# THE USE OF ADAPTIVE TECHNOLOGY AMONG VISUALLY IMPAIRED STUDENTS AT MALAYSIAN TERTIARY INSTITUTIONS



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UNIVERSITI PENDIDIKAN SULTAN IDRIS

2022

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# ABSTRACT

The purpose of this qualitative study is to explore, describe, and interpret the experiences of students at tertiary education with visual impairments in using adaptive technology particularly Digital Electronic Textbooks (DETB) with Screen Reading Programmes (SRP) to assist learning. This is a qualitative study which involves the methods of interview and observation. A total of six participants between the ages of 18 to 30 from tertiary institutions are selected. Findings show six emergence themes, types of vision loss, the types of adaptive technology used, awareness of adaptive technology, support from university administrators and parents, the benefits and disadvantages of adaptive technology. functionality of adaptive technologies, awareness of knowledge, support from parents, university administrators and lecturers, and direct benefits may influence visually impaired students' preference in adopting the use. Scarcity of DETB and accessibility conundrums are the disadvantages. Hence, for this study, the participants' decisions whether to adopt or to reject the use of DETB with SRP were chiefly dependent upon these emergent findings. In order to achieve optimum inclusion of visually impaired students' full participation in the classrooms and library, a clear implementation of adequate support from professionals, including university administrators, lecturers and librarians, are ultimately important in implementing adaptive technology in education settings. Visual impairment is not homogenous. limited visually impaired students at tertiary institutions met the researcher's criteria and types of adaptive technology used.future researchers may consider following the audit trail of this study to explore either primary or secondary visually impaired students' experiences in utilising other adaptive technology such as tablets, electronic braille and speak, screen magnifiers and refreshable braille gadgets to assist learning.

# PENGGUNAAN ADAPTIF TEKNOLOGI DIANTARA PELAJAR-PELAJAR KECACATAN PENGLIHATAN DI INSTITUTSI TINGGI MALAYSIA

## ABSTRAK

Tujuan kajian kualitatif ini adalah untuk meneroka, menerangkan, dan menafsirkan pengalaman pelajar di pendidikan tinggi dengan masalah penglihatan dalam menggunakan teknologi adaptif terutamanya Buku Teks Elektronik Digital (DETB) dengan Program pembaca Skrin (SRP) untuk membantu pembelajaran. Ini adalah kajian kualitatif yang melibatkan kaedah temu bual dan pemerhatian. Sebanyak enam peserta berumur antara 18 hingga 30 tahun dari institusi pengajian tinggi terpilih. Dapatan kajian memunculkan enam tema, jenis kehilangan penglihatan, jenis teknologi adaptif yang digunakan, kesedaran mengenai teknologi adaptif, sokongan daripada pentadbir university dan ibu bapa, kebaikan dan keburukan teknologi adaptif. Fungsi teknologi adaptif, kesedaran pengetahuan, sokongan daripada ibu bapa, pentadbir universiti dan pensyarah, dan faedah langsung boleh mempengaruhi pilihan pelajar yang cacat penglihatan dalam penggunaannya. Kekurangan DETB dan factor aksesibiliti adalah ciri-ciri kelemahan. Oleh itu, untuk kajian ini, keputusan peserta sama ada untuk mengadopsi atau menolak penggunaan DETB dengan SRP sangat bergantung pada dapatan kajian ini. ini. Untuk mencapai penyertaan optimum dari pembabitan penuh pelajar cacat penglihatan di bilik darjah dan perpustakaan, pelaksanaan yang jelas dari sokongan yang mencukupi dari para profesional, termasuk pentadbir universiti, pensyarah dan pustakawan, akhirnya penting dalam menerapkan teknologi adaptif dalam persekitaran pendidikan. Masalah cacat penglihatan adalah tidak homogen. Pelajar cacat penglihatan yang terhad di institusi pengajian tinggi tidak memenuhi criteria penyelidik dan jenis teknologi adaptif yang digunakan. penyelidik masa depan mungkin mempertimbangkan untuk mengikuti jejak audit kajian ini untuk meneroka pengalaman pelajar cacat penglihatan sekolah rendah ataupun menengah dalam menggunakan teknologi penyesuaian lain seperti tablet, braille elektronik dan pertuturan, pembesar skrin dan alat braille yang disegarkan untuk membantu pembelajaran.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADF | Automatic Document Feeder |
| APA | American Psychological Association |
| AST | Adaptive Structuration Theory |
| AT | Adaptive Technology |
| CAT | Comprehensive Assistive Technology |
| DETB | Digital Electronic Textbooks |
| DAB | Digital Audio Books |
| DAISY | Digital Accessible Information System |
| DOI | Diffusion of Innovation |
| DRR | Disabilities Resource Room |
| GUI | Graphic User Interface |
| HEIS | Malaysian Higher Education Institutions |
| ICT | Information and Communication Technology |
| IDEA | Individual with Disabilities Education Act |
| IWVB | Individuals with Visual Blindness |
| JAWS | Job Access With Speech |
| MAB | Malaysian Association for the Blind |
| MOE | Ministry of Education |
| MOHE | Ministry of Higher Education |
| Ms | Microsoft |
| NEA | National Education Association |
| NGO | Non-Governmental Organizations |
| NVDA | Non Visual Desktop Access |

| | |
|---|---|
| OCR | Optical Character Recognition |
| OKU | Orang Kurang Upaya (Disabled people) |
| PDA | Personal Digital Assistant |
| PDF | Portable Document Format |
| QOL | Quality of Life |
| RP | Retinitis Pigmentosa, |
| RQ | Research Question |
| SRP | Screen Reading Programme |
| TTS | Text-to-Speech |
| UDSM | University of Dar es Salaam |
| UM | University Malaya |
| WCAG | Web Content Accessibility Guidelines |
| WWW | World Wide Web |


