EXPERIENCES OF STUDENTS WITH VISUAL IMPAIRMENTS IN ADOPTION OF DIGITAL TALKING TEXTBOOKS: AN INTERPRETATIVE PHENOMENOLOGICAL ANALYSIS

By

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ABSTRACT

This study was conducted to explore the experiences of Malaysian secondary students with visual impairments in using digital talking textbooks (DTTs) to assist their learning. Data were obtained from individual in-depth interviews. An Interpretative Phenomenological Analysis (IPA) was used to understand the findings and confirm the emergent themes. Six super-ordinate themes emerged from the interview transcripts: (a) functionality, (b) user support, (c) knowledge/familiarity, (d) challenges of access, (e) alternative, and (f) adaptation of DTTs are discussed. In conclusion, four high-level recommendations are made for future DTT design: 1) design based on current and projected work habits of students, 2) develop proactive user support, 3) teacher training, and 4) design based on adaptation and flexibility.

Keywords: adoption, technology enhanced learning, assistive technology, digital talking textbooks, interpretative phenomenological analysis

INTRODUCTION

Assistive Technology (AT) refers to any technological tool or device that assists students with disabilities to access learning materials and perform learning tasks easily. This includes handheld magnifiers, large print texts, voice recognition, digital hearing aids, Optical Character Recognition (OCR) systems, electronic whiteboards, Braille reading, digital talking books, Braille translation software, and screen magnification software (Wong & Cohen, 2011; Georgia's Assistive Technology, 2011; Presley & D' Andrea, 2008).

AT devices have a positive impact on visually-impaired students' learning, such as motivating students (Cooper & Nichols, 2007; Kapperman, Sticken, & Heinze, 2002; Strobel, Fossa, Arthanat, & Brace, 2006), developing positive relationships to academic achievement (Huang & Russell, 2006; Trucano, 2005), increasing reading and comprehension rates (Corn, Wall, Jose, Bell, Wilcox, & Perez, 2002; Howell, 1996; Kennedy, 2002; Merbler, Azar, & Ulman, 1999), enhancing learning and gaining opportunities for equality in education (Coard, 2002), enabling participation in online discussions (Lee & Templeton, 2008), developing social networks (Gerber, 2003), understanding three-dimensional and non-linear illustrations in math (Cahill, Linehan, McCarthy, Bormans, & Engelen, 1996), and gaining access to curriculum materials generated in printed Braille (Farnsworth & Luckner, 2008; Fitchen, Asuncion, Barile, Ferraro, & Wolforth, 2009; Gerber, 2003; Kelly & Smith, 2011; Roentgen, Gelderblom, Soede, & Witte, 2009).

Barriers to Adoption of AT

Several barriers to the adoption of AT have been reported in the literature, such as lack of financial resources (Copley and Ziviani, 2004; Fifield & Fifield, 1997), high costs of equipment (Wehmeyer, 1998), a lack of knowledge and support from teachers and staff (Abner & Lahm, 2002; Alper & Raharinirina, 2006; Copley & Ziviani, 2004), lack of student willingness, complicated design, unreliable equipment, lack of technical support (Philips & Broadnax, 1992; Todis, 1996), lack of opportunities due to insufficient provision of assistive technology devices and time, insufficient funds to purchase the assistive technology

devices, lack of appropriate teacher training (Kapperman, Sticken, & Heinze, 2002; Copley & Ziviani, 2004), and difficulties procuring and managing equipment (Copley & Ziviani, 2004).

This study focuses on the experiences of secondary school visually-impaired students who used the DTTs in a variety of subjects including Malay language, English language, Islamic education, geography, history, and moral education. This paper discusses a qualitative research study that explored, described, interpreted, and situated the experiences of these students as they used DTTs to assist their learning. The purpose of this study was to explore the experiences of visually-impaired students as they were exposed to, and adopted (or rejected), the DTT technology.

