

## Abstract

### Technology Support Services in Postsecondary Education

Technology has a profound effect upon the lives of students with disabilities. This multi phase longitudinal analysis began with exploratory factor analysis of repeatedly administered nationally represented surveys of disability support providers followed by a qualitative cross case analysis of three purposefully selected postsecondary education support centers with a longitudinal follow-up analysis of one disability support service site known for outstanding technological support services. This study utilized cross-case analysis to explore how technology has impact upon the lives of individuals with disabilities. Qualitative thematic coding techniques relying upon grounded theoretical procedures were used with the 42 interviews to determine themes and anomalies as a way to confirm cross-validate and corroborate findings. This recursive process was based upon repeated sorting, coding and comparisons of interview data from the three North American colleges followed by a comparative analysis of the longitudinal data from one of the sites across four levels, coordinator, supervisors, support staff, and students within the disability support center. These themes were then compared creating categories that emerged in the thematic coding process as a way of more readily distinguishing how technology is viewed and used in postsecondary education.

**Key words:** Technology, Disability, Qualitative, Case Study, Support, Longitudinal.

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## Technology Support Services in Postsecondary Education

Technology as a modern apparatus has numerous benefits and drawbacks. For some, technology has become a crutch and an addiction. For others, technology equalizes or even liberates. Technology is so intertwined in our lives that it appears impossible to live without. Historically, 19th century writers such as Sinclaire, Whitman, and Lewis argued that technology is a malicious force, evil, and will result in the end of humankind. These authors indicated modernization, mechanization, and technological advancement would be the doom of the world. With the advent of the atomic age, the possibility that technology could result in the end mankind became a reality. Today, technology is so infused in our society it is no longer possible to live as we have in the past. For some, the idea of turning back time to where technology no longer dominates every aspect of life is romanticized. For others, technology is the only way to survive. This longitudinal qualitative case study will begin by first describing the culture of disability and how it is related to technology. This overview will provide a background for the examination of exemplary postsecondary technology supports that have influence upon the lives of students with disabilities and their educational careers. This study will then examine how technology is used by individuals with disabilities on a daily basis highlighting how technology can help equalize and liberate but does not always free those from outside barriers that impede the ability to excel.

### **The Culture of Disability**

Disability culture and the experience of being disabled are extremely unique and personal. Definitions of disabilities often ignore the complex interplay of social, cultural, educational, political, economic, and biological determinants that help or hinder

individuals with disabilities as they navigate through life. One goal in disability studies is to analyze disability as a phenomenon in the context of social practices, cultural values and human difference. Disability advocates argue that the term disability is a socially constructed term that often makes individuals appear broken- in the extreme-less than human. This view is degrading and can create a sense of helplessness and inferiority perpetuated by policies, the media, and the medical and educational community. Special education is one example of an institutional practice that relies upon "labeling and categorization", useful concepts for funding but potentially debilitating and harmful to those contrived to be broken as the concept indicated that they require an outside intervention. This deficit model is deeply embedded in Western society and maintains a stronghold to this day in the medical community. Technology is one intervention that has potential to reduce negative stigmatization and the barriers that have become institutionalized in the concept of disability.

Technology has enormous potential to equalize without degrading and this study demonstrates how it has had a positive impact upon the lives of individuals with disabilities attending three exemplary postsecondary institutions in North America. For some of the participants, technology allows mobility. For others, it provides the opportunity for active communication. Technology keeps countless individuals alive and opens pathways for those with significant disabilities unheard of a century ago. Technology is no longer limited to those with visible disabilities; it is also used by those with invisible disabilities as well. Still, many are constantly hindered by social barriers inflicted by society, and technology is one of the few tools that potentially can break down barriers by allowing individuals to wholly interact with society.

## **Barriers**

Social barriers hinder opportunities to work, socialize, and participate in many major life activities. Attitudinal barriers are particularly damaging and include low expectations, stigma, and prejudice that restrict opportunities to work, socialize, and become independent in living. Social barriers are negative attitudes that other people carry including ignorance, fear, pity, misunderstanding, or hate that limits people with disabilities from experiencing their full potential [1]. In essence, social stigma, inappropriate or harmful attitudes, and misperceptions function as disabling agents despite the fact that they often have nothing to do with the individual's potential.