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# CHAPTER 1

# INTRODUCTION

## 1.1 Preface

With the advancement of adaptive technology such as Screen Reading Programme (SRP) and Digital Electronic Textbooks (DETB), life of visually impaired students pursuing education particularly tertiary education is much easier in the 21st century. SRP is pre-installed into a window-based computer or electronic device to assist visually impaired students to navigate the contents and to read DETB, which is a conversion of traditional hard copy books into readable text, and enabling them to study independently (Rector, Salmon, Thornton, Joshi and Morris, 2017).

DETB is widely available in various formats, including PDF, Microsoft Word, not limited to Arkinston, HTML and E-Pub, which allows the learner to access them on multiple platforms of gadgets such as Windows and Macintosh computers,

smartphones, and tablets (Ragavi, Radja, & Chithra, 2016). Therefore, DETB could be classified as digital books that could assist students who have low vision or are totally blind.

DETB may enhance the capability of visually impaired students in numerous ways. First of all, it could increase the visually impaired students' Access to quality education because they could learn at any place or time that they prefer (Stolley, 2016). Subsequently, they could minimize the education discrimination and inequality experienced by the students with special need. DETB would also enable such students to enroll in online courses and access DETB via online library (Yoon, Dols, Hulscher and Newberry, 2016), which are relatively handy and convenient than studying on campus. However, the adaptation of technology is dependent on the structure of advanced adaptive technology and human factors, which will be explored in the current study.

Several Screen Reading Programs (SRP) that exist commercially are JAWS screen reader which literally stands for Job Access With Speech, could assist the blind and visually impaired people in navigating through DETB. Another one is popularly known as Hal screen reader (Chandran, Aravind, Gopinath, & Saranya, 2015). Blind learners could use the physical keyboards or flick their fingers on the accessible touch screen-based devices to navigate through a given text or to surf the internet. SRP could be broadly classified into two based on their mode of operation (Asakura & Watanabe, 2017). SRP that use speech synthesizer technology could receive audio commands from the user and-also convert the text file into an audio output. On the other hand, the input and output of some of the SRP are in the Dysie Braille format.

SRP could facilitate learning for visually impaired students in multiple ways. First, it could enhance their learning flexibility and freedom since they could study by means of listening to the text, which could improve their performance (Schlünz, Wilken, Moors, Gumede, Walt, Calteaux, & Niekerk, 2017), whereby they also enhance the ease of utilization of the user interface of the adaptive technology, which could increase the likelihood of the resource being utilized by students.

The efficiency of DETB in assisting visually impaired students is strongly correlated to the quality of the SRP being used. For instance, if the SRP is easy to use, it is likely to be acceptable by organizations and students. However, if it is complex, students who may not receive adequate training could find difficulty in operating it (Abdolrahmani & Kuber, 2016). Therefore, the two adaptive technologies could be explored together by utilizing the theoretical framework of adaptive structuration theory (AST) developed by Desanctis and Poole (1994).

Visual impairment could be broadly classified as low vision and blindness. Low vision could occur in several version including myopia, long-sightedness, and cataracts. Myopia occurs when a person cannot be able to see clearly further objects (Prasad, Malhotra, Kalaivani, Vashist, & Gupta, 2020). On the other hand, students who cannot focus on near objects are referred to long-sighted. Finally, people with cataracts could be unable to see things clearly. Therefore, the last two groups are the ones that are likely to benefit the most from adaptive technology distinctly DETB with SRP (World Health Organization, 2018).

On the other hand, blind students have zero vision, Consequently, they are compelled to learn using their auditory or touch senses. Therefore, the adaptive technology that could assist the class of visually impaired students should have speech synthesizer or Braille system (Bhalla, 2016). Blind students face most of the difficulty in learning because they cannot see the contents of the learning materials.

DETB with SRP could improve the learning of visually impaired students irrespective of the classification of their condition. However, it is crucial for adaptive technology to have features that could address the special needs of the students (Kleynhans & Fourie, 2014). Therefore, DETB with SRP that have both tactile and speech synthesizer are likely to be more efficient than those that offer one learning method. However, they are likely to be more expensive, which could reduce students access to resources.



Tertiary institutions could be broadly classified as undergraduate and graduate studies. Undergraduate studies refer to post-secondary education, which could involve the study of diplomas, certificates, and first degree (Malaysia Educational Statistics, 2018). For one to be enrolled in a particular course they must have the attributed the minimum grade requirement. In some cases, it may be necessary for a person to have a diploma or certificate before enrolling in anundergraduate degree. Tertiary education is more demanding since it involves the learning of advanced and specialized topics. Moreover, students are required to learn more concepts on their own than in high school.