Digital Talking Textbooks

In Malaysia, the Ministry of Education realizes and believes that Technology Enhanced Learning (TEL) is crucial for revolutionizing the education system. Thus, the Ministry formulated three main policies related to TEL and its importance for education: 1) TEL for all students, as an enabler to reduce the digital gap among schools, 2) TEL as a teaching and learning tool, and 3) TEL as a tool to increase productivity, efficiency, and effectiveness of the management system in schools. These policies are in line with Malaysia's aspiration to become a fully developed nation by the year 2020 (Ministry of Education, 2003).

In 2009, as a part of a larger effort to implement these TEL policies, the Ministry of Education developed and introduced Digital Talking Textbooks (DTTs) into the school system, specifically for students with visual impairments. DTTs were introduced to both primary grade (ages 7-12) and secondary grade students (ages 13-17). The Ministry of Education went to great lengths to build DTTs that were accessible. The DTTs were designed based on the Digital Accessible Information System (DAISY) standard, a global standard designed to deliver change and best practices for reading and publishing. The DAISY standard for digital talking books includes best practices for navigation, bookmarks, sound quality, devices and software compatibility and integration with stand-alone players and MP3 players (DAISY, 2013; Duarte & Carrico, 2007).

Research Approach

To understand students' experiences, the researchers employed and applied an Interpretative Phenomenological Analysis (IPA) as the strategy of inquiry. IPA was used to capture the essence of the student's experience (phenomenology) and understand how each student created complex meanings from their DTT experiences. Consistent with IPA theory, we assumed that the "data could tell us something about people's involvement in and orientation toward the world, and/or about how they make sense of this" (Smith, Flowers, & Larkin, 2009, p. 46).

The primary research question for this study was: What are the factors influencing students with visual impairments to adopt or to reject the DTTs? The findings of this research contribute to the knowledge base on diffusion of innovation, specifically focusing on the adoption of a technological innovation by visually-impaired students. The significance of the findings for future diffusion researchers, policy makers, educators, and friends and family are discussed.

Participants

Twelve students with visual impairments were selected based on a purposive sampling procedure. The participants were identified based on their characteristics, characteristics that were representative of the student population. This characteristic-based sampling method was consistent with previous IPA research (Johnson & Christensen, 2012; Patton, 2002). The characteristics of interest included blind and low vision, school age (15-17 years), gender, and received DTTs for at least one subject.

A combination of male and female students were selected to get a cross-gender perspective. Furthermore, students were selected who were in the age range of 15-17 because students at these ages had more time working with the DTT. Additionally, it was theorized that older students would be able to provide more substantive experiential information because of their maturity and overall life experiences with a variety of educational / learning processes and use of AT tools.

Data Collection

Individual semi-structured interviews were used to gather data from the participants. The interviews were conducted by the researcher toward the end of the first semester of the school year. The procedures of data collection were as follows:

(a) Each student was asked to answer a questionnaire that captured demographic information.

(b) Each student was asked to select a pseudonym or a pseudonym was assigned to each student to ensure anonymity.

(c) The researcher used guiding questions to explore the participant's experience in using DTTs. These questions included:

i) What do you know about DTTs?

ii) How do you access content of DTTs?

iii) How do school administrators and teachers support you in using the DTTs?

iv) How do parents and friends support you in using the DTTs?

v) What are the benefits of using the DTTs?

vi) What are disadvantages of using the DTTs?

vii) What are the challenges you faced in using the DTTs?

(d) Interviews were conducted in the learning resources room of the school.

(e) Each interview was recorded using a digital audio-recorder (consent to record was obtained).

(f) At the end of the interview session each student was informed about the individual member check session the following week.

Data Analysis

After the transcripts were translated to English, the researcher followed the six steps of IPA data analysis: (1) reading and re-reading the text or transcripts, (2) doing initial noting, (3) developing emergent themes, (4) searching for connections across emergent themes, (5) moving to the next participant, and (6) looking for patterns across participants (Smith, Flowers, & Larkin, 2009).

