What government, agencies, and organizations can do to improve access to computers for postsecondary students with disabilities: recommendations based on Canadian empirical data

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Computer, information and adaptive computer technologies have the potential to enhance the lives of people with disabilities but also to deny them equality of access to education, jobs, and community life. In a series of three studies we investigated the computer technology needs and concerns of approximately 800 postsecondary students with disabilities. Our data show that the vast majority of college and university students, regardless of sex, age, programme of study, or type of disability, can and do use computer technologies to help them succeed. A variety of government and non-governmental organizations provide computer supports for postsecondary students with disabilities. Here, we describe key aspects of our findings concerning what these organizations can do to improve the availability of technologies to students with disabilities in postsecondary education and formulate recommendations based on an environmental barriers perspective on disability. Although the research is focused on the experiences of Canadians, many of the findings and recommendations are relevant for other countries.

Wie Politik, Behörden und Organisationen behinderten Berufsschülern und Studenten den Zugang zum Computer Erleichtern Können: Empfehlungen auf der Basis von empirischen Daten aus Kanada

Computer-, Informations- und adaptive Technologien haben das Potential, das Leben von Menschen mit Behinderungen zu verbessern, aber auch, ihnen die Gleichberechtigung beim Zugang zu Ausbildung, Berufen und sozialem Leben zu verwehren. In einer Reihe von drei Studien haben wir den Bedarf an Computertechnologie und die Probleme von ca. 800 Berufsschülern und Studenten mit Behinderungen untersucht. Unsere Daten zeigen, daß die große Mehrheit der Schüler von Fachschulen und Studenten, unabhängig von Geschlecht, Alter, Art der Ausbildung, Art der Behinderung, Computertechnologie benutzen kann und sie auch benutzt, um zum Erfolg zu gelangen. Eine Reihe von politischen und nicht politischen Organisationen bietet Computerunterstützung für Studenten und Berufsschüler mit Behinderungen an. Wir beschreiben im folgenden die wichtigsten Erkenntnisse aus unseren Studien, was derartige Organisationen tun können, um die Verfügbarkeit solcher Technologien für Lernende mit Behinderungen in Studium oder Berufsausbildung zu verbessern, und formulieren Empfehlungen angesichts der Umweltbarrieren für Behinderte. Obwohl diese Untersuchungen auf kanadischen Erfahrungen basieren, sind viele Erkenntnisse und Empfehlungen für andere Länder ebenso relevant.

Moyens mis en Œuvre par les Gouvernements, les Agences et les Organisations pour Améliorer L'Accès Informatique aux Étudiants Handicapés: Recommandations Fondées sur des Données Canadiennes Empiriques

Les technologies de l'informatique, de la communication et de l'adaptation peuvent potentiellement améliorer la vie des personnes handicapées et leur accorder l'égalité de l'accès à l'éducation, au travail, et à la vie communautaire. Dans une série de trois études, nous avons examiné les besoins et les problèmes liés aux technologies de l'informatique chez environ 800 étudiants handicapés dans l'enseignement supérieur. Nos résultats montrent que la majorité des étudiants d'université et d'école supérieure, quels que soient le sexe, l'âge, le programme d'étude ou le type de handicap, ont recours aux technologies informatiques pour les aider à réussir. Divers organismes gouvernementaux et non gouvernementaux fournissent les supports informatiques aux étudiants handicapés. Dans cet article, nous décrivons les aspects essentiels de nos résultats concernant les moyens que ces organismes peuvent mettre en œuvre pour améliorer la mise à

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disposition de ces technologies pour les étudiants handicapés dans l'enseignement supérieur et nous donnons des recommandations relatives à l'aspect pratique de cette mise en œuvre, en particulier les obstacles environnementaux à franchir. Bien que notre étude soit surtout consacrée à l'expérience des Canadiens, la plupart des résultats et des recommandations peuvent s'appliquer aux autres pays.