Invisible attitudinal barriers are exceedingly difficult to overcome as they reside in societal attitudes and expectations, not in the person's disability. Attitudinal barriers are often seen in the work environment where employers regularly focus upon the disability rather than the individual's abilities. This works in concert with physical barriers to create a hostile environment that is exceedingly difficult to attain and maintain gainful employment [9]. Technology has had a huge effect upon employability for individuals with disabilities. Without accommodations provided in the form of technology, many people would be relegated to menial jobs or unemployment.

Psychological barriers exacerbate, intensify and occasionally construct conditions that can have profound effects upon the wellbeing of individuals with physical, academic, social and behavioral differences. At worst, society, institutions, and policy create a disabled human [4]. The very nature of societal views of individual differences, the policies that promote the labels and categories, and the climate within institutions such as education and work can create an environment so demeaning and segregating that the

individual begins to create their own world where they are “disabled” based upon messages from those outside their being [14]. Technology as an intervention is one tool that has potential to unlock the doors previously shut, thus allowing those with disabilities to shift their perceptions of the world as a hostile environment to a place where they can function and interact in society.

### **Postsecondary Technology Supports**

Over the past decade technology has helped to strengthen support services available for students with disabilities. This qualitative case study will provide a description and in depth analysis of how technology is provided and embraced by students with disabilities in postsecondary education. Data from a cross case analysis and longitudinal follow-up study of purposefully selected support service sites were used to reveal the culture of disability services and how technology has an effect upon the lives of students receiving technology related supports.

The study began in 1999 with survey information collected from disability support coordinators in postsecondary programs across the United States. Specifically, principal component analysis was used in the development of constructs, reliability was assessed, and regression was used to determine if the constructs were significantly different between the institutions surveyed (2-year and 4-year) and over two points in time (1999 and 2001). Multivariate analysis of variance (MANOVA) was then conducted to determine if institution type and time exhibited main or interaction effects. Analysis of the surveys revealed four primary constructs, one being assistive technology. Two-year and four-year institutions were found to be significantly different with Assistive Technology being provided more often in two year colleges than four year universities

[5]. Multivariate analysis revealed no interaction between institution type and time when all the constructs were combined. Only the main effect for institution type ( $F=18.50$ , 4 df,  $p=.000$ ) was found to be significantly different. These findings helped establish the parameters for the qualitative analysis of disability support services. Three sites were purposefully selected in 2002 and a cross case analysis [17] was performed to explore similarities and differences in the way technology was provided and utilized. One of the three sites was chosen for longitudinal analysis as there was interest in how technology services and supports for post secondary students was impacted by a significant budget reduction.

## **Methods**

Qualitative research methods were used to examine the role of technology for serving students with disabilities in postsecondary education. Data from three purposefully selected exemplary sites were examined using thematic coding [15] and cross case analysis techniques [2] [13] to provide an overview of how technology was being offered to students with disabilities. Cross case analysis was followed by a longitudinal follow-up study at one purposefully selected site as it possessed the most sophisticated technology services. The longitudinal analysis offered the opportunity to examine how technology was provided and utilized by postsecondary students with disabilities from the perspectives the coordinator, supervisors, service providers and students at the college [16].

## **Role of the Researcher**

This researcher used a pragmatic approach when examining disability related technology services used to support postsecondary education. Neither a purely post

positivist nor constructivist approach was embraced in this study. Although the survey analysis examined data to determine statistical significance and relationships between factors, the main purpose was to better understand what forms of technology are being used to support students with disabilities in colleges and universities across the United States. Thus, the survey analysis was used to identify criterion for purposeful selection of sites to conduct research as well as to inform, clarify, and justify what aspects of technology were to be studied in the qualitative analysis. A pragmatic methodological approach was used in the site selection, data collection and analysis phases of this longitudinal study for several reasons. As Patton [13] explains, pragmatism supersedes the one sided extremes of post positivism or constructivism by providing the opportunity to use practical methodological options best suited to the research problem. The pragmatist view allows a person to define and judge the quality of an evaluation based upon the purpose, procedures, resources, and intent of the study to determine if it matches the needs of the target audience. In sum, a pragmatic approach allowed the focus of the study to evolve as data were collected and recursively analyzed over time. This process is extensively described by Charmaz [3] in her explanation of the grounded theoretical approach. If this study had followed a typical linear post positivist framework it would have been controversial to reformulate the focus of the study as themes emerged or refine the research questions over time [4]. Similarly, the researcher recognized that a purely constructivist grounded theoretical approach as initially defined by Guba and Lincoln [6] was not possible as the researcher's prior knowledge and theoretical concepts of disability related technology supports would have influence upon the interpretation of findings. Multiple sources of information including emergent themes from the interviews,

