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School, Family and Other Influences on Assistive Technology Use: Experience of Access and

Challenges of Students with Visual Impairments in Singapore

Abstract

Assistive technologies are necessary enablers for individuals with visual impairments. For a

technologically-advanced country such as Singapore, students with visual impairments are not

fully participating in this technological society. This study investigates the barriers and

challenges to the use of assistive technologies with students with visual impairments in

Singapore from a special school context. Findings reveal limited content knowledge amongst

teachers in assistive technology resulting in inconsistencies and inadequacies in delivery of

instruction. Students also display mixed range of abilities from little to basic knowledge. Where

formal channels fail to impart knowledge, family and external influences feature as important

contributors to skill acquisition in assistive technology. Yet family are not always knowledgeable

on issues of technology and accessibility. Evidence highlight an urgent need to equip teachers

with training in assistive technology as well as strengthening collaboration between school and

stakeholders.

Introduction

According to the Global Competitiveness Report 2009-2010, Singapore has consistently been

ranked among the top ten countries, and number one in Asia and third in the world in terms of

competitiveness. The alignment of information and Communication Technologies (ICT) with

the needs of the economy and society has been attributed to Singapore's economic success. Singapore implemented national ICT masterplans since the 1980s with the intent to develop ICT manpower. ICT increased awareness and literacy of the general population and businesses. Today, the promulgation of Singapore's technological evolution is evident with Singapore ranked as the second most networked economy in the world (Global Information Technology Report, 2010). Building on the successes of the previous national Masterplans ICT 1 and 2 which were designed to transform the learning environments and upgrade the skills of the population for a knowledge economy, coordinated effort continues with the third Masterplan for ICT in Education for the years 2009 to 2014. One of the major aims is to strengthen the integration of ICT into curriculum, pedagogy and assessment to enhance learning and competencies for the 21st century (MOE, 2008).

In Singapore, education for primary-age children with visual impairments is offered at the Lighthouse School (formerly known as the Singapore School for the Visually Handicapped), a special school which follows the general curriculum. For students with visual impairments who choose to be educated in the mainstream, support is dependent on voluntary registration with social services. As a result, exact numbers are tentative and extension of support is tenuous. After the completion of the Primary Six Leaving Examination (PSLE), students have the option to enter one of four mainstream secondary schools catering to the visually impaired and are supported by resource teachers (Wong & Chia, 2010). As students with visual impairments are integrated into mainstream secondary schools, and thereafter join society, the expectation is that they will be part of an ICT intensive environment. This is evident as following the Masterplans, pupil-to-computer ratio increase from 6.6:1 to an ongoing target to reach a ratio of 1:1 by 2015

(Toh & So, 2010). Furthermore, annual surveys on ICT impact in schools reported 90% of mainstream pupils indicated IT had enhanced lessons, 82% had improved their learning and 77% were learning beyond the curriculum with benefits reported mainly from primary schools (MOE, 2002).

As the use of technology has become part of education, economic progress and careers, anecdotal evidence suggests that students with visual impairments are unable to access participation in the technological society. With basic assistive technology instruction offered at Lighthouse School, this study seeks to understand the extent to which students are using assistive technology and the factors hindering or facilitating its use.

Previous Research

According to the United States Assistive Technology Act of 1998 (Section 3), assistive technology is any item or equipment that is either acquired commercially or is custom-made that is used to improve or maintain functional capabilities of people who have disabilities. This general definition comprises a broad spectrum of devices-both high and low tech that can facilitate writing, computer access, reading, communication, and electronic aids for daily living, mobility, and leisure.

For many students with visual impairments, assistive technology is a necessity for their learning, and cognitive, social, and emotional development. The use of assistive technology enables these students to participate in activities typical of their age group and provides the means by which

these students can experience success academically, as well as, socially. The research literature overwhelmingly documents strong evidence for supporting the use of assistive technology for students with disabilities (Alper & Raharinirina, 2006; Kelker, 1993; Abner & Lahm, 2002; Mull & Sitlington, 2003; Okolo & Bouck (2007); Weikle & Hadadian, 2003).