Qué Pueden Hacer los Gobiernos, Agencias y Organizaciones Para Mejorar el Acceso A los Ordenadores de los Estudiantes de Enseñanza Postsecundaria Con Discapacidades: Recomendaciones Basadas en Datos Empíricos Canadienses

Los ordenadores, la información y las tecnologías adaptativas pueden mejorar la vida de las personas con discapacidades, pero también pueden impedir su acceso en condiciones de igualdad a la formación, al trabajo y a la vida comunitaria. En una serie de tres estudios examinamos las necesidades de tecnología informática y las inquietudes de unos 800 estudiantes de enseñanza postsecundaria con discapacidades. Nuestros datos demuestran que la gran mayoría de los estudiantes de postsecundaria, independientemente del sexo, la edad, el programa de estudios o el tipo de discapacidad, pueden utilizar, y de hecho utilizan, tecnología informática para conseguir el éxito. Varios gobiernos y organizaciones no gubernamentales facilitan apoyo informático a aquéllos de estos estudiantes que presentan discapacidades. Aquí describimos los aspectos clave de nuestros hallazgos en relación con lo que las mencionadas organizaciones pueden hacer para mejorar el acceso de tales estudiantes a estas tecnologías, y formulamos recomendaciones desde la perspectiva de las barreras ambientales de los discapacitados. Aunque la investigación se centra en las experiencias canadienses, muchos de los hallazgos y recomendaciones pueden aplicarse a otros países. *International Journal of Rehabilitation Research* 23:191-199 © 2000 Lippincott Williams & Wilkins.

Introduction

Computer and information technologies are rapidly expanding in all fields and are becoming important tools in the new economy. Because computer and technology literacy is a necessity for effective functioning in the new millennium, these competencies must become part of everyone's education. To ensure that people with disabilities can participate fully in all aspects of society, it is important that new computer and information technologies are accessible to them.

But how well have we succeeded in doing this and what changes need to be made to improve the situation? To answer these questions, we conducted three studies between the fall of 1997 and the spring of 1999, focusing on evaluating the computer, information, learning and adaptive technology needs and concerns of Canadian postsecondary students with disabilities (Fichten *et al.*, 1999a,b). Our purpose here is to share the findings and to make data-driven recommendations to governments and to organizations that help these students obtain the technologies they need. Although our research focused on the experiences of Canadians, many of the findings and recommendations are likely to be relevant for other countries.

Use of computer, information and adaptive technologies by people with disabilities

The characteristics of some existing computer tech-nologies prevent access by people with various disabilities (Banks and Coombs, 1998; Waddell, 1999). For example, most internet videoclips have no closed captioning. Some people have difficulties accessing internet web sites due to screen sizes and colors (Schoffro, 1996), while others, most notably people who are blind, have difficulties because graphic images do not have verbal descriptive tags for text based browsers and screen readers (Vanderheiden *et al.*, 1996).

Such disabling environments need not exist. In the past, technologies have worked in the service of people with disabilities by reducing or eliminating barriers and by improving a variety of aspects of quality of life (Day and Jutai, 1996). Computer technologies can continue this trend by working for – rather than against – people with disabilities. Bissonnette's review (1995) shows that the use of technologies to advance the education of people with disabilities has been an ongoing successful process for some time. The benefits of online education for students with disabilities have been described extensively (e.g., Shumila and Shumila, 1998) and there are data available that suggest that participation by students with disabilities in computer supports provided for them in offices was related to better academic performance (Shell *et al.*, 1988). Moreover, people with disabilities who have a high level of computer skill were shown to have more favourable employment outcomes (Pell *et al.*, 1997). Clearly, new information and learning

technologies used for the purpose of assisting all people through life-long learning must continue to be inclusive of people with disabilities.