on site observations, and statistical analysis of the survey helped identify potential constructs used to frame technology related interview questions in the qualitative analysis. This melding of information in a recursive fashion helped to refine the focus of the study and was embraced throughout all phases of data collection, analysis and writing of the findings. As Kamberelis and Dimitriadis [8] indicate, this type of qualitative research project does not attempt to isolate single variables, test their effects, or attempt to generate causal laws that are presumed to be “timeless or universal”. Instead, qualitative inquiry attempts to understand, interpret and explain complex and highly contextualized social phenomena” [8] (p.17).

The purpose of this study is to better understand how and why, to describe the complexities, textures, and nuances involved in how coordinators, supervisors, support providers, and students view technology used to support disabilities and the structure of the technology support services provided at their college. In this way a pragmatic approach to research advanced the understanding of how individuals at multiple levels within support services and the students they support experience themselves and their worlds as it relates to technology.

Although a single theoretical paradigm did not drive this study, prior experiences, education, and training had influence upon the focus of the evaluation and the research design. Care was taken to reduce inherent researcher bias when interpreting the information gathered for this study by using a logical progression to collect and analyze data allowing themes to emerge while maintaining the opportunity to use direct quotations to give voice to the participants when framing the interpretations. The researcher’s role in this qualitative case study was that of an interviewer and observer of

the participants as they interacted within their environment. No single theory, methods, or methodology dominate the study, nor did the philosophical views of the researcher overshadow the research topic or execution of the design. Theoretical conceptions did not force the study in any particular direction nor was theory used to drive a methodological preference or epistemological viewpoint that could disregard or influence the nature of the research topic. Several steps were taken to keep this research study focused. By succinctly defining the topic, bounding the case, and framing the semi structured interview and research questions, the intent of the study to better understand how support technology is viewed remained focused.

### **Procedures**

Purposeful site selection [10] for the cross case analysis was guided by experts at the National Center on Secondary Education Transition and the Center on Disability Studies. Criteria for selection were two-year demographically comparable postsecondary schools with a reputation for excellence and active record of funding from a variety of sources. Three sites were chosen from a pool, El Camino College (Los Angeles, California), Quinsigamond College (Worcester, Massachusetts), and George Brown College (Toronto, Canada).

Data collection was sequential with surveys administered in 1999 and 2001 and interviews conducted in 2002 and 2005. The surveys helped define semi structured interview questions and constructs used for coding. The cross case analysis then framed the longitudinal ethnographic phase by defining how the case would be bound and the interview questions to be asked. All interviews were held on site, conducted in person, digitally recorded and transcribed. Material used in the analysis included observations, in

depth interviews, and supplementary data used to describe services and technology. The interviews resulted in a total of 845 pages of transcripts generated from over 40 interviews used in the coding process.

The exploratory cross case analysis used multiple perspectives from within the colleges and relied upon axial and thematic coding strategies [13] to confirm, cross-validate, and corroborate themes about technology [7]. The longitudinal stage [2] provided the opportunity to analyze support services at four levels to determine how the culture of technology changed over time. Analysis was based upon Miles and Huberman [11], Patton [13] and Charmaz's [3] approach to qualitative research that relying upon immersion into the data through repeated sorting, coding and comparisons of categories into themes. This recursive process was conducted several times throughout all stages of data analysis. Raw data collected from the three sites were coded into categories called "Nodes" using NVivo, a computer generated qualitative analysis program [12]. The coded data were then used to generate reports that more readily distinguish similarities and anomalies in the way technology is provided at the institutions under investigation. Patterns in technology services were generated in a recursive fashion as suggested by Miles and Huberman [11] and Creswell [2]. The final analysis combined findings from the longitudinal and cross case analysis in order to provide a succinct picture of the role of technology for students with disabilities.