Alper and Raharinirina (2006), in a comprehensive review of the literature on assistive technology, concluded that individuals with disabilities are not fully benefiting from assistive technology use in home, school, and community settings. The researchers identified key shortcomings in the awareness, education of professionals, and integration of assistive technology is school settings. Other areas of concern included inadequate support and services for training for parents and lack of partnerships and collaboration among teachers, families, service providers and researchers. These concerns are echoed with findings of students with visual impairments in the United States. In one study, 60% of students with visual impairments were not benefitting from assistive technology. 'The 60 teachers reported that a total of 341 students required some form of alternative reading media. Of these students, only 137 (40%) used some form of assistive technology. Thus, 60% of the students who, in the authors' judgment, could benefit from the use of assistive technology were not given the opportunity to use it' (Kapperman, Sticken, & Heinze, 2002:107). In another study, the figure was between 59% and 71% of students who were inclined to benefit from assistive technology but did not have the opportunity to use it (Kelly, 2009).

While researchers on other continents have investigated the use of assistive technology by students with visual impairments, there is an enormous gap in the research in Singapore. The

research reported here is part of a larger study to understand the beliefs and practices of assistive technology amongst teachers and students in a special school for the visually impaired. This paper reports the experience of assistive technology from the students examining the barriers and facilitators to assistive technology usage.

Methods

Students and teachers from the Lighthouse School were recruited as respondents for the project. The research procedures were reviewed and approved by the Human Ethics Review Committee at the National Institute of Education in Singapore. A cover letter, explaining the aim of the study was sent to the principal of the Lighthouse School who is a project collaborator and endorsed the research. Participating teachers also signed an individual informed consent form.

Semi-structured qualitative interviews were conducted with 11 students ranging from ages 8 to 13 years. The enrolment of students with visual impairments totalled 34 students with visual impairments including those with additional disabilities. Teachers identified students only with visual impairments and respondents who gave assent and received parental consent participated. Of the 11 students, 3 had low vision while the others were totally blind. One student was suspected to display autistic characteristics though the school did not have any record of a formal diagnosis. Braille is a primary medium of instruction. For students with low vision, print is encouraged with the support of large print, CCTVs and magnifiers.

The interview questions sought to understand when the students used assistive technology in school and at home, who taught them the skills and whether they were able to use the devices. For this study, assistive technology refers to the high-tech assistive technology, such as text-to-speech devices, screen readers and computer screen-enlargement software.

The research data were analysed concurrently during data collection by researchers to check on the study's questions and make changes due to unanticipated results and insights. Transcriptions of the semi-structured individual interviews were analysed using Miles's and Huberman's (1994) approach to qualitative research. The themes from the interviews centred on the content of the questions and sub-themes were discovered, constructed and confirmed.

Findings

The interviews with the students at Lighthouse School revealed a divergent range of understanding and use of assistive technology. By and large, students had limited skills, concepts and use of assistive technology. Yet even with the students who were exposed to assistive technology, the extent of usage was at best basic. School-led use of assistive technology was inconsistent and usage was dependent on teacher competence. Key contributors were familial and external networks in reinforcing proficiency of usage. The findings are organized to introduce students' use and experience of assistive technology. All names are fictitious. Where necessary, relationships are modified to protect respondents without altering content.

Mixed Abilities

Students displayed a diversity of skills in technology. Where keyboarding skills are fundamental in accessing computers, students shared differing experiences regarding familiarity with a computer keyboard.

Marcy, an intelligent and cheerful 8 year old girl enjoys her English classes where computers are introduced. From learning the keyboard, Marcy shares: 'I know my alphabet on the keyboard. I don't really look, I feel…and I already know plus and minus and my numbers well'.

By contrast, Sunil, a 10 year old who uses Braille is aware of the computer keyboard but is unable to touch type. When asked who will teach him to type he replied:

'Nobody … Nobody will teach me'.

He shared that he had no understanding of how computers would be able to help him in his work. The reason for him was simple, he replied flatly:

'Cannot see the words'.

When the researchers suggested that the words could be enlarged through assistive technology software and asked Sunil if this might make it more accessible for him, Sunil replied unequivocally:

'Never try this before'.

Yet when Sunil was asked if he had access to a computer at home, he answered that he played pinball games at home because the graphics were large enough for him to see but he was unable to read the words.

Ironically, Sunil is able to use the keyboard controls to play pinball at home. His sister taught him which keys to operate the controls and he uses two fingers on either hand to play the game.