Microsoft, IBM, Adobe, and Apple have built-in adaptations for people with disabilities (Adobe, 1999; IBM, 1999, 2000; Microsoft, 1999a,b; Apple and Special Needs, 2000). People with various physical limitations in both academic and employment settings are becoming aware of the availability of ergonomically designed hardware, such as keyboards that are easier to use for people with carpal tunnel disorders. In addition, new specialized technologies have emerged: these include Aurora's communication station – a system of components that can be used to attach augmentative communication devices, laptop and other equipment suitable for mounting on wheelchairs, beds, and tables (e.g., Aurora, 1996a,b). Increasingly, specialized adaptive products are taking advantage on new developments in the industry, making them less expensive and more compatible with mainstream software and hardware (e.g., Henter-Joyce, 1998). In addition, a variety of free and inexpensive programmes that are of interest to students with disabilities have become available (Fichten *et al.*, 1999c).

Postsecondary education

Canada's community colleges and universities provided postsecondary education to well over a million Canadians in 1998–9 (Statistics Canada, 1999a,b). 'Postsecondary education has been targeted as one of the key vehicles for providing a labour force ready to meet the challenges of the new workplace. Human Resources Development Canada estimates that nearly half of the jobs created in the next decade will require a minimum of 17 years of education' (Butlin, 1999, p. 9).

It is only in the past two decades that postsecondary education institutions have begun to recognize the need to accommodate people with disabilities (Fichten *et al.*, 1987). During this time, the number of people with disabilities in postsecondary education has increased dramatically (Lavoie, 1986; Henderson, 1992; Hill, 1992, 1996; Louis Harris and Associates, 1994; McGill *et al.*, 1994; Leitch, 1995; Tousignant, 1995; Wolforth, 1995). Indeed, the 1999 Louis Harris and Associates poll in the United States (cited by the National Organization on Disability, 1999) showed that, 'by 1998 more than half of adults with disabilities (51%) had completed some college – a proportion almost identical to that for the nondisabled population.'

Postsecondary education for people who have a disability is important for the same reasons as it is for nondisabled people. It helps to fulfill personal goals, allows for effective competition in the job market and contributes to independence and financial security. American data show that graduation rates are similar for students with (54%) and without disabilities (64%) (Horn and Berktold, 1999). It has been shown, for example, that although employment figures for university graduates with disabilities is somewhat lower than that of their nondisabled peers (e.g., Horn and Berktold, 1999), once employed, salaries are similar, and their rates of employment are still substantially higher than those of students who did not complete university, who, in turn, fare better than those who never went to college (Government of Canada, 1996; Louis Harris and Associates, 1994).

Research programme of the Adaptech Project

The Adaptech Project consists of a team of academics, students and consumers. Based at Dawson College in Montreal, Canada, the project is funded by government grants. The project's research endeavours are guided by an active cross-Canada bilingual Advisory Board. Additional information about the Adaptech Project is available on the project web site:

< http://www.omega.dawsoncollege.qc.ca/adaptech >

In the context of the Adaptech Project's ongoing research, we recently completed three investigations assessing the computer, information and adaptive technology needs and concerns of Canadian postsecondary students with disabilities (Fichten *et al.*, 1999a). Our goals in doing this research were two-fold. First, we wanted to evaluate the use and the utility of computer technologies in the postsecondary education of students with disabilities. Second, we wanted to make empirical data available to better advise students, professors, and other members of the higher education community, as well as planners, policy makers, and developers and suppliers of mainstream and adaptive technologies.

In Study One we conducted four focus groups involving 31 individuals: one with postsecondary students with various disabilities; one with person-

nel who provide services to students with disabilities at colleges and universities; one with professors; and one with academics, computer technologists and other concerned individuals. From these meetings we obtained broad notions about what some of the key issues of interest to students with disabilities are. In Study 2 we went across Canada and conducted structured telephone interviews with 37 students with various disabilities and with 30 postsecondary disability service providers representing colleges and universities nationwide. Again, the main focus was on the needs and concerns of students. These interviews gave us much more detailed information on such issues as: what computer, information and adaptive technologies students have, use, and want; how students get funding for computer technologies, and what kinds of access to technology postsecondary educational institutions provide to students with different types of disabilities. Study 3 was conducted in the spring of 1999 with the help of more than 200 college and university disability service providers as well as our student group partners, the National Educational Association of Disabled Students (NEADS) and the Association québécoise des étudiants ayant des incapacités au postsecondaire (AQEIPS). In this study 725 Canadian students with various disabilities from 156 universities and colleges from all of Canada's provinces and territories completed a questionnaire concerning their experiences with computer, information and adaptive technologies.