### **Cross Case Analysis Phase**

El Camino, George Brown, and Quinsigamond all embraced technology as a means of providing access to students with disabilities. Although the three sites had remarkably similar technology as expected in exemplary sites, policies that drove funding

for technology were markedly different. The analysis revealed that the different funding sources had a direct effect upon the sophistication of technology and how often it was updated. As example, only El Camino College had advanced switching devices for activating computers for students with significant physical disabilities and middleware, a technology that links several software programs together. California's disability specific legislation provided funds for the most sophisticated technology program of the three colleges. Several factors had influence upon the strength of the program including the director's focus on access and staff interest in learning and teaching state of the art technology. Funding for hardware and software at El Camino College came through multiple sources including general fiscal dollars, state and federal grants, levies, donations, and disability specific headcount funds. The rich and diverse funding sources provided the opportunity to acquire and train personnel on state of the art technology. El Camino's High Technology Center excelled as a result of two decades of time, effort, and dedication by those involved. Dedication to technology was apparent in the interviews and appears to emanate from the philosophy that technology is a critical equalizer for students with disabilities to compete in the postsecondary arena. As example, the director stated "technology has a great role in helping the students and staff work greater, smarter, more efficiently".

The High Technology Center at El Camino College offered technology supports to students including Dragon-Naturally Speaking, a widely used voice recognition program, Joz, a program utilized by the Blind and those with Low Vision to verbalize scanned materials. JawBone, a type of middleware can link as example three separate programs such as Dragon Naturally Speaking, Joz, and Handi-Word, a word prediction

software program. According to the technology supervisor “some students who do not type as fast or have limited use of their hands can use Handi-Word. So now a student who has a hard time using their hands and cannot see can use voice recognition. They can also use Jawbone to perform voice commands, and have Joz read material back to them. By using multiple programs linked by middleware, the possibilities increase exponentially. Dragon, JunText, Joz and Handi-word can all be linked and then they can be used with word processing and spreadsheet programs like Microsoft Word and Excel.”

Easy-Keys, a type of switching technology is another example of state of the art technology used by students at El Camino College. According to the technology supervisor Easy-Keys “is just a basic switch for retainers, for your chin, your foot, it is a constant control. If someone is able to blink, they can use this technology.” According to the technology trainer, “with switching technology you can control, you can type, it has word-prediction, mouse-controls, everything you can do on any other computer all linked with the switch technology. I have seen some of our students with physical disabilities that can actually type faster using this technology than actual keyboards; it’s pretty amazing what it can do.”

Kurzweil 1000, software designed for individuals with visual impairments was available at all three of the colleges in this study. It is reading software that makes printed or electronic text accessible to people who are blind. It converts a PC and scanner into a reading machine. Kurzweil 1000 scans and then reads text with a computer generated voice that can be modified by changing reading speed and pitch to specific preferences and purposes. It can be used to create documents assisted by an audible

dictionary, thesaurus or prioritized spell checker, and the document can then archive the document using a file management dialog.

Kurzweil 3000 was also available at all three sites in 2002. It is a reading, writing, and learning software that is widely used by students with various learning disabilities who exhibit language and literacy difficulties. The software uses a multi-sensory approach presenting printed or electronic text on the computer screen with added visual and audible accessibility. Kurtzweil 3000 incorporates features including decoding, study skills, writing and test taking tools designed to adapt to each individual's learning style. This software can also be used to convert materials to different languages. According to the technology trainer at El Camino, you can switch the language. "By saying a word in English that I don't understand, it can read the word and define it in Spanish." There are currently six languages supported by Kurtzweil 3000, Spanish, Russian, German, Italian, French, and Spanish-Castilian. Joz also has the capability of reading back to you what you typed in a certain language, and then read back to you the definition in another language."

According to the technology supervisor at the High Technology Center "We have Pen-Mouse that uses infrared technology for on-screen keyboarding that can be linked through Jaw-Bone to word prediction software. You can use this infrared technology with a head mouse, typing, word prediction, online access." The infrared hardware and software which costs between two and three thousand dollars is excellent technology for those who do not have limb control. Unfortunately learning to use infrared technology is time consuming. According to the technician "It's very hard to have a student come in who has never used access technology or computers before and teach them for the very

first time. I usually have students start with point and click programs as they are first learning the computer and if they want, they can then move up to Dragon Naturally Speaking and learn voice commands as well as computer program operations.” Infrared technology software can make the keyboard bigger or smaller, it can be made to click faster or slower or it can be set to have a customized alphabetic keypad for a student who has never typed before.