On the other hand, postgraduate studies involve Post Graduate diplomas, masters, and PHD degrees. For a student to enroll in the program, they must have an undergraduate degree (Malaysia Educational Statistics, 2018). Moreover, in some courses, a student could be required to have a minimum requirement of experience in a related field. Students are required to conduct extensive research and master complex concepts. Therefore, students who are enrolled in postgraduate studies are most in need of adaptive technologies to assist them in accessing DETB as well as online libraries (Abdolrahmani, Kuber, & Branham, 2018).

Most of the tertiary education is not classroom oriented. For instance, there has been a growth in online courses (Erickson, Lee and Schrader, 2017). However, students with visual impairment could fail to enroll in such programs because most of them do not have support systems cater for their needs (Park, Kim, & So, 2016). Therefore, understanding the organization, individual factors and the features of DETB with SRP could enhance their utilization in tertiary education.

All in all, the current study aims to explore the human and technological structures that could determine the adoption or rejection of DETB with SRP by Malaysia University students. DETB refers to traditional print textbooks that that have already been converted in electronic formats in which the contents are accessible and readable by SRP like JAWS on a Windows-based computer (Bigham, Lin, & Savage, 2017). Therefore, SRP refers to speech synthesizers or Braille systems that are used to read DETB. DETB has the potential to improve the learning experiences of university students who have low vision or complete blindness.

## 1.2 Background of the study

Various adaptive technologies have, been innovated to assist visually impaired students. The first, adaptive technologies that were developed were spectacles that could remedy myopia and long sightedness. Students have also been taught how to navigate in schools using canes (American Foundation for the Blind, 2018). However, the advancement of information technology has contributed to the developed of various devices and programs that could enable visually impaired learners to learn through the high-tech adaptive technology particularly DETB with SRP system (Dolphin, 2021). Thus, adaptive technologies in the learning contest convert the educational resources into a form that visually impaired students could decipher.

Digital electronic textbooks (DETB) with screen reading programme (SRP) is among the leading adaptive technologies that are used by university students who are visually impaired. DETB refers to books that are in an electronic format that could have been converted into either PDF, HTML, Arkinston or Word formats output respectively by suitable computer software that is supported with SRP (Bouck, Weng, & Satsangi, 2016).Besides, SRP also enhanced the navigability of DETB by allowing the user to peruse through it through audio or touch commands.

With the rapid advancement of technology as well as the growing popularity of tablet electronic devices, reading tasks are shifting from traditional print to digital electronic formats. Many individuals with visual impairment are adopting mainstream technologies over other adaptive technology options (Cowan, Pantidi, Coyle, Morrissey, Clarke, Al-Shehri, Earley, & Bandeira, 2017). These user-friendly,

compact electronic devices designed with high-quality resolution, and they have a powerful Screen Reading Programme (SRP) pre-installed in such devices, and also other features that allow students to adjust the presentation of text or DETB, including its size, color and brightness (Center for Parent Information & Resources, 2016).

Visually impaired young adults and teenagers are likely to gravitate toward their trendier streamlined embedded features (Campaña & Ouimet, 2015). This enables more sense of independence and mobility when it comes to accessing printed information such as surfing the internet, accessing on-line library or even reading daily news electronically for personal gains (Chown, Beardon, Martin, & Ellis, 2016). DETB with SRP play a significant role for visually impaired students at tertiary institutions as the specific required resources may be limited or even none. Students generally use the adaptive technologies to assist them as studying for the lectures is almost a herculean task to unravel since books and handouts are hardly provided in an appropriate electronic format (Reddy & Thevi, 2017). The alteration of printed books in a suitable electronic format is hardly being prepared by the University and so visually blind students may have to change the texts themselves or refer to another volunteering organizations (Simui, Kasonde-Ngandu, Cheyeka, Simwinga, & Ndhlovu, 2018).

The technology has been utilized by various people who are visually impaired. For instance, some of the organizations have acquired the technology to enable their staff to read emails, memos, and reports. Additionally, learning institutions have also utilized the technology to deliver lessons in a suitable format for visually impaired students (Wilkinson & Shahid, 2018).

The use of DETB with SRP require that a student be trained on how to operate the SRP system. The technology could be run on multiple devices such as Smartphone, tablets, and Windows-based computers. Moreover, it could be installed in the students' portals, if they are enrolled in online courses (World Bank Group, 2017).

DETB with SRP could have a substantial impact on the quality of learning by visually impaired students (Davert, 2017). First, it could enable them to study on their own, which could improve their performance. Moreover, it could enhance the flexibility and autonomy of the learning of the students, since they could choose the setting and time for their studies, especially if they are enrolled in online courses (Dobler, 2015). Finally, it could reduce the education inequality between the students with normal vision and those who are visually impaired (Prasad, Totaram, & Usagawa, 2016).

Rogers' diffusion of innovations theory is the most appropriate for investigating the adoption of technology in higher education and educational environments. In fact, much diffusion research involves technological innovations so Rogers (2003) usually refers the word "technology" as "innovation".

