997) we conducted a series of four bilingual focus groups in the Montreal area. This involved 31 individuals. Groups were held for (1) postsecondary students with various disabilities, (2) college and university personnel responsible for providing services to students with disabilities, (3) professors from both arts and science disciplines, and (4) academics, computer specialists and other concerned individuals. From these meetings we obtained broad notions about some of the key issues of relevance to the effective use of computer, information and adaptive technologies by postsecondary students with disabilities.

In Phase II (spring 1998) we went across the country and conducted two sets of structured telephone interviews with 37 college and university students with disabilities (representing all provinces and territories) and with 30 college and university personnel responsible for providing services to students with disabilities nationwide. Again, the main focus was on the computer, information and adaptive technology needs and concerns of students with disabilities. Interviews were conducted in both English and French. These interviews gave us much more detailed information concerning issues such as: what computer, information and adaptive technologies students with different disabilities have, use, and want; how students get funding for computer technologies; and what kinds of access to technology different types of institutions provide to students with various disabilities.

In Phase III (spring '99) questionnaires were mailed to the membership of our two student group partners, the National Educational Association Of Disabled Students (NEADS), and the Association Québécoise des étudiants(es) handicapés(es) au post secondaire (AQEHPS). With the cooperation of more than 200 college and university personnel responsible for providing services to students with disabilities, copies of our questionnaire were made available to students at campuses across Canada. Questionnaires were made available in both English and French in a number of alternate formats: regular and large print, on tape, in Braille, and on diskette (both IBM and Macintosh). 725 current and recent (within the past 2 years) postsecondary students with disabilities returned completed questionnaires.

Findings and Conclusions

Information provided shows that Canadian colleges had a significantly and substantially larger proportion of students with disabilities than did universities, suggesting that technologies for students with disabilities need to be included in the overall computer and information technology planning not only at universities, but also at colleges. The latter are sometimes overlooked. Our data suggest that the vast majority of college and university students, regardless of sex, age, program of study, or type of disability, can and do use computer technologies to help them succeed. The number and nature of the advantages that computer technologies had for participants show how critical computers are to the success of students with disabilities. It is also interesting to note that personnel responsible for providing services to students with disabilities indicated that they saw the use of computers not only as beneficial for the students but also as cost effective for the institution.

About 1/2 of the students in our samples had two or more impairments/disabilities, suggesting the need for adapted work stations which can accommodate the needs of students with various disabilities. In this regard, there was a pronounced trend for students to "cross-use" technologies, i.e., for students with one kind of disability to use technologies intended for students with a different type of disability. For example, software that reads what is on the screen is used not only by students with visual impairments but also by students who have a learning disability. Use of large screen monitors and voice recognition (dictation) software provide additional instances of this trend. Multiple uses of adaptive technologies seems to be an important development, and the increasing number of accessibility features built into widely available mainstream products are of considerable interest to students with disabilities. Nevertheless, recent developments in sophisticated adaptive technologies have underscored the increasing importance of ensuring that different types of adaptive equipment be able to work together. In particular, the video card requirements of magnification software and the heavy hardware and training demands of voice recognition programs should be taken into consideration.

Perhaps the single most outstanding finding of our studies relates to students' concerns over the cost of computer, information and adaptive technologies. Regardless of what question was asked or how it was formulated, the high cost of acquiring and maintaining computer technologies was the single most important and common issue noted by computer users and non-users alike. The majority of students who had computer equipment at home indicated that they or their families had paid for these. When asked why they did not take advantage of a government program to help them obtain a computer or adaptive technologies, the single most popular answer was that students simply did not know about the existence of such programs. The solution to the problem is obvious: organizations/agencies that provide money, loans or computer technologies to students with disabilities need to do more effective "outreach." More broadly based information dissemination to better inform students (in alternate formats), financial aid offices, postsecondary personnel responsible for providing services to students with disabilities, and rehabilitation professionals about available opportunities is clearly needed.

The nature and implications of our findings are evident. Students with disabilities can and do use computer and information technologies to help them succeed in postsecondary education. Computers are best seen as enabling technologies - "electronic curb-cuts" - that allow students with disabilities to prepare for and to participate in the knowledge based economy of tomorrow. To plan for the future rather than catch up with the past we recommend that the broadest based consultations take place at colleges, universities and organizations and agencies which provide equipment and training for students with disabilities. Such consultations must involve students, who, of course, are ultimately the end-users. Personnel responsible for providing services to students with disabilities, professors, academic computer staff, adaptive technology and computer specialists, librarians, audio-visual specialists, rehabilitation professionals, college and university administrators, and representatives of various government agencies, among others, are key players in this equation. Creative partnerships and alliances are urgently needed.

Planning and decisions for campus-wide information technology purchases and systems development and implementation in postsecondary educational institutions are actively going on as this report is being prepared. In much of the planning, the needs of students with disabilities are simply overlooked - not taken into consideration - until it is discovered, much too late, that the expensive new campus-wide technology is inaccessible. Designing for accessibility always results in better, less expensive, and more timely solutions than retrofits. Data to guide decision making and specific recommendations concerning what could be done to ensure full access to postsecondary education for all of the students enrolled in Canadian colleges and universities are included in this report.

Recommendations

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What follows is a detailed set of recommendations to four groups of individuals: college and university personnel responsible for providing services to students with disabilities; professors; developers and distributors of mainstream and adaptive software and hardware; and organizations, ministries, and policy

making bodies who help students with disabilities obtain computer, information and adaptive technologies.