Unlike California’s funding structure, Massachusetts funding is provided through the general fiscal funds and state grants. Thus the sophistication of technology support was limited compared to California and Canada. George Brown College in Toronto also utilizes much of the same technology at a less sophisticated level as was used to serve students with disabilities at El Camino, but their funding sources are very different. Funding for technology in Ontario came through Bursary funds on an individual prescriptive basis. Students could purchase required technology in Ontario for students with disabilities up to \$10,000 a year.

### **Longitudinal Phase: Budget Constraints and Technology**

California was chosen for the longitudinal phase of this analysis to understand how technology was impacted by a significant budget reduction. Participants at multiple levels including support coordinator, three disability support supervisors, fourteen disability support providers, and five students were interviewed and observed within the college environment, the majority of which had been previously interviewed in 2002 adding to the strength of themes that emerged in final analysis which compared cross case and longitudinal findings in a comprehensive analysis. The semi structured interview questions for the longitudinal phase allowed for a deeper understanding of how

technology impacts the culture of disability within a postsecondary support system. By utilizing a longitudinal approach it was possible to examine technology services as they changed over time. Findings from the follow-up phase of the study will follow the structure of the disability support service office as a logical and accurate way of representing the culture of the organization, first, the coordinator, followed by the supervisors, support staff, and students.

### **Coordinator**

The coordinator of the Special Resource Center at El Camino College oversees all phases of disability support services and was acutely aware of how the budget reduction in 2003 significantly changed the way technology was managed at colleges statewide.

According to the coordinator “technology was a low priority statewide when compared to mandated disability services. When funds were reduced, money slated for technology improvements were diverted to pay for personnel and other disability related services.”

Unlike many other colleges in California, the coordinator at El Camino College prioritized technology. “I always had some money set aside from the categorical dollars to put towards the High Technology Center until the severe cuts happened three years ago. Now I rely upon donations and alternative funding to offset costs to keep the technical side maintained. “We did very well after 2003 considering the donations and supports that we received. I don't think that the students really suffered. We just did not use categorical dollars; we used other sources of finances to fund technology.”

Another factor that improved technology services for students with disabilities despite a downturn in financial support was the collaborative efforts between the disability support center and other departments within the college. Training was another critical factor that

helped maintain technology services. Despite drastic funding reductions in 2003 the coordinator continued to support staff attending statewide technology training sessions. “These guys are training staff above and beyond what we can do as far as in-house training. Our staff is learning highly specialized skills related to access and captioning. These sessions are especially helpful for the librarians, so that everybody is sure that they can have access.”

### **Support Supervisor**

Support staff indicated that there is a concerted effort to focus and maintain technology. “Each department is working to become proficient in technology so that they can better accommodate and serve the students.” The counselors, the learning disability specialists, the interpreters, mobility specialists, even secretarial support have a good understanding of the various technologies that are available at the technology center and the computer labs across campus.

Technology has made serving students with disabilities much more efficient. Staff can use technology to create alternative materials for students. As example, before voice recognition software and scanners, staff had to transcribe and record materials for the students. Now, technology can be used directly by the students reducing staff time considerably. Another advantage of technology training is staff can better understand what accommodations are necessary. This begins in the intake process with a technology evaluation.

### **Support Staff Personnel**

Support personnel at the Special Resource Center include all staff hired to provide services to students with disabilities. This includes interpreters, counselors, psychological

diagnosticians, technology specialists, vocational trainers and learning disability specialists. Representatives from all the support staff domains were interviewed about how technology is used and has evolved over a three year timeframe to better understand how technology has evolved during a period of financial constraint. One counselor indicated that “technology helps the students become much more independent and self reliant.” A learning disability specialist indicated that “many of the students who first arrive have never been evaluated for their technology needs”. By knowing available technology, learning disability specialists and counselors now have the knowledge necessary to make appropriate recommendations. According to another learning disability specialist “we screen their needs and if we suspect they should have an evaluation we walk them over for a formal technology evaluation. We also have a class where students are taught to use assistive technology in combination with study strategies. Those two things linked together really help the students. It's not just exposing and telling the students to use technology, it's a way to assure that they have the opportunity to practice and follow through.”

One intake counselor summarized how training has increased efficiency. “I am looking at things in a more comprehensive and holistic way. Through technology training I am better equipped to look at the students and their current skills when making evaluation recommendations and placement decisions. That's extremely important as example for the visually impaired and physically disabled population.”