Scholars on technology and adoption of innovation have made broad use of Rogers' diffusion of innovation model (2003) in different research studies. There is that need for an individual to experience five chronological stages, called "the innovation-decision process", on the basis of the model, prior to making a decision on the acceptance or rejection of DETB with SRP. It is possible to apply this adoption

decision-making procedure to the new technology tool to help students suffering from visual impairment in learning.

Knowledge, which takes place upon an individual being exposed to the existence of an innovation and comprehending it, is the first stage in the innovation-decision procedure (Rogers, 2003, p. 170).

Persuasion is the second stage. This takes place when a favourable or unfavourable attitude is developed by an individual towards innovation. This procedure is strongly linked to the characteristics of the innovation of which relative advantage and compatibility, as well as complexity, trial ability, and observability are all part of the decision on adoption or rejection of the new innovation is dependent on these innovation (Rogers, 2003, p. 229).

Decision is the third stage in the innovation-decision procedure. This stage calls for the engagement of an individual in activities resulting in the decision on whether to adopt or to reject the innovation (Rogers, 2003, p. 177). Implementation is the fourth stage. Typically, the decision stage is directly followed by this, and it takes place upon an individual putting the innovation into use (Rogers, 2003, p. 179).

Confirmation stage takes place upon students exerting efforts in the strengthening of the innovation-decision that they have come up with. It is possible for them to change their decision and discontinue the use of the innovation in the event that they discover conflicts of interest in the use of such innovation. Such action is known as rejection after the innovation adoption (Rogers, 2003, p. 189).

## 1.3 Research Problem Statement

There are many researchers have suggested that overall, people who are visually impaired tend to be at a disadvantage in terms of pursuing education particularly tertiary education (Alahoul, Azizan, & Alwi, 2016). The need to explore the challenges that people with vision impairment encounter in regard to tertiary education is imperative because many of these individuals are struggling in accessing printed reading materials and coping up with their studies.

Visual impairment is among the disabilities that can adversely affect the learning of a student enrolled in a tertiary institution. It is worthy to note that visually impaired students with different degree of visual acuity may require different needs or types of adaptive technologies. The main objective of the research is to address the education inequality faced by students with visual impairment. In particular, the research explores the factors that could influence the adoption of digital electronic textbooks (DETB) with screen reading programs (SRP) (Alase, 2017). Therefore, the aim of the study is to explore the visually impaired students' attitude towards adaptive technology.

Digital Electronic TextBooks (DETB) which can be read aloud, accessed and navigated by a Screen Reading Programme (SRP) technology could enable students to read on their own, as they would be able to listen to the audio (Edyburn, 2015). Not only must the visually impaired students gain access to a tertiary institution, but they must also be accommodated with suitable adaptive technology, sufficient lecturing structures as well as appropriate electronic format of reading materials in order to

prevent inequalities and discrimination. Otherwise, transforming traditional printed textbooks, reference books or other materials to electronic formats is extremely tedious and a great time-consuming process for students with visual impairments (Pradhan, Mehta, & Findlater, 2018). Hence, all students with visual impairments would require information on electronic formats, which is known as DETB, to meet their precise individualized needs.

Several studies have indicated that DETB with SRP could improve the learning experience of visually impaired students. University education is challenging as it requires students to read widely. This study will help in understanding the factors that could affect students' preference of technology. For instance, the exorbitant costs of high-tech adaptive technology may be one of the factors. Also, the lack of training on use of the technology could be identified as one of the reasons for the low acceptance of DETB with SRP (Pyae & Scifeet, 2018). Consequently, it could be recommended that visually impaired students be trained on the use of technology and to be informed about the existing DETB with SRP technology.

Students could also lack access to the resources due to lack of the appropriate financial and organizational support. Students from low-income families could lack the purchasing power to purchase supportive technologies (Knight, Khairi, Omar, Ramlee, & Isa 2018). On the other hand, university administrators could feel that they do not need to develop or acquire resources due to budgetary constraints. Therefore, the lack of financial support could hinder the likelihood of students to use the technology.

In 2017, data revealed by Ministry of Higher Education (MoHE) reported about 2444 students with disabilities had registered at Malaysian public universities. Hitherto, this number is too small as compared with the total student enrolment at higher education level, which contributes only 1.1% from total public universities students (MoHE Data Management Unit, 2017). In general, the universities have employed a number of initiatives to enhance the quality-of-service delivery to the students with disabilities. However, the quality level of dissemination of adaptive technology such as DETB and SRP, accessibility and disabled-friendly facilities of service delivery offered by Malaysian Higher Education Institutions (HEIs) is still unsatisfactory (Douglas, McLinden, Robertson, Travers, & Smith, 2016). As a result, visually impaired students may not be able to exert their true talent to the fullness, and hence, these could possibly affect the opportunities and achievement of visually impaired students adversely.



It was undeniably that despite the provisions of modern adaptive technology in the market, lack of resources and the availability of well-equipped facilities to accommodate visually impaired students, were a herculean task to unravel for many tertiary institutions. Digital Electronic Textbooks (DETB) were taken off in the late 20th century, and considered to be the most appropriate and competable technology. However, some visually impaired students would opt for other devices such as braille machines somehow. Accessibility is one of the major influencing factors and also lack of knowledge in utilising the high-tech adaptive technology to the fullness may have hindered the adoption of innovation (Bhowmick & Hazarika, 2017).