Recommendations For College And University Personnel Responsible For Providing Services To Students With Disabilities

Make technology for students with disabilities available on your campus

Some Canadian postsecondary institutions, especially smaller colleges and campuses, have little or no computer equipment or support for their students with disabilities. As the findings clearly illustrate, computer technology is fast becoming a necessity that is levelling the playing field for students with disabilities. Campuses currently not offering computer supports for their students with disabilities need to carefully examine this situation. We hope that personnel responsible for providing services to students with disabilities will make it a priority to become better informed about what software and hardware are currently available and what some of the related issues are.

Armed with this knowledge, the job begins! Senior management at colleges and universities as well as government sources will need to be lobbied for funding to provide at least a minimal level of computer support for students with disabilities on campus (e.g., at least one computer with various adaptations as a start). Remind everyone that accessibility also includes accessibility of computer, information and adaptive technologies.

Provide off-hours access to computer technologies

Most students have academic work schedules that differ from those of the traditional "nine to five" working day (e.g., writing and doing research during the evenings and weekends). Some students also have transportation and health concerns (e.g., fluctuating levels of energy during the day). These make it critical that students with disabilities be given as much, if not more, access at school to computer technologies as their nondisabled counterparts receive.

At many postsecondary institutions, mainstream computer labs and libraries have extended evening and weekend hours to meet the needs of their students. In recognition of this reality, and keeping in mind that many students with disabilities have no equipment of their own to use off campus, personnel responsible for providing services to students with disabilities need to develop creative solutions to allow students to use equipment where it is currently housed (e.g., have students turn in their ID cards at security, have them "sign in," install a key card system). An alternative is to move computer equipment out of restrictive "nine to five" locations into less limiting ones, such as mainstream computer labs or libraries. In cases where this is not possible the institution may wish to develop a program to loan equipment to students. For example, many students commented that they would benefit from being able to use laptops to work on assignments between classes or to take their own notes in class. Some participants in our research noted that such technological solutions could not only benefit students but could also be cost-effective.

Let students with disabilities know what is available to them on campus

If equipment is to be used, students with disabilities need to be made aware of its existence. At the start of every semester, new and old students alike should be acquainted with the types of technological supports available to them, where these can be found, and when they can be used. It is important to remember that many students with disabilities have little contact with the office which provides services to students with disabilities. Therefore, "open house" or other campus wide publicity, in adapted formats, may be useful. Print announcements in college bulletins reach only a subset of students with disabilities.

There is sometimes an assumption that only certain students with disabilities will benefit from specific pieces of hardware or software. However as we have learned in our research, students with disabilities

do, in fact, "cross-use" technology. For example, students who are blind and those with specific learning disabilities both reported using screen readers. Rather than assume or prescribe computer supports for students, students must be allowed to try all manner of available computer supports to decide for themselves what might work best for them. Indeed, allowing students to become familiar with the types of equipment available and to try out new types of technologies may result in creative solutions to students' computing problems.

Educate professors about effective use of computers

Professors generally don't know what kinds of things to do to ensure that students have full access to their electronic course materials [e.g., that Adobe Acrobat PDF files can have problems with accessibility for students with print impairments, that PowerPoint is problematic for some students with visual impairments, that text (.txt) versions that work in Windows don't necessarily work in a DOS environment, that students with hearing impairments will probably miss audio clips on web pages and CD-ROMs, that some students have problems in computer labs when using a mouse, etc.). They simply do not think of these issues when they are developing their courses. To help with this problem, we suggest that personnel providing services to students with disabilities consider holding a workshop or open house for professors concerning making electronic course materials accessible and useful for all of their students - inviting sophisticated computer user students with different disabilities is likely to help drive the important points home. Inserting a module on issues related to students with disabilities into regular computer courses geared toward faculty is also likely to be helpful.

Make training a priority both for students and college personnel

Lack of knowledge about how to use specialized computer technologies on the part of both students and staff who oversee the technology is an important concern. If it is to be used effectively, systematic training must be seen as part of the overall investment in the equipment itself.

Many students are intimidated by computer technologies. Others are not given the appropriate support to use it to its optimum. Rectifying this situation starts with having knowledgeable staff at the school who know how to use the equipment. Where offices responsible for providing services to students with disabilities have adaptive technology "specialists" or technicians responsible for overseeing the equipment, time and opportunities must be provided to allow them to learn to use the technologies. Periodic "in-service" workshops, demos by students or colleagues from other colleges and universities, professionals, or representatives of adaptive technology organizations and companies can provide a change of pace as well as information. Whether it is providing educational opportunities or allotting time to allow staff to learn on their own, this activity must take place.

Where adaptive technologies are located at various points and campuses, other staff (e.g., library staff, staff in computer labs) need to receive at least minimal training to enable them to assist students. Then, and only then, can students with disabilities themselves be adequately trained.

Many institutions offer students one day or half day workshops and hand-outs on the use of campus computer facilities. The same must hold true for students with disabilities. This doesn't have to be an expensive undertaking. Some students on campus have probably developed expertise in the use of specific hardware or software. Using a mentoring approach, these sophisticated students can be paired with other students who could benefit from their help. It makes sense that if there is equipment on campus, it is the responsibility of the institution to ensure that appropriate training takes place so that students can use the equipment. Putting a bunch of PCs in classrooms without offering students and faculty instruction in how to operate the equipment makes little sense for colleges and universities. The same goes for computer equipment for students with disabilities.

