Acceptance of Assistive Technology for Vision Impaired Students in the Saudi Universities

by

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Declaration

I certify that this thesis does not include any prior materials submitted for a degree or diploma in any university without acknowledgment; and to the best of the researcher knowledge and belief it does not include any prior material published or written by another individual with the exception of where due reference is used in the text.

Saeed Alshahrani

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Abstract

Assistive technology (AT) can help students with visual impairments to achieve their study goals but use of AT in Saudi universities is lower than expected. This study investigated barriers that hinder the acceptance of assistive technology by Saudi students with visual impairments, and it provides recommendations for improving acceptance.

The study used a formal model of technology acceptance based on the Unified Theory of Acceptance and Use of Technology (UTAUT), extended to incorporate factors that have previously been found to influence acceptance of AT. Saudi university students with visual impairment were surveyed about their view of acceptance determinants, and the survey data was analysed using Structural Equational Modelling (SEM) with the Partial Least Squares (PLS) technique. The results showed that the factors influencing technology acceptance in this context differed from those previously found to influence acceptance in other contexts.

Follow-up interviews were conducted with both AT users and AT support workers to seek explanations for the differences. Interviewees identified a number of context-specific factors as potential explanations for the survey findings, including the importance of AT for visually impaired users, limited awareness of visual disability and AT, and psychological sensitivity of disabled users in Saudi culture.

This research contributes to three areas:

- It has contributed to technology acceptance modelling by extending the UTAUT model so that it specifically addresses assistive technology

- It has contributed to technology acceptance studies by evaluating the extended model in a real-world context.
- It has contributed to the Saudi educational system by investigating factors that shape acceptance of AT by visually disabled Saudi university students

An important outcome of this study is a set of suggestions and recommendations for overcoming barriers that limit the acceptance of assistive techniques by Saudi students with visual disabilities, thus increasing acceptance and adoption of these technologies and helping the students to improve their abilities and achieve equality with other students. The research will also increase awareness among the other citizens of Saudi Arabia and help them understand the need for assistive technology for impaired students. Finally, the Government of Saudi Arabia and education administrators can use the suggestions to provide information for initiating schemes to help visually impaired students in colleges and universities.

Although this study is specifically focused on studying the factors affecting the acceptance and adoption of assistive technologies by students with visual disabilities in Saudi universities, it is likely that outcomes from the study will have applicability beyond that scope. For example, findings about factors that affect assistive technology use for Saudi university students may well apply to students at other levels in the Saudi education system, and findings that apply in Saudi Arabia are likely to apply in other countries with similar culture and circumstances, such as other Arabic Countries, other Islamic countries, or even other developing countries. Finally, it is likely that recommendations for Saudi government and administrators in relation to access to assistive technology in universities will also facilitate access to other technologies and in other contexts.

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List of Abbreviations

Abbreviation	Explanation
AC	Accessibility
AN	Anxiety
AT	Assistive Technology
ATT	Attitude Toward using Technology
AVE	Average Variance Extracted
AVISSA	Acceptance for Visually Impaired Students in Saudi Arabia
BI	Behavioural Intention
CBSEM	Covariance-Based Structural Equation Modelling
CFA	Confirmatory Factor Analysis
DOI	Diffusion of Innovation Theory
EE	Effort Expectancy
FC	Facilitating Conditions
GaStat	The General Authority for Statistics in Saudi Arabia
GoF	Goodness of Fit of the model
ICT	Information and Communications Technology
IS	Information System
IT	Information Technology
KAU	King Abdulaziz University
KFU	King Faisal University
KSA	The Kingdom of Saudi Arabia
KSCDR	King Salman Centre for Disability Research
KSU	King Saud University
LVC	Latent Variable Correlations
MGA	Multi-Group Analysis
MICOM	Measurement Invariance of Composite Models
MM	Motivation Model
MOE	Ministry of Education
MPCU	Model of PC Utilization
PBC	Perceived Behavioural Control
PE	Performance Expectancy
PEOU	Perceived Ease Of Use
PLS	Partial Least Square

Abbreviation	Explanation
PU	Perceived Usefulness
R^2	R-Square
SA	Saudi Arabia
SBREC	Social and Behavioural Research Ethics Committee
SCT	Social Cognitive Theory
SE	Self-Efficacy
SEM	Structural Equation Modelling
SI	Social Influence
TAM	Technology Acceptance Model
TAM2	Extension of the Technology Acceptance Model 2
TAM3	Extension of the Technology Acceptance Model 3
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTS	Text-To-Speech
UAP	Universal Access Program
UB	Use Behaviour
UTAUT	Unified Theory of Acceptance and Use of Technology
VIF	Variance Inflation Factor

Chapter 1 : Introduction

1.1 Introduction

People who have visual disabilities are likely to experience communication difficulties that may exclude them from social services, health, or education, and from participation in society, their community or even their family. For students, this exclusion can have long lasting and dire consequences because it may affect opportunities likely to come in their future (Al Wadaani et al., 2013).