The Marrakesh Treaty permits and facilitates the reproduction of accessible digital electronic books and other copyrighted works for people who are suffering from visual blindness or impairments as well as print disabled (NLS, 2020). The Marrakesh Treaty sets a norm for nations ratifying the treaty to have their domestic infringement copyright law be expunged and to allow dissemination of the digitally rendered materials across international borders. The Marrakesh Treaty was adopted in the year 2013 by the World Intellectual Property Organization (WIPO) to adjust the prevalent and predominant problem recognized as a "book famine," the situation where extremely limited digital electronic books are published in formats that are accessible to those who are blind or visually impaired (NLS, 2020). The ratification of 20 countries was the least of number for the Marrakesh Treaty to enter into effect. To date, sixty three nations signed the treaty as of the close of the diplomatic conference in Marrakesh. Unfortunately, Malaysia is yet to be part of the member.

The Ministry of Education (MOE), Non-Governmental Organizations (NGO) and other relevant stakeholders need to know how effective DETB with SRP are and how their use might be improved to facilitate learning distinctly at tertiary education levels. With this knowledge, they can make better decisions about its use in the future.

## 1.4 Research Purpose

The purpose of the study is to explore the factors that influence visually impaired students' decision to either adopt or reject the use of adaptive technology particularly DETB with SRP at tertiary institutions in Malaysia.

## 1.5 Research Objectives

The main objectives of this study are to:

1. Explore the types of adaptive technologies used by visually impaired students at Malaysian tertiary institutions.

2. Explore the awareness of knowledge and availability of Digital Electronic Textbooks (DETB) amongst visual impaired students at Malaysian tertiary institutions.

3. Understand the support and accessibility issues of assistive technology influence the use of Screen Reading Programme (SRP) amongst visually impaired students at Malaysian tertiary institutions.

4. Understand the benefits and disadvantages of using the DETB with SRP by visually impaired students at Malaysian tertiary institutions to assist their studies.



## 1.6 Research Question

Follows are the research questions addressed in the study:

Research question 1: What are the types of adaptive technologies used by visually impaired students at Malaysian tertiary institutions?

Research question 2: What is the awareness of knowledge and availability of Digital Electronic Textbooks (DETB) amongst visual impaired students at Malaysian tertiary institutions?

Research question 3: How does the support and accessibility issues of assistive technology influence the use of Screen Reading Programme (SRP) amongst visually impaired students at Malaysian tertiary institutions?

Research question 4: What are the benefits and disadvantages of using the DETB with SRP by visually impaired students at Malaysian tertiary institutions to assist their studies?

## 1.7 Theoretical Framework

This study explores the experiences of visually impaired students and factors that influence their adoption in utilizing adaptive technology, particularly DETB with SRP to assist learning at tertiary education.



The Adaptive Structuration Theory (AST) model developed by DeSanctis and Poole (1994) may be utilized in the current research study to identify the individual, social and technological factors that influence the adoption of adaptive technology, distinctly DETB with SRP amongst visually impaired students at tertiary education in Malaysia. The dependent constructs the theory could be classified as decision outcomes and new social structures (DeSanctis & Poole, 1994). The decision outcomes consist of commitment, consensus, quality, and efficiency. This proposition was applied in this study to explore the impact on education quality received by visually impaired students at tertiary institutions in Malaysia.

On the other hand, the new social structures comprise of rules and resources that are related to a given advanced information technology. The independent constructs of the framework could be classified into the structure of advanced information technology and other sources of structures. The main factors that are considered under the structure of the technology are its features and spirit. Different types of visual impairments may utilize different types of adaptive technology. For instance, totally blind individuals are highly likely use high-tech adaptive technology such as Screen Reading Programme, Optical Character Recognition and Digital Electronic Textbooks, in which the features and functionality of such devices will be the determining factors to adopt the innovation.

Other sources of structure consist of the organizational environment and the tasks that are involved in the adoption of the DETB with SRP. This proposition was utilized to explore the accessibility conundrums alongside the lack of resources and support from tertiary institutions would influence the paradigm shift of the adaptive technology adoption.

In spite of the fact that these attributes within the model have been broadly utilized in research study in numerous scholar disciplines, the model was, hence, applied in this research study to investigate the experiences of visually impaired students in utilizing DETB with SRP to assist learning.