Include students with disabilities in all computer, information and adaptive technologies purchase decisions

To ensure that the computer technologies purchased will actually be used by students, it is vital that students with disabilities be included in the decision making process. This is particularly important since our findings indicate that needs and concerns of personnel responsible for providing services to students with disabilities are often different from those of the students. Because of the nature of their tasks, issues that are important to service providers frequently relate to institutional concerns, budgets, relations with other sections of the college or university, etc. Both student and service provider perspectives are valuable, and students can be involved in the decision making process whether the institution has a formal or an informal decision making structure for the acquisition of new technologies. What may seem "interesting" or "useful" may be "too complex" or "useless" to the students themselves. In many instances students have prior experience using computer equipment that personnel responsible for providing services to students with disabilities do not have. It is important to take advantage of this most important resource - the students themselves.

Value the opinions of students with disabilities

If equipment sits idle, there is obviously a reason. Rather than assume "lack of interest" or "lack of knowledge" on the part of students, proactive steps should be taken to evaluate the views and opinions of students on the state of equipment and support available to them on campus. Candid, non-defensive discussions can be beneficial. Anonymous yearly "formative" evaluations can also be useful in providing honest feedback. If students are dissatisfied with the equipment and support currently available to them, what better argument to take to senior administration to lobby them for better or more funding for specialized computer technology and related support?

Make purchase decisions that reflect the needs of all students with disabilities

Computer, information and adaptive technologies purchased should meet the needs of all students with disabilities. For example, an overwhelming majority of schools in our sample did not have much equipment for students who are Deaf or hard of hearing. Since these schools had high percentages of students with hearing impairments, it is obvious that more effort needs to be made to ensure that the needs of these students are met.

In this regard, it needs to be stressed that some adaptive technologies can be "cross-used" by students with different disabilities. Thus, "educated" purchase decisions can, in the long run, prove to be more cost effective. For example, screen readers, as we found, can be beneficial not only to students who are blind or have low vision but also to students with specific learning disabilities. Similarly, voice recognition software can be useful to a host of students with disabilities.

Become informed and share information on government programs offering technology-based assistance for students with disabilities

It is evident from our findings that the vast majority of students in colleges and universities are not aware of what programs exist to help them acquire computer technologies. Although students who are frequent visitors to the office for students with disabilities or to specialized computer labs may be very knowledgeable, they are not representative of all students with disabilities. Personnel responsible for providing services to students with disabilities need to seek out information about funding sources and make this available not only to the students they serve, but also to individuals who work in other sectors of the institution which come into contact with students with disabilities: for example, financial aid offices, learning centers, counselling, and health services. Additionally, personnel responsible for providing services to students with disabilities should offer assistance and guidance to students in navigating through the maze of application requirements that often accompany such programs. After all, the more equipment students have for personal use, the lower the demand on institutional resources!

Make internet access for students with disabilities a priority

Our research indicates that postsecondary institutions provide internet access to their students. However, only half of the institutions indicated that they have adapted computers (e.g., computers with screen readers) that are capable of going online. The wealth of information available to students, the fact that course material and other school related information are increasingly being put on the web, and the usefulness of e-mail are three strong reasons why providing adapted internet access is critical.

Take advantage of the experience of others

Whether you are purchasing adaptive technology for students with disabilities for the first time or not, talking to your colleagues in the field, consulting other resources, and involving knowledgeable organizations as well as individuals with expertise on campus will make the process less daunting than expected. Lessons learned at schools that are of similar size as yours, knowledge about specific government programs to tap for funds, strategies for dealing with administration, and shopping around for equipment doesn't have to be done in isolation. Other options for acquiring a "starter" adaptive computer involve entering into an equipment sharing agreement with a nearby institution, for example, or learning about institutions that are looking to donate older, but still functioning equipment.

Participants in our research indicated that the active involvement of other sectors in the institutions was a tremendous benefit in helping to provide better access to computer, information and adaptive technologies (e.g., making purchase decisions after formal broad-based consultation with intersectorial committees including students, academic computer departments, computing support services, audio-visual, the library, learning center, physical plant representatives, faculty, student affairs, and adaptive technologists).

Get involved in planning bodies responsible for institution-wide information technology purchases and systems development

Two trends are evident in postsecondary institutions. Colleges and universities are adopting policies to ensure that their campuses are networked for the new millennium. They are also experimenting with new methods of delivering education (e.g., adding computer lab components to courses, placing course materials on the web). Both of these trends have consequences that affect the types of accommodations students with disabilities will require in the near future.

Involvement with other areas of the school can have benefits both for the present as well as for the future. Personnel responsible for providing services to students with disabilities must actively make themselves aware of the institutional "agenda" concerning campus-wide information technology purchases and systems development. They must lobby, strongly, on behalf of and in partnership with students with disabilities to ensure that accessibility of new computer and information technologies is made a priority. For example, to ensure inclusion of all students in classroom activities, adaptive equipment will have to be available in mainstream computer labs and site licenses and server versions of adaptive software will need to acquired in many instances.