Selected aspects of the findings

Our data suggest that the vast majority of college and university students, regardless of sex, age, programme of study, or type of disability, can and do use computer technologies to help them succeed. Personnel who provide support services to these students at colleges and universities also see the use of computers as beneficial, since these allow students to become independent by giving them access to information. College and university personnel responsible for providing services to students with disabilities also pointed out that the use of computers is cost effective for the institution, but that they experienced problems with adequate funding for computer technologies for institutional use. 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.

When students were asked about disadvantages, the most common problem noted was that computer technologies are costly. This is consistent with other investigations of learners with disabilities (e.g., Lee, 1999) as well as with economic realities of persons with disabilities in Canada (Fawcett, 1996). Other problems include: the need for continual upgrading, few opportunities for training on adaptive technologies, hardware and software compatibility problems, and lack of appropriate adaptations in the computer labs where courses are held.

Less than 5% of students surveyed indicated that they did not use a computer. When asked why, their answers reflected neither computer anxiety nor difficulties in learning. Students indicated that computers cost too much, were unavailable and too expensive to maintain, and, for many, were impossible to acquire through a government subsidy programme.

Approximately 40% of students in our samples stated that they needed adaptations such as screen magnification, dictation software, or Braille to use a computer effectively. Fewer than 60% of them reported that they actually used the needed adaptations. This finding is consistent with results of another study carried out for the National Educational Association of Disabled Students (Behnia *et al.*, 1993). When asked why they did not use adaptations, the overwhelmingly endorsed answer was that these cost too much. Other reasons cited include: it is unavailable to students, they are uncertain about where to buy adaptations, they don't know how to use the equipment, and equipment is too expensive to maintain.

Although provincial governments are a likely source (25%) and many students borrowed equipment from family or friends (14%), the most common way for students to obtain computer technology was to buy it for themselves (34%) or to have their families buy it for them (30%).

The majority of students surveyed (58%) did not avail themselves of a government programme to help them obtain a computer or adaptive computer technologies. When asked why, the most common answer was that students were not aware that there were any programmes out there for them. Students who chose not to apply even though they knew about the availability of programmes, indicated that there were too many restrictions, or that their family income or the nature of their disability excluded them from eligibility to existing programmes.

Recommendations to government and to organizations that help postsecondary students obtain computer, information and adaptive technologies

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 for students with disabilities. The implications of this omission are obvious. New technological barriers are slowly being erected where others have fallen.

Perhaps the most outstanding finding of our studies relates to students' concerns over the cost of computer technologies. Regardless of how questions were 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. Despite this, the majority of students who had computer equipment at home indicated that they or their families had paid for it. When asked why they did not apply to a government programme to help them obtain a computer or adaptive technologies, as noted earlier, the single most popular answer was that students simply did not know that any special government programmes existed.

Recommendation 1: Make the postsecondary education community more aware of the programmes available to them

Recommendation 2: Clarify and make transparent the rules and criteria for eligibility

Recommendation 3: Simplify the application process and make application information and forms available in alternative formats

The solution to the problem is obvious: organizations/agencies that provide money, loans or computer technologies to students with disabilities need to have more effective 'outreach'. More broadly based information dissemination about available opportunities is clearly needed to better inform students, financial aid offices, postsecondary personnel who provide services to students with disabilities and rehabilitation professionals. The information should be provided in alternative formats (e.g., in Braille, or on tape).

