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School, family and other influences on assistive technology use

Access and challenges for students with visual impairment in Singapore

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ABSTRACT Assistive technologies are essential enablers for individuals with visual impairments, but although Singapore is technologically advanced, students with visual impairments are not yet full participants in this technological society. This study investigates the barriers and challenges to the use of assistive technologies by students with visual impairments in Singapore in a special school context. Findings reveal limited content knowledge amongst teachers in assistive technology resulting in inconsistencies and inadequacies in the delivery of instruction. Students also display a mixed range of abilities ranging from little to basic knowledge. Where formal channels fail to impart knowledge, family and external influences are found to feature as potentially important contributors to skill acquisition in assistive technology and access. The evidence highlights an urgent need to equip teachers with training in assistive technology and to strengthen collaboration between school and stakeholders.

KEY WORDS *Special Education Singapore, Assistive Technology Use, Students with Visual Impairment, Accessibility*

INTRODUCTION

According to the Global Competitiveness Report 2009–2010, Singapore has consistently been ranked among the top ten countries, and is number one in Asia and third in the world in terms of competitiveness. Singapore's economic success has been attributed to the alignment of Information and Communication Technologies (ICT) with the needs of the economy and society. Singapore has been implementing national ICT masterplans since the 1980s with the intention of developing ICT

manpower. ICT has helped to increase the literacy of the general population and to advance businesses. Today, the promulgation of Singapore's technological evolution is evident in that Singapore is 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 ICT 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 opportunities and develop appropriate competencies for the 21st century (Ministry of Education [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 national curriculum. For students with visual impairments who choose to be educated in mainstream, support is dependent on voluntary registration with social services. As a result, exact numbers are tentative and availability of support is tenuous. After the completion of the Primary Six Leaving Examination (PSLE), students have the option of entering one of the four mainstream secondary schools catering for the visually impaired and are supported by resource teachers (Wong and 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 since, in line with the Masterplans, pupil-to-computer ratio is expected to increase from 6.6:1 to 1:1 by 2015 (Toh and So, 2010). Furthermore, annual surveys of ICT impact in schools report that 90 percent of mainstream pupils indicated IT had enhanced lessons, 82 percent felt it had improved their learning and 77 percent reported enhancements in learning beyond the curriculum, with particular benefits reported from primary schools (MOE, 2002).

As the use of technology has become part of education, economic progress and career development, anecdotal evidence suggests that students with visual impairments have only limited access to participation in the technological society. With reference to 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 that hinder or facilitate 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 covers electronic aids for daily living, mobility, and leisure.

For many students with visual impairments, assistive technology is a necessity for enhancing their learning, and their 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 provides overwhelming evidence supporting the use of assistive technology for students with disabilities (Abner and Lahm, 2002; Alper and Raharinirina, 2006; Kelker, 1993; Mull and Sitlington, 2003; Okolo and Bouck, 2007; Weikle and Hadadian, 2003).

However 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 and preparation of education professionals and in the integration of assistive technology in school settings. Other areas of concern included inadequate support and services for training for parents, and lack of partnerships and collaboration between teachers, families, service providers and researchers. These concerns are echoed in findings relating to students with visual impairments in the United States. In one study, 60 percent of students with visual impairments were found not to be benefiting 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 percent of the students who, in the authors' judgement, could benefit from the use of assistive technology were not given the opportunity to use it' (Kapperman, Sticken, and Heinze, 2002: 107). In another study, it was estimated that between 59 percent and 71 percent of students with visual impairment who had the potential to benefit from assistive technology 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 explore and understand the beliefs and practices relating to assistive technology amongst teachers and students in a special school for the visually impaired. This article reports the experience of assistive technology from the students' perspective, examining the barriers and facilitators to effective use of assistive technology.

METHODS

Students and teachers from the Lighthouse School were recruited as participants 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 covering 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.