Possible suggestions are: push strongly to ensure that all campus internet servers and web pages meet the minimum requirements for universal accessibility [eg: the W3C site (Chisholm et al., 1999); Cast’s (Cooper, 1999) Bobby Accessibility Checker]; make sure that a text-based browser is available; ensure that knowledgeable students and representatives of the office for students with disabilities sit on committees that review and implement campus-wide computing decisions to ensure that accessibility is always on the agenda; work with professors and academic computing staff to educate them on access issues related to internet and computer components of their courses (see recommendations for faculty for more details); influence decision makers to ensure that electronic versions of textbooks, "course-packs," and other instructional materials are made available in conjunction with print versions of the same information. These issues must be planned for and dealt with from the beginning, and not on an "ad hoc" basis, when it may be too late to do something for the student. The key point here is to work alongside, rather than separately from the campus community as a whole in addressing computer accessibility.

Recommendations For Faculty At Colleges And Universities

When planning courses which include some of the exciting new computer and information technologies, professors are generally concerned with the content of their course material as well as with the intricacies of how to best present these electronically. Class sizes vary widely, and can range from 10 to 500 students. Paradigms for how best to incorporate computer technologies into courses in specific disciplines are not yet evolved, and much energy goes into the design of electronic courseware. Regrettably, accessibility concerns of students with disabilities are simply overlooked in the planning. Even if professors were to think about accessibility issues, they are unlikely to have either appropriate information or resources at their disposal.

What follows is a list of suggestions for professors. These are by no means inclusive or highly technical. Instead, we have attempted to provide the minimal technical information that can allow professors to be "electronically welcoming" to their students with disabilities. Two helpful references, written in relatively jargon free language are by Chisholm et al., 1999 and Cooper (1999). These resources can point the way to more comprehensive information.

Ensure accessibility of your courses to all students

Most professors, when thinking of students with disabilities, think of students who use a wheelchair. Although students who use wheelchairs are present at many campuses, they are by no means the only students with disabilities who face access concerns related to computer technologies. Students with different impairments have different access issues, and even if two students have the same disability, their preferred solutions may be very different. The best thing for professors to do is to learn from their students. The professor is knowledgeable about his or her discipline and subject material. It is the student, however, who is knowledgeable about what adaptations work best for him or her. So, the first step towards making your course accessible is, "Ask the student what would be helpful."

Most professors have not considered which features of software and hardware make these inaccessible and they have little idea about how access problems could be circumvented or solved. For example, professors often don't know what to do to ensure that students have full access to their electronic course materials [e.g., that Adobe Acrobat PDF files can have problems with accessibility for students with print impairments, that PowerPoint is problematic for some students with visual impairments, that tables cause problems for software used by many students who are blind, that text (.txt) versions that work in Windows don't necessarily work in a DOS environment, that students with hearing impairments will probably miss audio clips and have problems with audio on web pages and CD-ROMs, that some students have problems in computer labs when they need to use a mouse, etc.).

Personnel responsible for providing services to students with disabilities can often advise professors about what kinds of problems exist and what kinds of solutions are available. Also, as noted earlier, students themselves often know a great deal about what kinds of technologies are helpful. For those professors who are interested in "readable," minimally technical presentations, the two resources noted earlier ("W3C Checkpoints" by Chisholm et al., 1999; and "Universal design of a web site" by Cooper, 1999) are likely to be of interest.

Put course information on the web well before the beginning of term

Putting one's course outline on the web is helpful for all students. Many students with print disabilities have to order their text books on audiotape. If the books do not exist on tape, then students must wait for someone to read the text onto tape. Since this is a time consuming process, knowing which books to order well before classes begin is likely to benefit those students who must access course materials using alternate media.

Until putting course outlines up on web pages is standardized at the institution, it would be helpful if professors were to inform the office providing services to students with disabilities when their course outline was available on the web (as well as the URL) so that students could be advised to check this information. Similarly, putting assignments, handouts, lecture notes, and practice tests, etc. on the web is likely to be useful for students who need to access print materials in alternate modalities. Needless to say, doing this is likely to benefit not only students with disabilities but all of the professor's students.

Make course-related web sites universally accessible

When designing web sites, the simpler the better. Pictures and images are problematic for students with visual impairments. These are also problematic for students with slow modems as well as for busy institutional servers. So, in general, the fewer images, the better.

Make web pages and course materials accessible to students who are blind

Of course, pictures and images of all types are totally inaccessible to students who are blind. Therefore, web pages should work well without the images. You can see what this would be like by turning off the images on your browser.

Most students who are blind use screen reading technologies to access information on the computer. Text is simply read out loud. But other web page elements, such as graphs, pictures, GIFs, animated images, etc. pose problems because the voice technology cannot recognize them. It simply does not know what to say.

Frames, too, pose problems for students who are blind, as do tables. A "no tables" version is best for students who are blind, and bulleted lists are preferred to tables. Even if information in tables is text-based, many voice technologies read words horizontally across the page. This makes tables difficult to access. If you must use tables, be sure to include a header row. In addition, detailed descriptions of graphs should be included.

In general, try to avoid Java, include "alt" tags for GIFs and small images (these are like the little yellow "tool tips" descriptions that you see when you leave your cursor on icons in Windows toolbars), use the new picture description option for complex images and pictures, and try to stay clear of Adobe Acrobat and PowerPoint presentations, which are difficult for some students to access.

Needless to say, projecting lecture notes from a web page or PowerPoint slide using an LCD projector in class does not work for these students.