Our research shows that both students with disabilities and personnel responsible for providing services to them are poorly informed about rehabilitation/government programmes that help students acquire computer and adaptive technologies. Also, specific rules and eligibility criteria for these programmes are not well known.

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

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

Recommendation 4: Leverage of computer infrastructure grants to postsecondary institutions

Another common complaint of students concerned overcrowding in laboratories and facilities where computer equipment for students with disabilities is housed. Similarly, many service providers noted that they encountered serious problems with funding for computer technologies located on campus for students with disabilities.

To increase the availability of computer technologies for students with disabilities on campus, we recommend that governments, when providing funds to colleges and universities to purchase computers or to experiment with new learning technologies, make funding conditional. Institutions should meet specific provisions for ensuring that equipment purchased with government funds contain appropriate accessibility features. Additional information about this topic can be found in the following American resources: Title II of the Americans with Disabilities Act (ADA, 1990), Section 504 of the Rehabilitation Act of 1974 (c.f., Fonosch, 1980) and Sec. 508 of the Workforce Investment Act of 1998 (Department of Justice, 2000). For example, asking for a detailed outline of steps taken to ensure accessibility for students with disabilities on institutional grant applications and taking responses to this question into consideration in the review process is likely to be helpful.

Recommendation 5: Treat different impairments on equal terms

To encourage equality in education, all impairment should be recognized on equal terms. Personnel providing services to students with disabilities are often limited in their ability to provide computer, information and adaptive technologies to students with disabilities due to lack of government funding for students with specific impairments. The situation is similar to funding programmes for the students themselves. This limits students with 'unrecognized' disabilities in the pursuit of higher education.

Recommendation 6: 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 and adaptive technologies must be able to access these in a timely manner. Our data suggest that waiting periods related to government computer subsidy programmes are often too long to meet the needs of postsecondary students with disabilities. Shorten waiting periods and ensure that equipment and training are consistent with the schedules of students in colleges and universities.

Conclusions

When reviewing the commonalities among all three studies upon which these recommendations are made, 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.

The argument that 'granting equality to the disabled population group is not justifiable because of the cost, because of opposing values, or because of the inconvenience to mainstream society' (Nagler, 1993, p. 33) is often made in this context. We contend that this type of argument needs to be rebutted wherever it surfaces. A small investment today is likely to pay handsome dividends in the long term. Not only is universal design cheaper than retrofitting (Falta, 1992; Coombs, 1998; NODE Networking, 1998; Ekberg, 1999; Jacobs, 1999), but

computer and information technology accommodations made today for students with disabilities will benefit many sectors of society in the future. This includes the aging baby-boomers, many of whom are computer literate and will soon find themselves in need of adaptations, owing to age-related disabilities. It is well to remember that ramps and curb cuts intended for people in wheelchairs have also been of benefit to people with baby carriages, those moving equipment, rollerbladers, etc. (Coombs, 1998).

Where government or other programmes exist to either provide or subsidize computer technologies for students with disabilities, it goes without saying that these should reflect the current needs of students. Unless the aim is to provide such programmes quietly to those who happen to find out about them through word of mouth or by accident, much more needs to be done to ensure that information, rules and regulations are made available across the postsecondary education community. Where current eligibility criteria bar students with certain disabilities from applying, these must be carefully reviewed and ultimately eliminated.

Limitation in access to computer and information technologies was a central issue in all three of our studies. Consistent with views promoted by social and environmental views of disability (Fine and Asch, 1988; Oliver, 1990, 1996; Boschen and Krane, 1992; Swain *et al.*, 1993; Whiteneck and Fougeyrollas, 1996), the solution seems to be that various groups work together to provide better access. This includes policy makers who create laws regarding information technologies, and those officials who plan programmes that provide access to computer technologies for students with disabilities. These people all have a role in ensuring that computer technologies are accessible and affordable. If these issues are not considered and changes in existing procedures are not made, we start the new millennium with a technological society wherein people with disabilities are again segregated by virtue of an inaccessible environment.

Acknowledgements

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