The instructional service advisor further supported the value of staff knowing about technology services. Through collaborative efforts the staff learn about the most commonly used technology like screen readers, Kurtzweil 1000, Kurtzweil 3000, and

Dragon Naturally Speaking. “Once staff learned about technology and the inherent strengths and limitations, they can make more appropriate referrals and better recommendations. The students learn technology in groups and their training includes repeated opportunities to use and practice on a regular basis. In the past, they may have learned about technology but they did not have the opportunity to use it. Now, training integrates the use the technology on a regular basis. This provides a situation where the students become more independent in their learning processes.”

Lessons were learned from the budget reduction including how technology support services were maintained despite the loss of all casual hire technology support staff. Changes were made to the way technology was taught after 2003. This included a complete restructuring of courses and workshops that are now taught by the technology coordinator in groups. This provides the counselors and the specialists more time to determine if the students need technology training specific to a disability or if they should get general technology training in the computer labs or basic computer classes on campus. According to the technology specialist, “After we lost the hourly staff, computer classes, teachers, we still needed to serve the students. So we decided to reinvent the way we did things by training in groups, teaching classes, and providing workshops.” The technology staff also trained teachers, library staff and personnel. Lunch workshops highlighting technology were established and all are invited. That way staff are aware of technology and it’s availability at El Camino.

The budget reduction forced many technological constraints. One of the technology specialists indicated that software like Digital Text, Kurzweill 3000 and Dragon Naturally Speaking are wonderful tools but require considerable training. “My

immediate thought was technology would solve all our access problems. We all jumped on the bandwagon but the students couldn't get served because we couldn't keep up with learning how to use and train the technology.” The services for students have not changed all that much, but the direction of the technology center has changed. “In the past, basically, we were assisting or even babysitting. Now the High Tech Center focuses on training students how to use the computers, the software and the technology. When students are referred, they are evaluated and trained by the technology coordinator. Those students in turn become trainers of other students.” As of 2005, there were four part time trainers added to the two permanent hire employees. “Each of the trainers has been taught a single program by the technology coordinator. One teaches Jaws, one teaches Dragon, one teaches Open book, and one teaches Kurtzweil 3000. Once they become experts they will learn all the other software. Ultimately, the goal is to train the students well enough so that they can use the tools in all 22 computer labs across campus. The goal is to convert the High Tech Center into a training center. “That's the mission of the High Tech Center, to give the students the opportunity to integrate technology as a way to help them be successful. Now we are focusing on making sure that we have the technology here in the High Tech Center, and were trying to spread it across campus as much as we can.”

### **Students Perspectives**

One student who is heavily reliant upon technology due visual, gross and fine motor disabilities was asked about access. She indicated that “being able to get around campus and learning all the technology offered by the new computer programs has made life easier”. When asked if the college is supporting her needs, she replied that indeed her technology service needs were being met. “I think the staff is supporting the students

well. When the computer lab is available I come in to the Special Resource Center. This helps because I don't have a computer at home that can read the material to me, so that's a problem. The only way that I can use a computer with a scanner is to do it here. I use Dragon Naturally Speaking, I listen to Kurtzweil 1000 and Jaws, and use the scanner with books.”

Another student who has low vision spoke about services that he is using in the Technology Center. “Basically, access means giving me the ability to do my tasks as if I didn't have a disability, especially things that help me see the smaller details and stuff like that. I have my own Gordie which is like a pair of goggles with a control box which is connected to the goggles with LCD screens that are over the eye. The unit has a camera in the front and so it really enlarges the images. And I've got a toolbox that varies the contrast so I can magnify things.” The Special Resource Center also helped to prepare for work by teaching specific technology skills. “Learning about technology helped me get a job. And the text program in Jaw's latest edition is helping me pass my classes. This is helping me to build up my self-confidence to become a better self advocate. Coming to El Camino was definitely good for me.”

One student who had virtually no body control and was blind indicated the importance of technology in her life. “Being able to get around campus and the technology offered by the new computer programs makes my life a little more independent. Certainly that may be the case for all disabled individuals, but especially for me. The High Technology Center has all the services that I need in college, things like books on tape. Also I can bring the books in and they'll read it for me so I can take them home and study. And there are test accommodations and all the support and services like

the computers and software. I think all around they are supporting the students well. I'm learning Dragon Naturally Speaking, and I listen to Kurtzweil as well as Jaws.”