Make web pages and course materials accessible to students who have low vision

Students with low vision sometimes also use voice technology. In addition, many use screen magnification. Modern mainstream programs allow for changes in font type, font size and background color, enabling students to enlarge letters and to change the contrast. Most CD-ROMs and some popular software do not do this. In particular, popular formats used on web pages, such as Adobe Acrobat (.pdf) and PowerPoint (.ppt) can cause problems.

There are a variety of free or inexpensive document reading voice technologies that allow students with some usable vision to read text and the contents of the clipboard using free and inexpensive technologies. Several of these work in either French or English [a listing for World Wide Web addresses of these as well as additional information is available in a document entitled "Mainstream, Free, and Inexpensive Computer, Information And Adaptive Technologies" Fichten et al. (1999)]. What makes these technologies interesting for professors is that they provide "quick and dirty" solutions to frequent problems such as having to make a last minute handout for a student who needs an audiotape to take away.

Similarly, when a professor wants a student in his/her office to read something that is available on disk, once more the document reading voice technology can be accessed. Unless the material is scientific or highly technical in nature, these free or inexpensive technologies can read the material to the students without the assistance of a reader. Similarly, free and inexpensive magnification software can allow students to see what is on the computer screen.

Projecting lecture notes from a web page or PowerPoint slides using an LCD projector in class does not work well for many of these students either. Students who have a laptop available in class may be able to follow the lecture under certain circumstances. Discussions with the institution's computer support technicians is likely to be helpful.

Make web pages and course materials accessible to students who have hearing impairments

As noted elsewhere in this report there are relatively few computer technologies available to assist students with hearing impairments. These students have difficulty with streaming audio, audio clips, music, and the audio portion of video clips. Closed captioning (subtitles which have to be turned "on" by the user), long available on some televisions shows, have only recently been introduced into the electronic world. Regrettably, it does not yet work well.

A technological solution that works well for these students is e-mail and internet chat programs, including groupware which has "whiteboard" capability. Take note that while the student is looking at your LCD presentation, he or she cannot read you lips or look at the face and hands of an interpreter. Similarly, while working in a computer lab, the student may have difficulty looking at the screen as well as hearing your explanation about what to do.

Make web pages and course materials accessible to students with learning disabilities

These students can and do profit from all kinds of electronic and web access. Professors can help these students gain better access to their courses by ensuring that information is presented multi-modally (e.g., both picture and text). In addition, adaptations that are useful for students with low vision and with hearing impairments can also be useful for students with learning disabilities (e.g., document reader, graphics and illustrations).

Make textbooks, course materials, assignments, handouts, and exams available in alternate formats

Many students profit from electronic texts. Electronic text books, "course-packs" and electronic versions of all course materials are likely to be useful for all students. When making a disk version, most word processors can access ASCII text. When producing print materials for students with visual impairments, ARIAL 18 is the minimum font size for large print. Note that simply making an enlargement with a photocopier is not as helpful as using a larger font.

Other useful hints

Encourage students to use "virtual office hours" using e-mail. Allow students to audiotape lectures and allow them to take notes on a computer in class. Allow students to submit assignments and exams in alternate formats such as e-mail, disk, fax, and audiotape.

In conclusion

Computer technologies can enable or cause problems for students with disabilities. Little effort is required to make materials accessible to ALL students. Moreover, non disabled students are likely to benefit from the recommended modifications as well.

Recommendations For Manufacturers/Distributors Of Mainstream And Adaptive Technologies

Strive for universal access

Over the years, those working to promote access for people with disabilities have learnt two important lessons. First is the cost-effectiveness of incorporating universal accessibility features at the outset of a project. For instance, implementing accessibility features in the initial layout of a building results in fewer design, construction and, legal expenses (Falta, 1992). Not only is this cost-effective, but universal accessibility features created primarily for people with disabilities tend to benefit all people. A prime example of this is the "curb-cut" which was initially built for people who use wheelchairs and which has proven beneficial for cyclists, people on roller blades, strollers etc. Second is the need to consult with progressive and sophisticated consumer groups. These individuals' diverse backgrounds make them uniquely qualified to think of creative solutions to environmental barriers created by lack of access.

Perhaps it is fitting that the concerns and lessons related to universal access be described by Microsoft (1999).

"In meeting the needs and preferences of people with varying degrees of physical abilities, accessible computers and software programs can make it possible for more people to use these technologies successfully in work, education, and recreation. The number of people impacted by inaccessible computer and software design is difficult to calculate precisely, but is estimated to be over 30 million in the United States alone. Other estimates indicate that as many as 15 to 20 percent of Americans have a disability. As computers become more and more a part of everyday activities, the concern for making them truly accessible grows more critical. Already a lot has been done. Accessibility options, features, and controls have been built into software and operating systems, and a large number of accessibility aids have been developed to help people with more severe disabilities. Still there's more to do to provide equal and reasonable access to the world of computers." (Microsoft 1999, Accessibility & Microsoft: What is Accessibility? Available June 6, 1999 on the World Wide Web: http://www.microsoft.com/enable/microsoft/overview.htm

Formalize company policies and make them known broadly

Some of the recommendations below are offered by several firms on a individual basis. What we are recommending here, however, are suggestions that need to be embraced as company policies, and advertised as such. They are based on our findings and are reflective of the "higher education and students with disabilities" market.