Each interview transcript was read several times, and the investigator made exploratory comments on the transcripts and recorded the comments in the 'Annotations' section of the NVivo10 software. The exploratory comments were analyzed to identify the emerging themes in the third step. In the fourth step, the emerging themes were then clustered based on 'natural clusters of concepts' and 'hierarchical relationship.' This process required the researcher to move back and forth among the lists of emerging themes and involved charting the development of how the researcher thought the themes could fit together. Then, the investigator moved to the next student's interview transcript, and repeated the process as performed with the data from the first transcript. Finally, patterns were identified and a master table of themes was developed which included the cluster and subordinate themes with quotations from the transcripts as evidence.

Findings

Analysis of the data revealed 23 emergent themes, which were clustered into six super-ordinate themes: (a) functionality, (b) user support, (c) knowledge/familiarity, (d) challenges of access, (e) alternative, and (f) adaptation of DTTs. Each of these super-ordinate themes is discussed below and broken into subthemes to help convey the findings of the research. Pseudonyms are used to present the findings and protect the identity of each student.

Functionality

During the interviews students spent a considerable amount of time talking about the DTT functionality. This super-ordinate theme is best described as five subthemes including usability, comfort with the innovation, difficulty, and usefulness/time saving.

Usability: Several students perceived the DTTs as usable or compatible with the existing applications and software, hardware players, their learning needs, and subjects' need. Naim shared, "I use media player software that is already installed in my computer." Enn mentioned, "With the computer, I access the digital talking textbooks by the FSReader™...the software for the visually-impaired people."

Some students viewed the DTTs as fulfilling their education needs. Naim declared, "One of the reasons [to adopt the DTTs] was my eyes could not see clearly if I were to read from the regular textbooks." Zaiful said, "For those who do not really enjoy reading, then the digital talking textbooks would be the perfect choice." Several students adopted

the DTTs because there were no alternatives for a certain subjects. Teh shared, "There is no Braille textbook for Islamic Education…and there is also no other reading material to assist learning for that subject." However, for some subjects like science and languages, the DTTs were found to be less useful by the students. Daniel said, "I think the digital talking textbooks are not suitable to aid the teaching and learning activities [activity-based lessons]."

Comfort with the innovation: Students expressed a mixture of responses that all related to their comfort while using the DTT. Daniel strongly stated, "I do not feel quite comfortable…as I said, it is because of the contents' instructions and the voices used to convey the contents." However, several students pointed out that they were comfortable with the DTTs. For example, Enn expressed, "We do not have to read anymore, all we need to do is just listen to the digital talking textbooks." Zaiful asserted, "I can doze off while listening to the voices."

Difficulty: A grouping of students expressed difficulty with using the DTT. Basyirah commented, "Technically the digital talking textbooks are not that feasible, as we cannot simply rewind the CD to the section that we wanted to go." Zaiful remarked that accessing the content on DTTs was quite complicated, "It is a little more difficult to use the digital talking textbooks [for topical exercises]…because we need to fast-forward and rewind to figure out the answers for the questions, it is way more difficult to search for the answers."

Usefulness/Time saving: According to Naim, "The digital talking textbooks really help us to comprehend and be prepared for the group discussions." Daniel commented that "time-wise, I can save a lot more time when I use the digital talking textbooks for other school activities [homework]." Zaiful pointed out, "During the free time, we certainly could listen to the contents of the subjects from the DTTs; it is also lightweight, handy, and portable." Mirul said, "It is super easy too…can be used anywhere…with the digital talking textbooks, we just need to switch on the computer, find the pages that the teachers would want us to focus, and we just browse through the pages needed."

User support

The second emergent super-ordinate theme centered on support while using the DDT. Interviewees talked about support from teachers, and interesting to note, they spent considerable time discussing the importance of the support they received from friends and family. This super-ordinate theme is best described as three subthemes including teacher support, peer support, and self-driven behavior.

Teacher support: Zaiful said, "The teachers are all really helpful in terms of granting the permission to bring our own laptops." Ning also said that the teachers encouraged them to use the DTTs, "The teacher demonstrated to my other peers, and one of my peers showed me how to use the digital talking textbook."