## 1.8 Conceptual framework

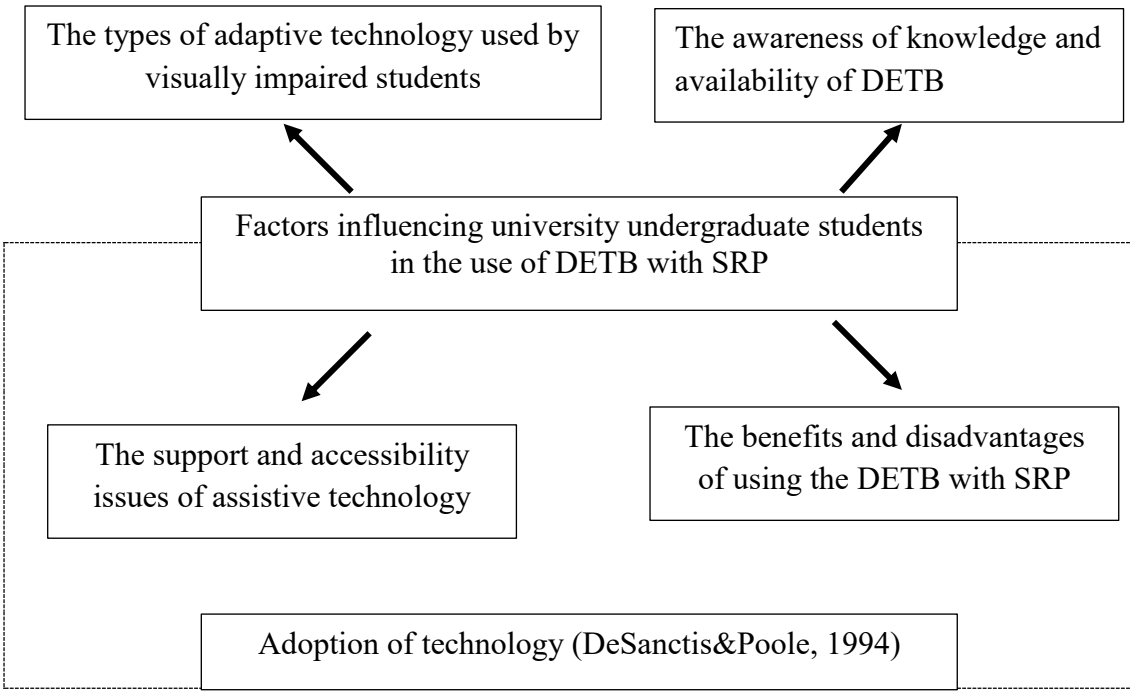


*Diagram 1.0.* Conceptual framework for the study

The conceptual framework is for the study of exploratory of the use of adaptive technology particularly DETB with SRP amongst visually impaired students at tertiary education institutions in Malaysia. The central scope of the study is the factors which will be measured through the four research questions. The first two questions which are derived from the theoretical framework by DeSanctis and Poole (1994) referring to the structure of technology which used to significantly improve the understanding in relation to the phenomenon in this study. They focus on the qualities and the advancement of the adaptive technology among university students who are suffering from visual impairments. Also, understanding the different needs of students with different visual disorders as well as their awareness about the adaptive technology.

While the subsequent two questions are also derived from theoretical framework of DeSanctis and Poole (1994) referring to the adoption of technology. They focus on the factors whether students with visual impairments are to adopt DETB with SRP or otherwise.

It was assumed that possession of inadequate knowledge and skills about the adaptive technologies as well as lack of support from university administrators, lecturers and parents may significantly affect the utilization of them (Elmannai & Elleithy, 2017).

Accessibility conundrums and availability of the adaptive technology particularly DETB with SRP may be contributing factors that influence visually impaired students in adopting the use of such devices. Printed books which are in digital format may not be able to be accessed by SRP if the contents contained graphics, hyperlinks and buttons which are not labelled, or the text is out of order, which means the file is not designed or compatible with the SRP (Osiceanu & Popa, 2015). Moreover, many libraries at school's including tertiary institutions do not make DETB widely available for the visually impaired students to read offhand, but even if they do, they provide books that are highly inaccessible for the blind students (Gunn, 2016).

## 1.9 Significance of the Study

The involvement of students with visually impairment in tertiary education programmes is a critical part of the transition process stipulated in the Individual with Disabilities Education Act 2004 (IDEA). The Act mandates that appropriate support services of adaptive technology need to be provided for students with disabilities in postsecondary education settings to enable them to increase, maintain and improve the functional capabilities

It is not uncommon that visually impaired students are less likely to complete their under-graduate programmes than those without disabilities. This could probably be either a result of academic failure because of inadequate of adaptive technology support at tertiary institutions (Kettler, Elliott, Beddow, & Kurz, 2018). Staff working at the Universities' Disabilities Resource Room (DRR) or libraries should be trained to understand various prevalent visual disorders as to facilitate them in assisting students with visual impairments (Billah, Ashok, Porter, & Ramakrishnan, 2017).

The prevalence of low vision and blindness has increased significantly over the past few decades. More than 30 million people across the world are blind (Bourne, Flaxman, Braithwaite, Cicinelli, Das, Jonas, & Naidoo, 2017). Students are the most affected, and they could be compelled to use visual aids such as eyewear or to seek corrective surgical procedures (Mutalib, Zin, Shahir, & Hassan, 2019). However, students who are severely visually impaired or blind could be compelled to use adaptive technologies such as DETB with SRP. Therefore, physical impairment could

lead to inequalities in the Malaysian education sector, if learning institutions do not adopt appropriate technologies to support learners with special needs.