Provide student discounts

By far the most disturbing thing we learned during our research was the exorbitant cost of much of the adaptive hardware and software on the market. Perhaps institutions and agencies are in a better position to afford this technology, and the argument that prices "may" be decreasing always exists, but there has to be an understanding that the average student with a disability simply does not have the means to acquire this technology. We strongly urge manufacturers and distributors of adaptive technology to adopt the policies that mainstream companies often do with respect to student/educational discounts or rebates. Not only is this intuitively appealing, it makes good "business" sense. If a company wishes to tap into the market that is increasingly demanding its products, and will undoubtedly need them in the future, then it must target them and make its products attractive in price. There may also be a misperception on the part of adaptive manufacturers/suppliers that students only need access to the technology at school. As our research clearly shows, this is not the case.

Another misperception is that government programs provide all necessary technology for students. Our data show that this, too, is not the case. Currently, certain disabilities are not recognized by government programs. Therefore students with one of these disabilities who could benefit from certain technologies, simply do not have the equipment available to them. Also, subsidy programs often select one of several "competing" items. Students' needs may best be met by a product not on the "approved" list.

Students need to access computer technologies whenever and wherever it is easiest for them to do so. Providing discounts for students will go a long way in helping them purchase what they need. If a company's objective is to be committed to providing accessibility to consumers with disabilities, then postsecondary students with disabilities must not be forgotten as a market.

Provide educational grants and enter into partnerships with postsecondary institutions

Again, this concept is familiar to the mainstream computer industry. It is a matter of extending such priorities to the adaptive technology industry. Personnel responsible for providing services to students with disabilities often work under budgetary constraints. Adaptive computer technology manufacturers/suppliers are often unaware of these. Schools must frequently make do with older out-of-date equipment because of lack of funds to buy new hardware/software. Given the robust findings concerning the need for on campus computer supports for students with disabilities, manufacturers/suppliers need to play their part by providing educational grants to schools that wish to purchase equipment for their students. For many schools, needed equipment is well beyond the cost that can be justified to administration.

We suggest that adaptive suppliers/manufacturers enter into partnerships with schools and provide equipment at an "educationally friendly" cost, along with the necessary support in the form of comprehensive staff training and dedicated technical back-up. Personnel responsible for providing services to students with disabilities need to become more familiar with adaptive technologies if they are going to make these available to their students.

As colleges and universities move toward adopting policies to ensure that their campuses are networked for the new millennium, and as they experiment with new methods of delivering education (e.g., adding computer lab components to courses, using LCD projection in class, placing course materials on the web), expertise from adaptive technology suppliers/manufacturers on how their equipment can be interfaced with these new learning technologies is urgently needed. What's in it for the company? A generation of computer users who have mastered your products as well as a valuable testing site for new adaptive technologies.

Target advertising to the students

One of the major concerns noted in all phases of our research is that people did not know what products are available or where to purchase these. This clearly speaks to the lack of visibility manufacturers/suppliers of adaptive technology have in the higher education community. Therefore, we recommend that a more concerted effort be made to target advertising specifically to this market, i.e., not only to the professionals, but to the students who ultimately are the end-users. Suggestions include holding technical open houses at the start of fall and winter academic terms in cities with colleges and universities; contacting schools to arrange for on site visits to demonstrate new products to students and to staff; and appearances at conferences such as that of the National Educational Association of Disabled Students (NEADS) where the intended market is likely to be reached. What we are suggesting is that both visibility and integration into the higher education community is needed. Again, companies would gain valuable feedback concerning the unique characteristics and needs of this "particular market". One respondent suggested using students as beta testers. This would definitely be a good start!

Provide trial periods

If a student or institution is willing to invest in sophisticated technology, they should be given the opportunity to try out the product for a reasonable period (e.g., two weeks to one month) in their own "environment" prior to purchase. During a demonstration, equipment often works well. But once used in an actual school setting (e.g., scanning course hand-outs, trying out voice recognition software), the results may be disappointing. In this way, individuals can choose which product is best suited to their needs without having to make a sizeable and potentially disastrous investment. This is how ill feelings are avoided and product loyalties are forged.

Provide superior, timely, and free training as well as technical support

Our research shows the need for better training and technical support. What was especially dismaying was that some respondents indicated that not only was there an expense in buying the actual equipment but, in addition, individuals had to pay for training and technical support. Receiving "on site" assistance with installation would be a considerable improvement from having to follow what can oftentimes be confusing written or telephone instructions.

The job of students is to keep up-to-date with their academic pursuits, rather than to act as computer technicians. Training and technical support should not be viewed as a privilege. Rather it should be considered a part of the responsibility a company has to its client. As noted earlier, the higher education community has unique demands. One of these happens to be timeliness.

Make hardware and software more user friendly

The longer it takes to understand command structures, equipment installation procedures, etc., the less likely it is that the equipment will be used. The easier a product is to use, the higher the customer's satisfaction. In essence, postsecondary students with disabilities and the staff who oversee the equipment for these students are likely to stick with a company that provides equipment that is easy to use.