Peer support: Reflecting on support, Daniel admitted, "…my peers are being so supportive about the digital talking textbooks…they [peers] show me a lot about how to use the digital talking textbooks more efficiently." Students also reported that they received support and encouragement to use the DTTs from their parents. Naim said, "I use it sometimes at home…and they [parents] also encourage me to use it…They [parents] are absolutely okay with the digital talking textbooks, mainly because it serves its purposes well."

Self-driven behavior: Interest in using the DTTs also comes from within, which forms the theme of self-driven behavior. According to Mirul, "I have my own interest too, to use the digital talking textbooks…I explore everything by myself…it is super easy." Teh said that most of the time she explored the DTTs by herself and received help from friends. She proudly shared that she was also able to access the DTTs out of her own curiosity as, "Umhh…I did explore everything by myself and asked my peers around."

Knowledge / Familiarity

It is important to note that the knowledge/familiarity theme was guided by interview question number one, what do you know about DTTs? Student responses varied, and these findings generated important considerations. Basyirah mentioned, "It was provided by the Ministry of Education for the blind students to be used in learning." Naim echoed, "The digital talking textbooks were provided by the Ministry of Education to be utilized by all students with visual impairments." Students discussed their familiarity with the DTTs in different ways. Ning mentioned, "I am not getting

used to it yet. I will see what I could do with that." Hong said, "I just used it last week so I may need some time to really master it." Basyirah perceived that other students may not be familiar with the necessary computer skills to master the DTT innovation, "Some of the students are not really skillful in using the computer…therefore, to get the CD functions [DTT functionality] correctly might be a new challenge for them…and it will be time-consuming to learn all these new skills."

The school's administrators and the teachers were the primary sources of information and knowledge about the DTTs. Students' Affairs provided the DTTs and informed the staff and students about the use of the DTTs. As Celine pointed out, "I am just being informed about the digital talking textbooks. We received the CD of the digital talking textbooks last week from Mrs. Ruzi" [the Senior Assistant of the Students' Affair].

Challenges of Access

Having access to the DTTs emerged as a concern and a super-ordinate theme. Students shared three major challenges related to access: teachers' lack of trust, unavailability of the devices, and limitations of time.

Teachers' lack of trust: It is interesting to note that several students reported issues of trust between themselves and their teachers. Students, who were using the DTTs during the school hours, felt as if the teachers were always watching over their work to see if they were on task. Mirul shared, "The teachers sometimes might get suspicious with us…that we might actually listen to the music, not to the contents of the syllabus." This may have been derived from the teachers' past experiences with certain students listening to music instead of listening to the DTTs.

Unavailability of the devices: The students agreed that the absence of the device affected the adoption of the content to the DTTs. Hong claimed, "For students who do not own laptops or the DAISY players, they will not be able to use the digital talking textbooks." Similarly, Enn experienced the absence of a device when she wanted to use the DTTs: "Whenever I wanted to use the DTT, I do not have a computer available. If I have limited time to execute certain tasks, I would use the Braille textbooks. It is a lot quicker and more feasible."

Limitations of time: Furthermore and related to unavailability of the devices, several students noted that other school activities, particularly co-curricular activities, were among the main reasons they refrained from using the DTTs. Enn disclosed, "I had quite a lot of homework to finish up, so I did not have space to use the digital talking textbooks." Similarly, Celine said, "I usually use it at home because the schedules while I am at school are so tight." In addition to the tight schedules and amount of activities designed for that particular school, the students experienced limitations of time to use the computer laboratory facilities. Zaiful said, "The computer laboratory at school is operated within its limited time schedule."