The enrolment of students with visual impairments in the school totals 34 students, including those with additional disabilities. Teachers identified students who had visual impairment as their only significant disability and from this group, those who gave assent and received parental consent participated in the study. Semi-structured qualitative interviews were therefore conducted with 11 students ranging from ages 8 to 13 years. Of the 11 students, three had low vision while the others were totally blind. One student was suspected to have characteristics consistent with autism, though the school did not have any record of a formal diagnosis. Although Braille is a primary medium of instruction in the school, students with low vision are encouraged to use print 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 independently. For the purposes of 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 diverse levels 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 used in the following sections are fictitious. Although the content remains unaltered, where necessary, relationships have been modified to protect respondents' identities.

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. With regard to learning the keyboard, Marcy reports that: '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 indicated 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 (tried) 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 six years at school and would be graduating to secondary school in the following year, their assistive technology experiences suggest little progress since their junior classes.

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 in class, 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 antisestablishmentarianism'. What follows is a list of websites listing definitions of the word.

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, (and) 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'.

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, explains that he did not attend assistive technology classes because the classes clashed with his music lesson and, therefore, he had to miss technology classes altogether. He says, 'That time every Thursday they have computer class, but I go music class so I don't have (a) computer lesson ...'.

The form teacher for Jay's Primary 3 class is Mrs Banty, who admits that she is unfamiliar with ICT. As a result, computer lessons are organized as extra-curricular classes with a volunteer, 'Uncle Bob', who leads the

class. Jay says, 'Sometimes Uncle Bob, I don't know er ... I not sure. because I never join them. Because I go music class'.

Yet even these classes were not long-term. Jay comments: 'they had the computer lesson(s) but now they (have) 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 programme that is designed for training touch typing 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 is based in the computer lab for her lessons, the students reported that various teachers also used the computer lab to conduct classes. However, an interesting observation was that the teachers did not always use the computers, they just preferred the room as a teaching location. Two examples illustrate this 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 classes for example, Ms Bascomb would organize lessons in the computer lab so she could use the internet to locate interesting and information relevant to the topic she was teaching. Ms Bascomb would read the information to her class while they took notes on their Brailers. Christopher recalls that his teacher 'Goes to the internet and search(es) 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 memorize, 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 Brailers to take notes instead of using the computers when they were

available to the class, seems incongruous. When asked why the children did not use the computers instead of Brailers, Christopher replied: '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'.

Jay's teacher is Mrs Banty and he says that the class visits the computer lab occasionally for stories. Mrs Banty's class sits in the computer lab and she either reads the children a story or plays an audio book for the children. '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, students' school experiences of assistive technology have been inconsistent. Whether it is 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 of it at all. Yet conversations with the students reveal that there are other channels by which they receive information and experience of assistive technology: the family or external networks. These will be considered next.

FAMILY AND EXTERNAL INFLUENCES ON ASSISTIVE TECHNOLOGY

For those students who demonstrated a relatively greater understanding of assistive technology, an active family member or an external social contact had been prominent in raising or enhancing awareness.

Marcy's father has been a key influence in introducing her to computer-linked activities. At home, Marcy uses a computer with JAWS navigation. She finds JAWS useful and explains how this works for her. She said, 'Whatever I type the letters (or a) 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 how Daddy helped her to learn the keyboard by putting the Braille alphabet stickers on the keyboard, '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 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(s) "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(es) me how to save. Press a 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 have been 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 interest. For Marcy, it's about 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 ...'.

Marcy is 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 Mathematics statements into 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 families are not always able to provide assistive technology opportunities to students with visual impairments. The experiences of Susan, Mindy and Kate contrast strikingly to Marcy's.

Susan 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 to 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 (them) as well'. In spite of not having assistive technology installed, Susan uses the computer in what little ways she can to help her sister. 'I practise with my sister, because I don't know how to use it ... she just reads something, if not, (I) 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 ... I can ... I don't know, but I (would) very much like to ... because ... I don't know much and it's unaffordable. Also, I don't know how to use it'.