Make manuals/tutorials easier to understand, and make them available in a variety of alternate formats

Unintelligible manuals and tutorials used to plague the computer industry as a whole. In the field of adaptive technologies, the problem has, in many cases remained. Students with disabilities rarely have leisure time to sort through unintelligible instructions. What is needed is clearly written information that is easily indexed to allow users to find information. Training tutorials could follow well documented instructional models. For example, providing practice exercises to go along with the didactic material. Simply providing sequences of commands is insufficient. Moreover, it goes without saying that making material available in alternate formats to meet the needs of the customers is vital. For example, it is pointless to furnish manuals for a screen reader on diskette when the individual will need to know how to use the screen reader to access it. This is an area where companies can learn from the educational institutions themselves, which are, for the most part, committed to providing materials in suitable alternate formats. Companies who charge for providing materials in alternate formats should reconsider and revise this policy.

Continue to create possibilities for mainstream hardware to interface with adaptive software

We applaud current efforts to integrate mainstream and adaptive products. For example, new screen reading software that is compatible with existing sound cards decreased costs substantially. This trend needs to continue!

Technology created for people with specific needs may be useful to the majority of people. One should consider however, that equipment will not be purchased if it is not affordable. What is the point of

manufacturing specific technology if it is too expensive to be used by those for whom it is designed? Less expensive solutions will be purchased by more customers.

Recommendations For Organizations, Ministries, And Policy Making Bodies Who Help Students With Disabilities Obtain Computer, Information And Adaptive Technologies

Perhaps the single most outstanding finding of our studies relates to students' concerns over the cost of computer, information and adaptive technologies. Regardless of what question was asked or how it was formulated, the high cost of acquiring and maintaining computer technologies was the single most important and common issue noted by computer users and non-users alike. The majority of students who had computer equipment at home indicated that they or their families had paid for these. When asked why they did not take advantage of a government program to help them obtain a computer or adaptive technologies, the single most popular answer was that students simply did not know about the existence of such programs. The solution to the problem is obvious: organizations/agencies that provide money, loans or computer technologies to students with disabilities need to do more effective "outreach." More broadly based information dissemination to better inform students (in alternate formats), financial aid offices, postsecondary personnel responsible for providing services to students with disabilities, and rehabilitation professionals about available opportunities is clearly needed.

Make the postsecondary education community more aware of the programs available to them

Clarify and make transparent the rules and criteria for eligibility

Simplify the application process and make application information and forms available in alternate formats

Our research clearly shows that both students with disabilities as well as personnel responsible for services to students with disabilities are poorly informed about government programs which help students acquire computer, information and adaptive technologies. Specific rules and eligibility criteria for programs are also not well known even by individuals who are aware of the existence of specific programs.

To rectify the situation, we recommend that agencies make the effort to inform the postsecondary education community about the full range of programs, the rules and regulations, and the eligibility criteria. Provide all information that could be helpful to potential applicants and to the personnel at colleges and universities who advise students with disabilities concerning financial matters.

Information packages should be sent to national and provincial organizations for students with disabilities as well as to college and university personnel responsible for services to students with disabilities for broad based dissemination to students and to other concerned professionals (e.g., financial aid officers). Material should be made available, of course, in alternate formats (i.e., Braille, tape, diskette, regular and large print). Information should also be posted on web sites, and the location widely publicised.

Site visits by program officials to meet with students and with personnel responsible for services to students with disabilities would also be useful. An orientation to government assistance programs which relate to computer technologies at conferences for the postsecondary education community would also be helpful.

Standardise federal funding programs for computer technologies across the country

At present, for the same federal programs, there are large discrepancies in funding levels and criteria between provinces. Thus, the nature of a student's disability and the part of the country in which he/she resides can have an important impact on access to funding for technology. We recommend a review of current practices with a view to ensuring equal access to federal funding for technological support for postsecondary students with disabilities across the country.

Leverage computer infrastructure grants to postsecondary institutions by insisting on accessibility of computer technologies purchased in supported projects

When federal or provincial governments provide funds to purchase computers or to experiment with new learning technologies, funding should be conditional on meeting specific provisions for ensuring that equipment purchased with government funds contain appropriate accessibility features. A "watchdog and monitoring" body can be set up to scrutinise applications for compliance with accessibility criteria.

It is clear that we are moving into an exciting age where new learning technologies and the internet are providing educational possibilities that did not exist before. What makes these developments troubling to us is the absence, in many cases, of planning for access by students with disabilities. The implications of this omission are obvious. New technological barriers are slowly being erected where others have fallen. Rather than paying lip service to the idea of accessibility, government funding bodies need to take tangible steps. For example, asking for a detailed outline of steps taken to ensure accessibility for students with disabilities on grant applications and taking responses to this question into consideration in the review process is likely to be helpful.

Another possibility is to use an incentive plan to ensure that Canadian business and industry develop and market new products and technologies that are accessible to students with disabilities.

Treat different impairments on equal terms

To encourage equity in education, government programs need to recognize all impairments on equal terms. College and university personnel working with students who have disabilities are often limited in their ability to provide computer, information and adaptive technologies to students with specific impairments due to lack of funding for students with specific disabilities. This limits students with "unrecognised" impairments in the pursuit of higher education.

Shorten waiting periods and fund training

Courses at colleges and universities have firm start and end times. Exams and assignments are scheduled with fixed dates. Students who need to use computer, information and adaptive technologies must be able to access these in a timely manner. Our data suggest that waiting periods in many government programs are simply too long to meet the needs of postsecondary students with disabilities. Shorten waiting periods and ensure that equipment and training are consistent with the needs of students in colleges and universities.