Alternatives to the DTTs

Instead of solely using the DTTs, students also discussed how they used other AT in conjunction with the DTT for learning. They discussed using AT such as printed Braille textbooks, Closed Circuit Televisions (CCTV), personal readers, Internet, and notes from teachers. Basyirah stated, "I use the Brailler. The teachers also provided the notes in the soft copy." Some students viewed the Internet as a valuable learning resource and succinctly described the importance of the Internet in their learning process. Mirul pointed out, "I also use the Internet and other reference revision books [reference books other than Ministry's textbooks]."

Another alternative to the DTTs are personal readers. Naim said, "I also use the reader or ask others to read aloud for me, usually my peers." Enn employed a personal reader for the specific subjects without the digital talking textbooks or Braille textbooks. She pointed out, "There are certain subjects that do not have the Braille textbooks available such as the Living Skills [subject of living skills]; therefore, we may need to ask peers to read out loud for us from the Braille textbooks."

Ning shared her experience, "I use CCTV to read the regular textbooks." She only opted to use the DTTs when the CCTV was not available, such as when she was in a dormitory. "Sometimes I could not get the CCTV in my dormitory. Therefore, the digital talking textbooks might help me access the contents of the syllabus."

Adaptation to DTTs

Adaptation occurred when students took initiatives in using the DTTs, based on financial affordability, to own certain devices such as external speakers and MP3 players. Teh stated, "The CD can be burnt [copied or transferred], and I could listen to the content by using the MP3 player." Naim added, "I do have copies of the digital talking textbooks' contents in MP3 files. We can save everything in a pen drive, and we could listen to it anywhere at our own convenience." Mirul transferred the contents of the digital talking textbooks into a "thumb" drive and listened to the contents using an external speaker. He stated, "we could save the learning contents into a 'thumb' drive and use a small speaker to listen to the contents."

Discussion

Table 1 lists the superordinate themes that emerged from this study, support for each theme from the literature, and suggested DTT recommendations /considerations. The significance of each design consideration is discussed below.

Functionality

As was presented in the findings, functionality was consistently discussed as both a reason for adoption and/or rejection of the DTT. Rogers mentioned that compatibility of an innovation consisted of three components that may lead to adoption: (a) previously introduced ideas, (b) users' need, and (c) values and belief. More specifically, in a diffusion study that involved users with disabilities, Baker & Bellorde (2004) found that incompatibilities of an innovation with users' purposes appeared to generate barriers to adoption and may have persuaded the subjects to reject learning interventions.

Super ordinate themes and Design consideration	Connection to literature
Functionality	Compatibility (Rogers, 2003;
• Maintain/increase compatibility	Holcombe, 2000)
• Promote and design for user needs and behaviors	Rejection of AT due to complexity
• Focus on course subjects that have few alternatives	(Baker & Bellorde, 2004).
• Design for adaptation	Adaptability (Rogers, 2003)
User support	Social systems (Rogers, 2003)
• Provide training on use and change agency for teachers/administrators	Communication networks (Rogers, 2003)
• Provide opportunity for peer - to - peer support	
• Provide information for parents	
Knowledge/familiarity	
• Opportunities to try	Trialability (Rogers, 2003)
Challenges to access	
• Provide access to players and computers	Time/observability (Rogers, 2003)
• Incorporate use into curriculum and activities	
Alternatives	
• Highlight multi - AT opportunities / best practices	Decision stage (Rogers, 2003)
• Design for multi -AT use	

Table 1. Super-ordinate theme, connection to literature, and DTT design consideration.

We recommend that future design focus on DTT functionality, making it compatible with existing ideas, user needs, and beliefs. For example, technical difficulties such as being unable to rewind the CD to a specific section, and having to stop the device to answer course exercises, which increased the time of use were incompatible with users' current practices and behaviors. Student users reported that this incompatibility led them to reject the DTT. It is suggested that DTT designers evaluate current student behavior, including reviewing behavior (rewinding), pausing, skimming, and current approaches that students use to save time. Functionality that is compatible with current behaviors should be considered and where appropriate designed into the DTT functionality.