Students with visual impairments deal with many problems in their educational settings. All students need access to the information and texts provided in their study areas and need to be able to participate in class activities. Assistive technology devices are one of the ways through which visually impaired students can be helped to get greater benefit from their studies. This will enable them to participate more fully in society, which will in turn enable them to contribute to the community and their family.

1.2 Background of the Study

As a result of continued globalization, many countries have increased their use of new technologies in order to match the pace of the advancing world. In the case of Saudi Arabia the government has recently adopted Saudi Vision 2030 whose goal is digital transformation of many aspects of society, including the education system (Saudi Vision 2030, 2018).

According to the World Health Organization (2017), there are more than 1 billion individuals who need to use assistive technology around the world, and this number is estimated to reach 2 billion by 2030. In 2017 there were around 32.5 million Saudis, of which around 1.5 million had a disability, with close to half of these being visually impaired (GaStat, 2017). Following the establishment of the Al-Noor Institute for the Blind in 1960, special education services became available throughout the kingdom (Hersh & Johnson, 2008) and several Saudi universities now provide specialized disability support units.

Assistive technology (AT) can be broadly defined as "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities" (U.S Government, 1998) . The focus of this thesis is IT-based AT, where the technology takes the form of an electronic device or computer software.

With the widespread use of mobile phone and other electronic devices, IT-based assistive technologies are potentially available to most students. Nevertheless, such assistive technologies do not appear to be widely used by Saudi university students, which suggests that there may be barriers to adoption. This thesis describes research whose focus is on identifying factors that influence adoption of assistive technology by visually disabled Saudi university students, with a view to overcoming barriers that are currently limiting use of the technology.

1.3 The Study Problem and Significance

According to (Kentab et al., 2015) the World Health Organization (WHO) estimated in 2010 that about 4% of the global population (amounting to around 285 million people) were visually impaired, with 90% living in developing countries. WHO (2017) defines visual disability as a limitation in the ability to see which cannot be fixed by the usual means such as glasses. WHO characterises visual disability in four levels: visual acuity between 6/12 and 6/18 is defined as mild visual impairment; visual acuity between 6/18 and 6/60 is defined as moderate visual impairment; visual acuity between 6/60 and 3/60 is defined as severe visual impairment; and visual acuity worse than 3/60 is defined as blindness. In these definitions, visual acuity is expressed as a fraction that compares an individual's visual ability with that of someone with normal vision. For example an individual who have 6/60 vision would need to be at 6 metres distance to be able to see what an individual with normal vision could see at 60 meters.

The size of the problem is growing; in 2015 estimates of the prevalence of visual impairment had increased to 6% (Bourne et al., 2017), comprising 2.6% with moderate visual impairment, 2.9% with severe visual impairment, and 0.5% who were blind.

A comprehensive disability survey conducted in 2017 under the auspices of the General Authority for Statistics of the Saudi government GaStat (2017) showed that 7.1% of the Saudi population (nearly 1.5 million out of a total population of just over 20 million) experienced one or more difficulties due to disability, and that difficulty with seeing was the most common problem, either alone or in conjunction with others. Overall, the rate of visual

disability was 4.0%, with 2.8% experiencing mild difficulties and 1.2% experiencing severe or extreme difficulties.

Although the GaStat survey did not specifically identify university students, it does provide data about the proportion of the disabled Saudi population who hold university degrees or higher (11%), and about the proportion who are currently enrolled as students at all levels (5.6%). If the rate of visual disability in the various cohorts was similar to the rate in the disabled population as a whole, then in 2017 there were around 90 thousand visually disabled Saudis with a university degree or higher, and around 45 thousand visually disabled Saudi students. According to GaStat (2017), one of the most important factors that impede education of individuals is disability (19.6% for male and 19.4% for female).

The use of assistive technology (AT) can help overcome difficulties caused by disability. For visually disabled students, the provision of appropriate assistive technologies is one of the most important necessities in order to help them to obtain the quality of education available to students without disabilities. These benefits of AT for disabled students have been recognised in legislation. For example the U.S Government (1998) identifies improvement in academic achievement as one of the main objectives of the use of assistive technologies. Moreover, the Individuals with Disabilities Education Act (IDEA) by U.S Government (2004) affirms the right of students with disabilities to have the right technology to help them obtain an education.

Although the expected benefit of using AT for students with disabilities is high, a study by Alquraini (2012) found that the rate of acceptance of the technology by students in Saudi Arabia is poor and its use in the academic context is still low. Poudel (2014) believes that

this low adoption rate is due to several factors related to the psychological, social and environmental aspects of students with disabilities such as user self-confidence and motivation; user awareness, training, and skills; the stigma attached to disability; self-perceptions; teacher support; and the differences in the learning environments between school and college.