Vision disability could he caused by genetics, environmental factors, or a combination of both. Low vision is strongly correlated with age since it mostly affects older people (Amzat & Li, 2019). Moreover, several studies have associated blindness with the socio-economic status of an individual or level of education. Genetic diseases such as diabetes have been associated with a high prevalence of vision problems mainly due to diabetic retinopathy (Abougalambou & Abougalambou, 2015). Physical injuries to the eye could also lead to blindness. Lack of adequate outdoor exposure also increases the risk of myopia. The two most common vision impairment conditions are cataracts, which is responsible for 39% of the cases, and retinal diseases, which account for approximately 29% of the population with special vision needs (Tsang & Muecke, 2015). Therefore, by identifying predisposing factors, the research could help to reduce the prevalence of vision disorders as people would try to avoid exposure to the causes.

Significant emphasis in providing reasonable accommodation on adaptive technology support has been placed in recent years as technology has become a tremendous equalizer between the visually impaired students and the sighted students at tertiary institutions.

The main aim of the research is to explore the existing technologies that could support students with vision disorders to learn effectively. The study will focus on the students in tertiary education institutions who have permanent or temporary

conditions that cannot be remedied by surgery, eyewear, and other adaptive technologies (Simui, Kasonde-Ngandu, Cheyeka, Simwinga, & Ndhlovu, 2018). The affected students would be asked to use an adaptive technology that could enable them to use the digital learning platforms that are available to other students. Therefore, the research will concentrate on DETB with SRP since it is advanced technology and effective in improving the learning experience of visually impaired student.

Additionally, the study will explore the acceptance of DETB with SRP by students who are aged 18-30 years who are enrolled in Malaysian universities. Such information could be useful in policy making since the education stakeholders could prioritize the adoption of the technology if it is perceived to significantly improve the learning process of visually impaired students. Moreover, the study will suggest features, which lead to the acceptance or rejection of the technology that could lead to significant improvement of DETB with SRP.

## 1.10 Research Assumption

Several assumptions will be made in the study to enhance its feasibility. First, it will be assumed that the sampling techniques were effective. Using statistical methods Ito determine the optimum sample sue does not always guarantee proper representation if the population has a high variance (Etikan, Musa, & Alkassim, 2016). The assumption will enable the generalization of the findings of the study. Secondly, it will be assumed that gender does not influence the acceptance of specific adaptive

technologies. This assumption will enable the researcher to examine the relationship between the study variables. Finally, it will be presumed that the respondents will provide honest responses. People with special needs are likely to give misleading information or to be offended by questions that they perceive as undermining theirself-worth and privacy (Jameel & Shamim, 2019). Consequently, for the assumption to be valid, it is important that the interviews and questionnaire contain non-sensitive information (Chown, Beardon, Martin, & Ellis, 2016).

The researcher also identified three main assumptions before initiating the research. First, it is presumed that DETB with SRP is the optimal adaptive technology for students suffering from visual impairment because it complies with the DAISY standards. Secondly, the researcher assumed that students with visual impairment perceive technological innovation positively. Finally, it was assumed that students with visual impairment will use the technology to improve their learning experiences. Therefore, it is crucial that the researcher mitigates the impact of the assumptions on the reliability of the findings.

## 1.11 Operational Definitions

It is vital to note that some terminologies or phrases may either cover a wide range of definitions or could be too narrow-minded. As such, I have coined the operational definitions below.

### 1.11.1 Adaptive Technology

Assistive technology is formally defined by Individuals with Disabilities Education Act (IDEA, 1990) as "any item or equipment piece, or a system of product, regardless of such being commercially acquired off the shelf or not, undergoes modification or customisation, used in increasing, maintaining, or improving functional proficiencies of a child suffering from disability" are all part of adaptive technology.

Adaptive technology is defined by the United Nations as an “adapted and explicitly designed technology for improving the function of individuals suffering from disability” (World Health Organization, 2018; Borg, Lindstrom & Larsson, 2009, p. 1863).Assistive technology, in the United States, is a reference to “any item or equipment piece, or a system of product, regardless of such being commercially acquired off the shelf or not, that undergoes modification or customisation, used in increasing, maintaining, or improving the functional proficiencies of individuals suffering from disabilities" (The State of Minnesota, 2021). Assistive technology includes hardware like screen magnifiers and alternative keyboards, together with software like optical character recognition and onscreen keyboards, as well as voice recognition

### 1.11.2 Digital Electronic Textbooks (DETB)

Electronic textbooks are a digital form of a print textbook that may have some additional features such as annotative abilities, which include customization tools,

links to various media such as videos, podcasts, live hyperlinks, and other resources (Dobler, 2015).

Basic forms of electronic textbooks are digitized versions of traditional textbooks that may or may not have interactive tools and features included (Bouck, Weng, & Satsangi, 2016).

Digital Electronic Textbooks (DETB) in this research is operationalised as an electronic version of a traditional hardcopy book for visually impaired students, which could be accessed by using a windows-based computer or by using an electronic device. DETB are available in variety formats such as Portable Document Format (PDF), Microsoft Word, E-Pub or HyperText Markup Language (HTML).



### 1.11.3 Screen Reading Programme (SRP)

E-readers, tablets, smartphones, and computers are the types of devices and software such as Voice-Over, Talk Back, NVDA and Hal screen reader are required to read electronic textbooks (Dolphin, 2021).