## **Conclusions**

The purpose of this study was to understand the culture of disability services and explore how the technology services that were provided had impact upon students at purposefully selected exemplary postsecondary institutions. The four research questions that guided this study were refined during the cross case analysis and subsequent longitudinal study of one site allowing for a more focused and meaningful evaluation of technology services. Conclusions will be presented in the same format as was developed for the cross case and longitudinal phase with information presented that is directly related to the research questions.

The first question focused upon how support services were provided to students with disabilities in three purposefully selected exemplary postsecondary institutions. Analysis revealed that technology training was primarily administered individually at the three sites in 2002. All sites provided a variety of specialized technological supports but the funding for technology at two of the sites was directly tied to legislation. Analysis of Canada's provincial and the United States federal and state postsecondary disability funding legislation revealed that El Camino and George Brown have disability specific funding sources that pay for technology training and modern hardware and software while Quinsigamond's funding for technology supports were only supported by general fiscal funds and grants. California's Lanterman Act has been in place for over thirty years creating stability and funding for disability specific technology services as was the case with Ontario's provincial bursary funding. The cross case analysis revealed that

legislation that drives funding has influence upon technology services. Specifically, the two sites that receive disability specific funding had greater abundance of staff, equipment, facilities, and time available for students requesting services. Second, the size of the institution and the number of students that self identified and requested services had bearing on the level of sophistication inherent in the technology services. Both El Camino and George Brown Colleges with more than 15,000 students were at advantage over the smaller college as technology could be shared between departments. Although there is potential for larger institutions to rely upon services provided to all students as a cost saving alternative to administering disability specific supports, this reliance upon college wide supports only functions when executed with care. This was the case at El Camino and George Brown colleges. The third theme that emerged in the cross case analysis was that large colleges had a sophisticated range of technology supports in place and the staff understood the strengths and limitations of those services. Thus, the staff was able to understand the technology that was available allowing for more accurate referrals for technology training and support. The fourth theme that emerged was that technology instructions and strategies were individually taught in most cases to the students with disabilities at the three colleges in 2002.

The striking difference in the way services were provided emerged in the longitudinal phase of the study. As a result of the budget reduction and restructuring of the High Technology Center at El Camino College, students were being taught technology in classes and workshops rather than individually. This shift, prompted by a significant decrease in funds, resulted in a transformation to the way technology supports were administered. El Camino no longer provides individual training, yet staff and

students remarked that technology support did not degrade. This change, instigated by necessity, resulted in a level of efficiency not seen before in the High Technology Center. Most staff saw the restructuring process as a painful but positive shift. Interviews at all four levels of the institution revealed that providing services in groups made little difference in the applicability of the supports students receive. All respondents indicated that grouping students had no visible negative impact as the technology services were well thought out and executed. Thus, finding can potentially influence how technology services for students with disabilities are provided, but unless service delivery is well designed by competent and dedicated staff there is significant potential for the level of technology services to degrade. Reduction of funds, in most instances, severely limits or reduces to a level of ineffectiveness the technology services that are offered. Grouping students had no perceived negative effects as a result of careful planning according to the respondents. This finding, according to the respondents, was in part due to a level of expertise exhibited by staff that is uncommon in the field. It would be negligent and potentially damaging for the concept of grouping as a cost saving measure to be taken out of context. Grouping students when teaching technology saves funds, but it is only viable if the training is skillfully executed by dedicated and knowledgeable staff.

Although students indicated no perceivable difference in the way the services were provided, staff was acutely aware of the changes. The shift from individual to group administered technology training did extract a toll. Staff had to take on much broader duties and their roles drastically shifted. In order to maintain services after the budget reduction, staff volunteered their time in order to make ends meet. It is not clear if this level of dedication would have maintained over a longer period of time. The fear of the

coordinator and supervisors was that the staff would become disillusioned without relief. This was not the case as the budget improved late in 2004 allowing the coordinator to hire more support personnel including technology trainers to share in the workload.