For senior students, such as Susan and Kate, who had been at the school since kindergarten, their knowledge of and experience with assistive technology did not correspond with their seniority. Considering that they would have spent at least 6 years at school and would be graduating to secondary school in the following year, their assistive technology experiences suggest little progress from their juniors.

When asked, Susan, a 12 year old girl reported that Mrs Freeman taught them: 'typing skills, alphabetic typing, going to the internet'. Susan said that she was able to type but in response to whether she could touch type, she said 'Ya but I still have to feel'. To what assistive technology software she was using, she replied: 'I don't know ... I'm not sure.'

Beyond the elementary typing lessons, Susan was asked if she had visited the internet to which

she replied: 'Err, we did already, but only go for awhile'. As to the websites she would visit:

'sometimes Mrs Freeman goes to dictionary.com'. When probed further about what other

websites that they would visit, the reply was a thoughtful 'Hmm, we go to...but these are not

websites…I go to define…'

 'Define' is another way in which students are taught to search for words in Google. In the

search box, they are taught to type define followed by the word they wish to search. For

example in the Google search box, students are taught to key 'define

antidisestablishmentarianism'. What follows is a list of websites listing definitions to the word.

For Susan's classmate, Kate, a 13 year old girl relates that during the classes where computers

are taught, Mrs Freeman uses the time to 'write sentences, letters and paragraphs' with the

students. The class does not surf the internet 'No, we don't go to the internet, just analysis of

word meaning'. Similarly, Christopher, confirms that searching word meanings remains a major

part of the lesson: 'Sometimes we borrow a storybook from the library here and then we read

then the meaning that we don't know then we can search it on the internet.'

Computers and Literacy

A common feature of the students' experiences was the use of assistive technology with the

teaching of English-related subjects from basic keyboarding skills to an interactive lesson of

writing, vocabulary building and dictation. Without this opportunity, many of the students would go through school with little exposure to the potential of assistive technology. Judging from their comments, these lessons are welcomed as students express their eagerness for learning with technology.

 'Mrs. Freeman will be teaching me how to write letters and how to make sentences with the computer'. When asked if she enjoys her time with the computer, Marcy replies positively 'Yes! I like to write stories'.

Similarly, Mike, an 11 year old boy enjoys the lessons where computers are used and he explains: 'We can learn, we can type letters, we can learn something from the computer'.

For Christopher, a 13 year old senior at the school shares his experiences of transcribing books for his primary one juniors. He said, 'sometimes we have to key in books….that means right, we read a book right, like after reading a line, we key in the Microsoft. But but not the whole book because we don't have much time doing that ... ya. First, we start from the thin book, then slowly go to thicker and thicker books.'

Ad Hoc Assistive Technology Classes

With discrepancy of skills noted amongst students, the unpredictable scheduling of assistive technology classes points towards further inconsistency. Students were unclear when their assistive technology class would be scheduled. Christopher was tentative when responding to how frequently his class has computer use: 'Once a week, sometimes 2 weeks once, sometimes…'

Jay , a 9 year old primary 3 boy describes that he did not attend assistive technology classes because the classes clashed with his music lesson and, therefore, had to miss classes altogether. He says, 'That time every Thursday they have computer class, but I go music class so I don't have computer lesson…'

For primary 3 class, such as Jay's, the form teacher is Mrs Banty who admits that she is unfamiliar with ICT. As such, the computer classes were organized as extra-curricular classes with a volunteer, Uncle Bob who leads the class. Jay says, 'Sometimes Uncle Bob, I don't know ar… I not sure. because I never join them. Because I go music class'.

Yet even these classes were not long-term arrangements. Jay comments: 'they had the computer lesson but now they stopped'.

Non-Computer Lessons in the Computer Lab

The school has a single air-conditioned computer lab with eight computers, running Microsoft Windows, equipped with internet connections and JAWS screen reader software. The computers are also installed with some basic teaching programmes such as Talking Typer and Math Flash. Talking Typer is a computer keyboard software that is designed for typing training with drills, practices and typing games accompanied with voice outputs and adjustments for various sight impairments. Math Flash is an educational math instruction software that teaches addition, subtraction, multiplication and division for children.