Unlike in 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 (a) 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 can fill the gap. Christopher first learnt to type while he was at school but it was his friend who advanced his knowledge of 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, how to use email and gave him an introduction to JAWS. Christopher explained that '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.

Learning about computers and how to navigate with JAWS has opened Christopher's social world and helps him 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 and apparently become friends thereafter in cyberspace.

When asked if Christopher chats with his schoolmates on instant messaging, he explains pointedly: '(I) don't have (that)', and none of his schoolmates have an account. This is not surprising given the general low knowledge and experience of IT and assistive technology.

Some children have no home access to IT and computers as Mindy, an 11 year old explains: '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 neighbour 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 access to assistive technology is not adequately provided for in school for students with visual impairments. Current school practices indicate an inconsistency in how assistive technology is delivered and used as a means of accessing information and as a tool to complement teaching and learning.

Evidence suggests that the majority of teachers in the school are not sufficiently aware of the benefits of assistive technology. Only one teacher emerges as a proponent of assistive technology in the school and there is insufficient expertise to develop a differentiated assistive technology curriculum to meet the needs of students with such varying degrees of understanding. There was some evidence that students in primary 2 to primary 6 were using the computers to begin acquiring keyboard skills and search for word definitions but beyond these efforts, there was limited evidence of efforts to advance the students' use and knowledge of assistive technology.

Where the school is not adequately meeting the assistive technological needs of the students, external channels of influence are critical contributors to shaping knowledge of assistive technology. Parental involvement is emerging as a vital facilitator for laying down the basic knowledge while siblings and friends represent potential resources for

developing skills. The importance of family and social networks cannot be underestimated in expanding and reinforcing opportunities and skills where formal channels are inadequate. Clearly the role of charities in championing assistive technology for persons with visual impairments needs strengthening. Greater advocacy and collaboration between Lighthouse School and appropriate champions is necessary to establish appropriate support.

IMPLICATIONS OF THE STUDY

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 of assistive technology as a tool for teaching and learning must be promulgated. An immediate action could be to organize hands-on workshops to inform school leaders and teachers of the potential of assistive technology and its implications for pedagogy.
- 2 The provision of in-service professional development programmes to foster competence and maintain knowledge of up-to-date developments in assistive technology is crucial. The National Institute of Education also needs to include assistive technology as part of the initial teacher preparation curriculum.

Parent and sibling education

- 3 Parental education is important if parents are to have a hand in helping the child to become comfortable with technology. Parents in this study fell into two general groups: parents who do not use ICT themselves and remain unaware of assistive technology and its potential; parents who have some awareness of ICT and assistive technology. Both groups can benefit from information, updates and strategies to enhance their knowledge. Workshops to introduce parents to assistive technology (AT) are critical to raise awareness of the possibilities of AT and of the benefits that can facilitate independence for their child. Once trained, parent volunteers can become a school resource. Where necessary, charities should consider providing subsidies to help parents acquire assistive technology.
- 4 Siblings are a key resource in advancing familiarity in ICT. Brothers and sisters of the student with visual impairment have been born into

a generation that is naturally more pre-disposed to ICT and all things digital. This makes communication and coaching between siblings an obvious area for development.

- 5 By extension, external networks of friends and peers from the same generation offer opportunities for peer coaching and for social networking through inter-school collaborations. Communication media offer a tangible way of building skills in assistive technology. Email, instant messaging, text messaging can enable 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.
- 6 Accessible computer games are an untapped resource that can introduce students to the possibilities of computers other than for school work. Games, in this instance, are a bridge to stimulate interest in AT.
- 7 For IT and assistive technology to benefit students with visual impairments, it is critical that access to the hardware and software is available at home and in school. Limited access is a major obstacle to extending knowledge and further handicaps students with visual impairments in the curriculum. To avoid students working in silos, greater collaboration between Lighthouse School, Singapore Association of the Visually Handicapped and the InfoComm Accessibility Centre is essential.

CONCLUSION

The assistive technology experiences of students with visual impairments have revealed limitations in pre-service and in-service 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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