Job Access with Speech, the developer of the world's most popular SRP, enables visual impaired students to navigate the Internet, write a document, read an email and create presentations from the office, remote desktop, or from home (Freedom Scientific, 2021).

Screen Reading Programme (SRP)in this research is operationalised as a software application that employs a Text-To-Speech (TTS) engine to convert screen information into speech, enables students with visual impairment to navigate a windows-based computer independently, and other common applications including DETB. JAWS,

### 1.11.4 Visually impaired

The classification system of visual impairments is:

a) B1- Totally blind. Individuals who may acquire light perception but are unable to recognise any hand shakes at any distance;

b) B2- Low vision. Individuals may perceive hand shakes but only acquire visual acuity of not better than 20/600 and/or those individuals who acquire less than 5 degree through 20 degree;

c) B3- Partial visual impairment. Individuals who possess visual acuity ranging from 20/599 through 20/200 and/or for individuals who acquire 5 degree through 20 degree in visual field (MAB, 2021).

Visual impairment is categorized as having a visual acuity of 20/200 or worse even with eyeglasses (Atowa, Hansraj, & Wajuihian, 2019).

"Visual impairment" is defined by the Centres for Disease Control and Prevention (2018) to indicate a situation where correction can no longer be made to an individual’s eyesight in order for his/her vision to reach a "normal level".

Visually impaired students in this research are operationalised as an individual who is either suffering from a low vision or complete blindness, whether or not he or she is congenitally or adventitiously blind, after corrective lenses, is not able to read the contents of a hardcopy book or DETB with his or her sight (Farmer, Ng, Rudkin, Craig, Wangmo, Tsang, & Muecke, 2015).

### 1.11.5 Tertiary Institutions

Both private and public universities, community colleges, polytechnics and other government agencies which involved in tertiary education programmes and activities are under the purview of the Malaysian MOE (Malaysia Educational Statistics, 2018).



Tertiary institutions in this research is operationalised as either a public or private higher education institution which is also known as public or private university or college, for students who are visually impaired to pursue their undergraduate programmes.

## 1.12 Research Delimitations

The main research delimitation is the wide array of visual disorders that are likely to be experienced by students. For instance, the adaptive technology that could be suitable for students with low vision cannot be suitable for the blind. Therefore, since

the study covers all visually- impaired students, choosing adaptive technologies might be a challenge.

The distinctive characteristic of the visually impaired participants that may sway the findings was the individual skills and knowledge of utilising the innovation, particularly DETB with SRP to access the content of their reading materials. Under no account, the researcher absorbed this characteristic as part of the participants' recruitment due to the different types of innovations used including hardware components as well as software applications. Nevertheless, it is imaginable that these skills and knowledge may highly likely affect the participants' experiences in using DETB with SRP. Probably, findings in relation to challenges for effective utilisation of DETB with SRP and the functionality of the innovation may be explicated by this characteristic.



The researcher has no intention or whatsoever to make a generalisation of this study to a larger population, however, the researcher made every possible effort to form a rather homogeneous sample in recruiting and selecting the visually impaired participants. For PA study. The homogeneous sample for this study were visually impaired students with the similar levels of exposure in term of skills to innovation, and similar adaptive technology environment used would result in a similar experience (Taipale, Mikhailova, Ojamo, et al., 2019; Li, Muñoz, Rong, Chen, Xiao, Tian, Arditi, & Yousuf, 2019). Prior to selection of participants, the researcher made an attempt to call various local universities and furnished them the criteria for participants. Due to very limited visually blind students at tertiary education and random recommendations, the recruited participants were not homogenous in term of

skills utilising DETB with SRP as well as types and specifications of adaptive technology used.

Another possible limitation is the unwillingness for visually impaired participants to openly discuss adverse facets of their experiences in utilising DETB with SRP at their respective university. Prior to conducting interviews, the researcher introduced himself as a student who was suffering from total visual blindness so as to develop participants' honesty to share their experiences in utilising the innovation, distinctly DETB with SRP.

Although the researcher managed to establish rapport with the students, the participants' responses such as: "Do you know my lecturers personally?" or "What will you (the researcher) do with my interview?" This strongly indicated that it may have affected participants' willingness to discuss adverse facets of DETB with SRP at university in detail. Some participants may perceive that their honest disclosure in response to the interview questions will have a remote possibility to bring a bad reputation to their university, administrators, and lecturers.

The researcher always attempted to adopt heterogeneous and non-discriminatory approach when it came to recruiting visually impaired participants for the study. However, prospective female participants were reluctant to participate in the study and were unwillingly be recorded during the interview sessions. As such, all recruited were only male participants.

## 1.13 Summary

Life of visually impaired individuals without technology is akin to the life as in dark ages. What's more on education? It was almost impossible for a visually impaired student to go to school, or to read and write. The advancement of technology in the modern era, has made it possible to visually impaired students to pursue their dreams all the way to tertiary education level. Distinctly Digital Electronic Textbooks (DETB) and the development of Screen Reading Programme (SRP), which is a piece of text to speech (TTS) software application, have changed the life of visually impaired students at tertiary institutions tremendously. This study is to explore the factors that determine the adoption or rejection of DETB with SRP among visually impaired students at tertiary institutions in Malaysia.