Other than Mrs Freeman who uses the computer lab for her lessons, the students related that various teachers also used the computer lab to conduct classes. However, the interesting observation was that they did not always use the computers, rather they preferred the location of the room. Two examples illustrate the situation.

Some teachers would use the computer lab for the internet facilities to search for information on learning and teaching tools for the students. In science class for example, Ms Bascomb would organize the students in the computer lab while she uses the internet to locate interesting and relevant information to a topic relating to her class. Ms Bascomb would read the information to her class and conduct a lesson while they would participate in the lesson and take notes on their Braillers.

To begin, the visit to the computer lab was not a regular schedule for his science lesson, Christopher recalls an infrequent arrangement, 'maybe 1, 2 months once like that'. Christopher describes his science class with some detail of his teacher: 'She goes to the internet and search

some notes and information about the topic we are learning, we just sit there and listen what she says…then she just tell us and ask us some questions from the internet'. During the course of the lesson, the class will take notes: 'she will read out then after we will Braille it'.

To ensure there is learning, Ms Bascomb would test the students. Christopher continues: 'Ah yeah. After she tell, then we will memorise, then revise, then she will test a few days later or a few weeks later…'

The situation of the class in the computer lab, with students using their Braillers to take notes instead of using the computers, when they were available to the class, seemed incongruous. When asked why not use the computers instead of Braillers, Christopher replies: 'she don't want', followed by 'I don't know'. Christopher explained that given a choice, he would prefer typing: 'I prefer to type, actually, typing is easier'.

For Jay, he relates his experience in the computer lab. As his form teacher is Mrs Banty, the class visits the computer lab occasionally for stories. Mrs Banty would have the class sit in the computer lab and she would either read the children a story or play an audio book for the children with her radio.

Jay gives his account of his experience to the computer lab: 'Only sometime when we listen to stories then we go there, to hear stories. My teacher gets the radio from her cupboard or sometimes she will tell us stories'.

Thus far, the school experiences of students and assistive technology have been inconsistent. Whether used as an introduction to keyboard skills, a tool in a lesson, or motivation to foster interest of its potential, students are not on the same page with assistive technology. Some students are more familiar with assistive technology while others have little or no understanding at all. Yet conversations with the students reveal a further channel by which they receive information and experience of assistive technology: the family or external network. This will be considered next.

Family and External Influences to Assistive Technology

For students who demonstrated relatively greater understanding of assistive technology, the feature of an active family member or external influence by way of social contacts was prominent in raising or enhancing awareness.

In Marcy's case, her father is a key influence in introducing computer-linked activities to Marcy. At home, Marcy uses the computer with JAWS to navigate around the programme. She finds JAWS useful and explains how this works for her. She said, 'Whatever I type, the letters, sentence, I press a button then it will read out the sentences I typed'.

Marcy's father has also used Braille alphabet stickers to label the keyboard for Marcy. Marcy explains with some levity how daddy helps her to learn the keyboard by putting the Braille alphabet stickers on the keyboard, but looks like with some trouble getting them to stay in place.

She says, 'I type Braille letters and he sticks them on the computer….but looks like some of them fell off again…'A' and 'Z'!'.

While Marcy does not have a personal copy of the JAWS screen reader software, her father has installed the trial version of the software that allows a free use for 30 minutes before it needs to be restarted. Marcy's father switches on the computer for her and sets up the screen reader ready for Marcy to use.

'Yes, I have JAWS at home. Never bought it, It's just free…it's a trial one but I only can do half an hour'. 'I can restart the computer…and when I start again, everything will still be there!'. Marcy elaborates further: 'Sometimes the composition is long and the computer say, five more minutes and it'll be off…I put 'Save Document.' then I reset it again and continue it'. Marcy replies exactly how she learnt this: 'My father teach me how to save. Press a button…. at the button, Then press the letter 'S', and I save it after that'.

From this exercise, basic keyboarding skills and word processing skills as well as general understanding of files, folders and saving documents are introduced to Marcy. Navigation can

sometimes be difficult, particularly with a mouse and in those situations, Marcy explains: 'I need my father's help with clicking the mouse'.