Both the cross case and longitudinal analysis revealed the relationship between positive leadership qualities and staff cohesion in the way technology services were supported and administered. This finding helped to answer the second research question. Specifically, leadership had a direct effect upon the provision of technology and related disability support services at the three exemplary institutions. In particular, each of the disability service coordinators as described by staff, were highly skilled, driven and dedicated with a sharp focus upon providing the best technology services possible for students with disabilities. There were common patterns at all the sites; the leaders were competent, adaptive and innovative. Specifically, the disability support coordinators and supervisors appropriately defined and shared their values about the importance of technology with staff. This in turn promoted the value of technology as a tool useful for providing access for students with disabilities. This theme emerged across the four levels of the organization in the longitudinal analysis. Providing useful and productive technology for students with disabilities created a sense of cohesion and job satisfaction for many of the staff. This service orientation, established by the coordinator, emphasized high expectations for all participants. These expectations were modeled by the coordinator, the supervisors, the support staff and technology trainers who updated their knowledge about technology regularly. This interest in technology instigated by members of the disability support center at El Camino College staff carried over to the students

who in turn had high expectations for mastering the tools that helped support their education.

The third research question focused upon changes that were made as a result of declining funds. Several themes emerged and not all were negative as initially hypothesized. Staff at El Camino indicated that they were capable of maintaining most of the services and technology that were in place before the significant budget reduction. Further, technology services were made more efficient and appeared to improve despite the loss of personnel. This was the result of significant modifications to the format and content of technology training. Although technology support drastically changed, the quality of the services according to staff and students interviewed did not degrade. This was only possible by transforming how technology was provided. Rather than reducing hardware, software, and technology training as is typical in most budget reductions, the disability support coordinator determined that the level of technology could be retained through a more efficient system of delivery and alternative funding sources. The coordinators solution was to eliminate individually administered training sessions and solicit donations of hardware and software from private industry to offset the loss of 10 part time technology specialists after the 40% budget reduction in 2003. The coordinator and technology supervisor worked together to restructure the roles of staff in the High Technology Department. The technology coordinator now teaches workshops and courses specific to software while the technology specialist now oversees hardware related issues and administers technology specific evaluations. This reconfiguration reduced the number of hours staff were repeating instructions by providing group related training.

The fourth research question examined the differences in the way students and staff views the effectiveness of technology related disability support services. This question was remarkably simple to answer. Both students and staff saw little difference. The 18 staff interviewed in 2005 consistently indicated that technology services continued to be very effective and appropriate. Despite considerable organizational restructuring and reduction of available staff, the strength of technology remained intact. This can be attributed to two reasons; first, the wise decisions made by the coordinator, supervisors, and staff related to how technology services were provided. Second, the dedication and commitment exhibited by staff to provide exemplary technology services to students with disabilities remained intact despite hardships created by drastic funding reduction.

Technology created to support individuals with disabilities has potential to enhance lives, independence and life long learning and education. For individuals with disabilities, technology is not an evil force as was described in the 19th century. Students with moderate to severe disabilities are now capable of independently studying, physically navigating, and communicating with those in their surroundings, which was impossible only ten years earlier. Further, many of the technological supports available reduce the time required to support individuals with disabilities. Although technology cannot completely replace the support that individuals may require, it has the potential to reduce the labor intensity of providing disability related services.

In summary, the three exemplary sites were dedicated to providing cutting edge technology as a way to eliminate barriers that inhibit performance. All sites placed a high value upon technology as a means of supporting students and all staff recognized that

technology helped provide students with the opportunity to become independent and less reliant upon human supports. The longitudinal analysis also revealed that El Camino College managed to maintain and in some cases improve technology supports despite a significant budget reduction. This was due to careful planning by the coordinator and execution by technology trainers. Despite dedication and careful planning, the longitudinal analysis revealed that not all services did as well as technology. Many other valuable services were devastated including highly coveted supports such as the vocational, career, and job related services. These supplementary services were simply eliminated when the college president required all non essential personnel be terminated in 2003.

El Camino's technology services survived the budget reduction because the Disability Support Center was highly organized and adequately funded. Thus, the technology center was more capable of handling a significant reduction as it exhibited strengths surpassing most colleges across the nation. These characteristics may have placed El Camino in a much better position to deal with reductions than other colleges across North America. Without strong leadership, dedication, and preexisting supports, technology services would most likely have been devastated. El Camino was particularly fortunate as the staff working in the technology center had navigated successfully through previous budget reductions. What has been learned in this study is that technology when managed effectively has potential to significantly improve chances for students in postsecondary education to excel and move closer to an independent and productive life.

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