Additionally, DTTs functionality appeared to be dependent on the topic being studied. As Rogers (2003) suggests innovations must have a significant advantage relative to other competing innovations. Several students declared that DTTs were not suitable for English and Malay language subjects where other methods and materials for learning existed. Consequently, students stopped using the DTTs designed for these subjects after an initial use. It appeared that students were more likely to adopt the DTT if the subject did not have alternative and adequate learning resources. We suggest that DTT designers first focus on subjects that have few audio-based alternatives.

Students reported experiencing many functional benefits of DTTs, such as assisting with school tasks, preparing for class and group discussion, and comprehending the lessons. These direct benefits stimulate students to adopt DTTs because the innovation saved them time in executing their homework and helped them understand the content. Specifically students discussed features included portability and accessibility of the content. For example,

students reported they copied the contents of the DTTs onto a thumb drive, then used an MP3 player and portable external speakers to access content of DTTs. Students consistently reported on the benefits of being able to adapt DTTs to their "way of doing things" and how this made the DTT usable. Buabeng-Andoh (2012) reported that the effective and successful use of innovation depends on this type of accessibility. Rogers (2003) suggested that one strategy for effective diffusion of an innovation is to get the users to adapt an innovation, incorporating the functionality into their behavioral routine and making it their own. We suggest that DTT designers continue to allow the DTT technology to be copied, transported, and adapted in these ways. Furthermore, we suggest that administrators and change agents provide affordable devices, such as MP3 players and thumb drives that will enable this type of adaptation and use.

We make this recommendation with the following caveat. Using an MP3 player and portable external speaker could limit students' access to the advanced features of DTTs, such as bookmarks. If these features are considered vital we suggest that the DTTs be designed around a single technology, such as DAISY players, so that students are ensured full opportunity of using the advanced features.

User support

Some students reported that school administrators, particularly assistant principals and teachers, encouraged students to use DTTs. It was described as "granting permission," "teacher encouraged me," and "teacher demonstrated." However, other students declared that they did not have full support from the school administrators, teachers, and parents to adopt DTTs. Establishing a plan for training and supporting change agents (the leader of the change effort) has clearly been effective in stimulating adoption of an innovation and speeding up the diffusion process (Beigel, 2000; Rogers, 2003; Sharpe, 2011).

We suggest that DTT developers provide training for administrators and teachers. This training should not only be in "best uses" of DTT, but should include training on change agency and how best to secure the adoption of this type of technology.

Peer-to-peer support, parental guidance, and self-driven behavior also emerged as a strong theme that was related to favorable adoption of the DTT. Opportunities for peer-to-peer support and for students and their parents to learn and explore the use of DTTs should be planned for and provided. For example, parents could support adoption by providing laptops and affordable tools to be used with DTTs, such as external speakers and thumb drives. As Rogers (2003) suggested these types of informal communication networks are vital to successful adoption.

Knowledge/familiarly

The study indicates that students were knowledgeable about the purpose and the features of DTTs as quoted "to help us in learning," "to be utilized by students with visual impairments," "the audio books," and "we could listen to the books with computer." However, students did not have sufficient skill to make full use of DTTs due to, particularly, lack of guidance and less training on the use of DTTs. Instead, students who adopted the DTT were self-directed and curious. This self-exploration led them to incorporate these tools into their learning process.

Challenges to access

Teachers' skepticism was an unexpected theme that emerged. Some teachers apparently had doubts that their students were listening to DTTs one student said, "teachers sometimes might get suspicious with us." There was some evidence that teachers may have lacked a basic understanding of the DTT innovation and how to best use it in a classroom setting. Some students commented that their teachers rarely talked about the DTT nor did they provide guidance or demonstration of its best use. Teachers' pessimistic attitudes toward the DTT innovation were recognized in other research studies as one of the challenging factors for students with visual impairments to effectively use the innovation (Cook & Hussey, 2002; Copley & Zivani, 2004; Fraser & Maguvhe, 2008; Messinger-Willman & Marino, 2010).