Conclusions

Our approach to the conceptualization of computer, information and adaptive technologies is that it is environmental factors and accessibility features of computer and information technologies that form either facilitators or barriers to students with disabilities. For example, environmental factors can either be barriers (e.g., printed material for people who have print disabilities), or facilitators (e.g., printed material for people with hearing impairments). Of course, the same environmental factors can either be "facilitators" or "barriers" (e.g., public address systems at airports are facilitators for people with visual

impairments but can be barriers for people with hearing impairments. Social, political, and environmental aspects of funding programs for students with disabilities can create both access as well as exclusion.

When reviewing the commonalties among all samples studied in this investigation it is evident that the potential of computer, information and adaptive technologies to remove barriers to students with disabilities is enormous. Nonetheless, environmental barriers are continually being created. It is imperative that solutions are identified and implemented while the technologies and their implementation in postsecondary educational institutions are still in a developing stage.

Environmental factors have been implicated in denying people with disabilities goods and services as well as education (cf., Whiteneck & Fougeyrollas, 1996). Participants in our research seemed aware that many present educational policies dealing with students with disabilities act as "barriers" rather than "facilitators" in determining access to education for students with disabilities by denying them access to what is rapidly becoming a necessity for students in colleges and universities. Computer, information and adaptive technologies are no longer a luxury to assist a few privileged individuals. Current trends in postsecondary education make it virtually impossible for students to complete their education if they have no access to computers or to the internet. The main problems with policies arise from the fact that, as noted by Lemieux-Brassard (1996), there are discrepancies between the intent of the policies and how they are applied.

Many policies reflect the view that problems originate from within the individual rather than arising from the environment. The approach taken, therefore, is to try to remediate or to provide accommodation for individual impairments rather than to locate the problem in the environment and the prevailing social structure. If one takes the latter approach, as suggested by both the Social Model of Disability and the Environmental Factors Model (Oliver, 1990; Oliver, 1996; Swain, Finkelstein, French, & Oliver, 1993; Whiteneck & Fougeyrollas, 1996), then the environment is the problem and it is the environment that must be "remediated." Unless there is a shift away from the current person-centered ideology toward a broader, more systemic view then students with disabilities will continue to be denied full access to postsecondary education because computer and information technologies will continue to be designed and built with inaccessible features. Substantial effort must be undertaken to educate manufacturers of computer technologies as well as to formulate and implement strong federal legislation, similar to that now in effect in the United States regarding technology, to render technologies accessible.

The enormous potential of computers to remove barriers to students with disabilities and concerns over barriers posed by limitations in access were central issues noted by respondents in all categories in all phases of the research. Implicit is the message that various groups need to work together to ensure better access. This includes: industries that design and build software and hardware; policy makers who create laws regarding information technologies; policy makers who plan programs which provide access to computer technologies for students with disabilities; educational and government administrators; "front line workers" who provide information to students with disabilities; and, most important, consumers with disabilities.

Elsewhere we made concrete recommendations for specific groups whose collaboration is vitally needed in the postsecondary education milieu. These people and organizations all have a role in ensuring that computer technologies are accessible and affordable. If the access issues noted by our participants are not addressed and if changes in existing policies and procedures are not made, we will approach the next millennium with a technological society wherein people with disabilities will again be segregated by virtue of an inaccessible environment. This, must be avoided at all costs!

Bibliography

Adaptech Project, Dawson College, Montreal, Canada: http://www.adaptech.org/pubs.htm

Chisholm, W., Vanderheiden, G., & Jacobs, I. (1999). **List of checkpoints for Web content accessibility guidelines 1.0 - W3C**. Retrieved May 6, 1999 from the World Wide Web: http://www.w3.org/TR/1999/WAI-WEBCONTENT-199990505/checkpoint-list.html.

Cooper, M. (1999). **Universal design of a Web site** – CSUN '99 presentation. Retrieved May 6, 1999 from the World Wide Web: http://www.cast.org/presentations/mcooper/csun1999/.

Falta, P.L. (1992, November). **Vers l'accessibilité universelle**. Presented at the Colloque scientifique international "10 ans de recherche a partager." Montreal, QC.

Fichten, C.S., Lavers, J., Barile, M., Asuncion, J., Généreux, C., & Robillard, C. (1999). Mainstream and "free" computer information and adaptive technologies revisited. **Alert: The Official Newsletter of the Association on Higher Education and Disability (AHEAD), 23**(2), 12-14. Available Oct. 12, 1999 at the Adaptech site.

Lemieux-Brassard, L. (1996). What characteristics would the revised version of the international classification of impairment, disabilities and handicap have to have in order that it get our support? **ICIDH Environmental Factors International Network, 8**(3), 19-21.

Microsoft Corporation (1999). **Accessibility & Microsoft: Microsoft accessibility technology for everyone**. Retrieved summer 1999 from the World Wide Web: http://www.microsoft.com/enable/microsoft/default.htm.

Oliver, M. (1990). **Politics of disablement**. London: Macmillan.

Oliver, M. (1996). **Understanding disability from theory to practice**. New York: St. Martin Press.

Swain, J. Finkelstein, V., French, S., & Oliver, M. (1993). **Disabling barriers enabling environments**. London: Sage Publications.

Whiteneck, G. & Fougeyrollas P.(1996). **Environmental factors task force position papers. ICIDH Environmental Factors International Network, 8**(3), 14-18.

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