This study is based on detailed research about the acceptance of assistive technology by visually impaired Saudi students. By using a formal model of technology acceptance, the study explores the factors that are responsible for slowing down the acceptance process. The study findings may help Saudi universities in providing an environment conducive to the acceptance of the use of AT in education, and it may help government and university authorities to implement changes to the education system that will foster the use of such technologies for people with visual disabilities. These changes will help support digital transformation, which is one of the Saudi government's most important initiatives in Saudi Vision 2030. A detailed explanation of the relationship between this research and Saudi Vision 2030 appears in Section 2.3.

1.4 Research Gap

Many studies, such as those by Woodward and Rieth (1997) and Bender (2001), have shown that the use of AT by students with disabilities helps to improve study outcomes, although most predate recent technology developments such as the widespread use of mobile devices.

Previous studies have investigated various aspects of the barriers and factors that prevent the acceptance and the effective use of AT:

- AT characteristics (Orellano-Colón et al., 2016), (Borg & Östergren, 2015)
- policies relating to the use of AT (Borg & Östergren, 2015), (Orellano-Colón et al., 2016), (Hughes et al., 2014)
- organizational administration and structure (Orellano-Colón et al., 2016), (Ahmad, 2015), (Alves et al., 2009) (Hughes et al., 2014)
- people who are in contact with disabled students, including teachers, specialists, and administrative staff (Borg & Östergren, 2015), (Ahmad, 2015), (Hughes et al., 2014), (Abner & Lahm, 2002), Constantinescu (2015), (Borg & Östergren, 2015), (Burgos, 2015).

This study arises from the realization that disabled students themselves are a very important determiner in deciding whether or not they will accept assistive technologies. There are few studies that have investigated engaging students in the decision-making process in designing and applying AT in the educational context. Moreover, little has been done to investigate barriers to AT acceptance that relate to the personal characteristics and abilities of disabled students, and none is known to have focused on Saudi Arabia. The Saudi context differs from that in many other countries because of differences of culture and customs, and because of the importance of family and community attitudes towards disability. Understanding the effect of these differences is necessary in order to identify factors that may affect the process of acceptance of AT for people with visual disabilities in Saudi universities. Because of these differences, existing research sheds little light on causes for rejection of AT in the Saudi context and offers few pointers for potential interventions to increase the uptake of assistive technology devices.

This study is the first to investigate the specific barriers and obstacles that hinder the acceptance by visually impaired Saudi university students of assistive technology in the learning environment, and it provides recommendations and solutions to overcome the obstacles to technology acceptance.

1.5 Research Aims and Objectives

This study has 3 key aims:

- To determine the factors shaping attitudes towards the adoption and acceptance of assistive technologies for visually impaired students in Saudi universities
- To develop and implement a model for acceptance of assistive technology by visually impaired students in Saudi universities, and a set of instruments to test the effect and context of model factors.
- To seek explanations for the low acceptance of assistive technology by visually impaired students in Saudi universities and formulate strategies for improving acceptance.

A main outcome of this study is a set of suggestions and recommendations for overcoming the barriers that limit the process of acceptance of assistive techniques by Saudi students with visual disabilities. This increase will acceptance and adoption of these technologies and help students to improve their abilities and achieve equality with other students. The research will also increase awareness among the other citizens of Saudi Arabia and help them understand the need for assistive technology for impaired students. Finally, the Government of Saudi

Arabia and education administrators can use the suggestions to provide them information for initiating schemes to help visually impaired students in colleges and universities.

1.6 Research Questions

To identify, understand, and study the factors that influence the acceptance and use of assistive technologies by visually impaired students in Saudi universities, the following questions have been formulated:

Q1: What are the factors shaping attitudes towards the adoption and acceptance of assistive technologies for vision impaired students in Saudi universities?

Q2: How well do current technology acceptance models account for acceptance of AT by vision impaired students in Saudi universities?

Q3: How can the acceptance of assistive technology for visually impaired students in Saudi universities be improved?

1.7 Methodology of the Research

Both quantitative and qualitative methods were used in the conduct of this research. A survey was used in order to gather quantitative data because a survey is considered to be one of the most suitable methods for gathering numerical information on a specific topic (Creswell, 2012). The survey assessed the attitudes and opinions of Saudi university students with visual impairments about assistive technology. Participants were drawn from students registered as having visual disabilities in Saudi universities with disability support units. Semi-structured interviews were used to gather qualitative data because interviews allowed participants scope to express their point of view. Interviews were conducted with both

assistive technology users (visually disabled students in Saudi universities) and disability support workers (staff who work in the disability units of Saudi universities and who have experience in working with visually disabled students), to seek explanations about the survey results in order to give a clearer picture and deeper understanding of the findings.