But contact with the computer at home is not just about work. Adventures with the computer also include visiting websites such as Youtube to look for clips of interests. For Marcy, it's keeping updated with a children's programme Hi-Five. She says: 'sometimes my father will go to the Internet and let me hear what's happening - like the shows, what's happening. Sometimes, we'll… I watch Hi-Five. ah, and they say Hi-Five, everyone is leaving. Then there'll be all new Hi-Five people…'

Moving forward, Marcy remains inquisitive and wants to learn about the row of keys above the numbers on the keyboard. 'I want to know what are those other keys. There are two sets of numbers…how come? They say 1, 2, 3, 4, 5, 6, 7, 8, 9 then 0, but then on top there's another set 1,2,3,4,5,6,7,8,9,0. How come there are two sets? Sometimes I can type on that Mathematics statements in the computer. I write 3 plus 4 equals 7. Like that. I do the 3, then I do the plus sign then I change this space. Then plus, then 4 then space, equal, 7...'

Yet familial contribution can also be a non-contributor to extending assistive technology in the lives of students with visual impairments. The examples of Susan, Mindy and Kate contrast strikingly to Marcy's where family and external networks served as a critical means to enhance

the experience of assistive technology outside the school, situations where ICT usage was not prominent was an obvious barrier to IT and assistive technology.

Take the case of Susan who lives with her 17 year old brother, 14 year old sister and parents. There are desktop and laptop computers at home. None of the computers have assistive technology software loaded on them but that does not stop Susan. 'We have one computer and one laptop. These belong to my brother and sister but sometimes I use as well'. In spite of not having assistive technology installed, Susan uses the computer in what little way she is able to help her sister. 'I practice with my sister, because I don't know how to use it....she just reads something, if not just play play play and type something anyhow...err, sometimes just help her type this or that…'. When asked if she would like to have assistive technology such as a screen reader to help her she replies: 'Yes but I don't think so I can... I don't know but I very much like to...because... I don't know much and its unaffordable. Also, I don't know how to use it.'

Unlike Marcy's case where her mother was a prominent advocate of assistive technology, Susan's parents and siblings are unfamiliar with assistive technology and are constrained in how they can help. Susan explained, 'My mother doesn't know computer. My father also doesn't know. Last time he does, now he doesn't.. He is now full time bus conductor.. so he can't learn….can't learn very much on the road'.

Where family support and influence are limited, external networks for the use of assistive technology fills in the gap. Christopher first learnt to type while at school but it was his friend who advanced his knowledge in IT and assistive technology. Christopher learnt about computers from a schoolmate. His friend has since graduated to secondary school. Christopher's friend taught him how to open files on the computer, email and gave him an introduction to JAWS. Christopher related, 'One of my friends told me about JAWS. He told me about JAWS quite a period of time ago when he was still here…"(now he is in secondary school.) Christopher's friend taught him: 'how to open files, like email all these he taught me, about email account…I wanted to create a Gmail account but not yet'. Beyond the standard knowledge of computers, Christopher was also able to comment about his preference between popular screen readers.

> 'I still prefer X to Y. Because if you type short form in the X then it will not read out the thing, the long form but for Y, they will. For example, if you're chatting with people online, on MSN, after that you type something short form right, then it will just read out the short form that you type. Like BTW instead of by the way'.

Having learnt about computers and how to navigate with JAWS, Christopher has opened his social world to interact with networks outside his school through the internet. He explains: 'I use MSN Messenger, maybe use it for 10 – 15 minutes then I go off. I chat with some of my tuition volunteers'. The volunteers are university undergraduates who volunteer one afternoon a week at school to tutor and coach students with their homework who apparently become friends thereafter in cyberspace.

When asked if Christopher chats with his schoolmates on instant messaging, he explains

pointedly: 'don't have', none of his schoolmates have an account. This is no surprising given the

general knowledge and experience of IT and assistive technology.

Yet not having an email account is one limitation, access to IT and computers is another barrier

as Mindy, an 11 year old shares: 'I don't have a computer at home, only a toy one'. Being the

only child, Mindy lives at home with her parents and she offers a glimpse to her social world

after school: 'I have no neighbor friends, only got school friends….my friends call me on the

telephone'. She describes her hobbies as: 'I listen to radio and reading'.

Discussion

The findings indicate that the assistive technology usage in school is not adequately provided for

the students with visual impairments. Current school practices indicate an inconsistency with

how assistive technology is delivered and incorporated as a means of accessing information as

well as a tool to complement teaching and learning.