DTT developers and state education departments could concentrate on efforts to encourage school administrators, teachers, and students to adopt this innovation. These stakeholders could organize workshops and trainings to introduce and promote the DTTs for school administrators,

teachers, and students.

Alternatives

The current study reveals that students were attempting to figure out how best to use or incorporate DTTs into their current learning methods. After using the DTTs for quite some time, low-vision students appeared to revert to printed/Braille textbooks and CCTV, as well as notes from teachers to access the lessons. Furthermore, some students decided to reject DTTs because of the limitations found within the innovation which included lack of illustrations, tables, and charts compared to Braille textbooks for the same subjects. In addition, it is notable that the contents' structure of DTTs was very similar to the organization and structure in the printed textbooks. Students reported that sections such as the acknowledgments, preface, references, as well as long irrelevant passages are not suitable to be included in DTTs. DTT designers should consider each section of the textbook as unique having its own design challenges and requirements.

The advantages of the printed textbook alternative and limitation of the given DTT combined caused many of the low vision students to reject the DTT. This finding is similar to other research where electronic devices such as CCTV and non-electronic optical devices such as magnifiers were shown to be more accepted, effective, and accessible than DTTs, particularly to students with low vision (Jutai, Strong, & Russell-Minda, 2009). Therefore, we recommend that DTT designers spend a considerable effort to understand the learning behaviors and educational needs of low-vision students. Matching these users' needs and behaviors may improve the adoption rates for DTT technology.

It was apparent that the introduction of the DTT created a complex scenario for students as they attempted to figure out how to best incorporate the DTT within their learning environment. Here we strongly suggest that additional research and coordination are needed to identify "best practices" for DTT use. For example, in the context of this study, we suggest that the Ministry, with cooperation from different divisions including the Curriculum Development Center, the Textbook Division, and the Special Education Division, could coordinate an effort and design DTTs that specifically address the weaknesses of other AT such as Braille textbooks, CCTV, teachers' notes, and the Internet. This will help students receive the highest quality DTTs and foster full adoption of the innovation.Adaptation of the DTTs

To access the content of the DTTs, students adapted DTTs usage to suit their devices. The Ministry of Education provided DTTs for students in the form of audio CDs with two types of files: Synchronized Multimedia Integration Language (SMIL) files and MP3 files. The SMIL files could be opened with both DAISY and with a CD player. Students without the DAISY application or CD player, copied the contents of DTTs in an MP3 format onto a thumb drive then accessed the contents using an MP3 player or with an external speaker, which are more affordable than other dedicated readers. The researcher assumes that students' creativity in adapting the innovation played an important role in adoption of DTTs to assist learning. Adaptation to the innovation is an important factor influencing the adoption of an innovation (Kintsch & DePaula, 2002; Riemer-Reiss & Wacker, 2000; Scherer, Sax, Vanbierrvliet, Cushman, & Scherer, 2005).

Conclusions

This IPA study looks at the adoption of an innovation among students with visual impairments The researcher interpreted students' experiences in using DTTs by conducting IPA procedures. The findings reveal the students' experiences in six super-ordinate themes: functionality, user support, knowledge/familiarity, challenges of access, alternative, and adaptation of DTTs. We conclude that future development of DTTs can and should be informed by current implementations.

Toward this end, we recommend four high-level considerations. First, DTTs should be designed based on both current and projected student work habits/needs and projected innovative functionality. Textbooks adapted into a DTT format may complicate students' study behaviors and cause frustration. These behaviors should be carefully considered in DTT design. Second, developers need to develop and provide interactive user support (both for the student, parent, and teacher). User support needs should be developed proactively and given additional priority.

Third, teachers need to be trained on how to incorporate these tools into their curriculum. Teacher anxiety was a consistent theme. Fourth, we recognizes that the adoption of DTTs could be enhanced by encouraging alternative use, modification, and adaptation of DTTs and other tools. DTTs should be designed in ways that allow for and even encourage students to freely pick and choose the tools that help them learn best. These behaviors should be studied intently and the findings used to redesign assistive tools to further enhance learning.

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