Evidence show that the larger teacher population in the school is not sufficiently aware of the

benefits of assistive technology. The resulting situation where a single teacher is emerging as the

primary assistive technology proponent in the school means that only students under the care of

this teacher will have been introduced to assistive technology while those students in the charge

of other teachers are excluded from assistive technology. Being the sole proponent of assistive

technology, the single advocate is limited by knowledge and time in developing a differentiated

curriculum in teaching and incorporating assistive technology to meet the needs of students with varying degrees of understanding. There was some differentiation in content for students in primary 2 to primary 6 who were using the computer to begin acquiring keyboard skills; moving to reinforcement and knowledge of the keyboard through typing sentences and stories and finally to searching for word definitions on the web. Beyond these efforts, there was little evidence of a developed curriculum moving forward to advance the students in use and knowledge of assistive technology. The abilities of the students remain inconsistent.

Where the school is not adequately meeting the assistive technological needs of the students, external channels of influence are critical contributors to shaping knowledge on assistive technology. Parental involvement is emerging as a vital facilitator in laying down the fundamental knowledge while siblings and friends represent potential resources. Family and social networks cannot be undermined in expanding and reinforcing opportunity and skill where formal channels are inadequate. This further divides the skilled and unskilled students. Additionally,, the role of charities championing for assistive technology and persons with visual impairments needs strengthening. Greater advocacy and collaboration between Lighthouse School and appropriate champions is necessary to establish support. The implications emerging from the study include:

Teacher Education

1. School-wide adoption of assistive technology for teaching and learning is critical. If the students are to benefit from assistive technology, a shared vision in assistive technology

as a tool for teaching and learning must be promulgated. The immediate action is to organize hands on workshops to inform school leaders and teachers of the potential of assistive technology and its implications for pedagogy.

2. To extend understanding, professional development courses to foster competence and maintain knowledge of up-to-date developments in assistive technology is crucial. The National Institute of Education needs to include assistive technology as part of the teacher preparation curriculum.

Parent and Sibling Education

3. Parental education is important if they are to have a hand in helping the child to develop and be comfortable with technology. Parents form two general groups. Parents who do not use ICT themselves let alone assistive technology and its potential; parents already aware of ICT and assistive technology. Both groups can benefit from information, updates and strategies to enhance knowledge. Workshops to introduce parents to assistive technology are critical to raise awareness of the possibilities and benefits that can facilitate independence for their child. The evidence show that where family involvement is a clear facilitator to promoting assistive technology, not having familial support inhibits access to acquisition of ICT and assistive technology. Once trained, parent volunteers can be another school resource. Information on subsidies to acquire assistive technology is necessary for parents who are confronted with additional outlays for devices.

4. Siblings are a further resource to advance familiarity in ICT. Brothers and sisters of the student with visual impairment means digital natives of the same generation are naturally more pre-disposed to ICT and all things digital. This makes for ease of communication and coaching between siblings.

5. By extension, external networks such as friends and peers from the same generation offers opportunities for peer coaching and for social networks through inter-school collaborations to be formed. One tangible means of building on assistive technology is communication. This can include email, instant messaging, text messaging to encourage electronic interaction amongst schoolmates, family and friends. Communication is multi-dimensional and if students with visual impairments are to explore and enjoy the potential of electronic communication, a network of users must first be in place in order for communication to take place.

6. To trigger interest in IT and assistive technology, use of accessible computer games are an untapped resource to introduce computers to students other than for school work. Games, in this instance, are a bridge to stimulate interest.

7. For IT and assistive technology to benefit students with visual impairments, it is critical that access to the hardware and software are available at home and in school. Limited access is a major obstacle in extending knowledge and further handicaps students with visual impairments in the curriculum. To avoid working in silos, greater collaboration between Lighthouse School, Singapore Association of the Visually Handicapped and the InfoComm Accessibility Centre are resources not to be overlooked. Concurrently, existing services need to be upgraded to skill, train and offer effective services.

Conclusion

The assistive technology experiences of students with visual impairments have surfaced limitations in preservice and inservice teacher training; weaknesses in school and social services collaboration in assistive technology. Fundamental provision and training in assistive technology is imperative if students with visual impairments are not to be further isolated and have a chance to participate in an ICT intensive society in Singapore.

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