1.8 Thesis Structure

The thesis is structured as follows:

Chapter 1 gives a brief initial picture of the entire research. It presents the sequence in which the research was conducted, and the procedures followed at each step of the research. It includes the research problem, the research questions, the research aims and objectives, the research methods, the research scope, and the thesis structure.

Chapter 2 provides a research background in the field of this study, organized into two sections. The first section includes some definitions of the term assistive technology (AT) in addition to describing some of these technologies for people with visual disabilities. It also provides a general overview of the adoption and acceptance of AT and some of the barriers that prevent acceptance. The second section presents an overview of the context of this study, including a review of the history of education for visually impaired students in Saudi Arabia, along with some statistics information about the study's target audience and information about the actual use of assistive technologies in Saudi universities.

Chapter 3 examines the previous literature in the field of the study. First, it reviews several previous studies related to the importance and benefits of using assistive technologies in the field of education, as well as some of the barriers facing educational organizations in the use

of assistive technologies. Second, it examines some widely used technology acceptance models in and identifies the Unified Theory of Acceptance and Use of Technology (UTAUT) as the most appropriate model for the context of this study.

Chapter 4 discusses the conceptual model of this study. It begins by presenting the basic UTAUT model, and then discusses the expansion of this model by integrating the factors that are expected to influence the acceptance of assistive technology in the study's context, as described in the literature review. Finally, it presents the hypotheses of the study.

Chapter 5 presents the study's research methodology, including the research paradigm, research design and approach, methods of data collection, validation, and ethical considerations. The chapter explains the mixed methods approach used in the research and addresses both the quantitative and qualitative methods that were used.

Chapter 6 presents the quantitative study results, including demographic information for participants, validity and reliability of the results, and an assessment of acceptance model fit and its implications on the research hypotheses. Data collected through an online survey was analysed using a variety of quantitative procedures and tools in three steps: preparing the data to enable analysis; measuring the reliability and the validity of the data, and checking and discussing the results and the hypotheses of the thesis. The quantitative study found that some UTAUT model factors were significant in affecting acceptance of assistive technology for the target audience, but that others were not significant.

Chapter 7 presents the qualitative study results. The qualitative study was conducted to supplement the quantitative results and to obtain deeper insight and explanations to explain

the unexpected results obtained from the quantitative study. Semi-structured interviews were conducted with both visually impaired students in Saudi universities, and individuals who work in the disability support units of Saudi universities and who have experience in dealing with visually disabled students. The qualitative results showed additional factors such as the importance and the need for assistive technology for the visually impaired students, the lack of Saudi community awareness about the needs of assistive technology users or the potential benefits of the technology, the psychologically sensitive situation of those students, and lack of support for the use of the technology in some Saudi universities.

Chapter 8 contains a discussion of the results of both quantitative and qualitative studies to provide a clear and detailed picture of the findings. The chapter discusses themes that emerged from the qualitative study and that explain the quantitative results more deeply. The themes are related to specific details of the context of the technology under consideration: assistive technology (specifically as it applies to visually disabled users); Saudi culture; or the university environment in Saudi Arabia. An overview of previous studies in the field of technology acceptance shows that context dependency is common in technology acceptance studies, which suggest that technology acceptance models should acknowledge contextual influences.

Chapter 9 concludes the thesis and includes a summary of the study outcomes, contributions, limitations, and recommendations for future research. It presents an overview of the study including what has been done in relation to achieving the study goals, and it shows the contributions of the study in both practical and theoretical fields. Finally, the chapter presents study recommendations, limitations, and suggestions for future research.

Chapter 2 : Research Background

2.1 Overview of Assistive Technologies

2.1.1 Range of Assistive Technologies

According to the definition found by U.S Government (1998), an assistive technology (AT) device is "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities". Furthermore, the Act describes assistive technology services as "any services that directly assist an individual with a disability in the selection, acquisition, or use of an assistive technology device". Assistive technology services specifically include financing, accessing, repairing, and maintaining of AT, together with promoting the adoption of devices and providing their users with training and technological knowhow to operate them safely. In addition to the Act's descriptions, Forgrave (2002) and Rose (2000) specify AT as hardware and software technological devices that are specifically designed and manufactured for the aid of people to address physically disabling barriers.

According to Watson and Johnston (2007), assistive technologies can be categorized as either high-tech or low-tech. High-tech aids are described as being more complex and require specialist training since they may include complicated features such as word predictive software and voice recognition software. Low-tech aids are simpler to use and require minimal training.

Assistive technologies offer an opportunity for the disabled to improve their quality of life and in some cases assert their independence by being able to perform tasks that would be impossible to accomplish without the intervention of technology. LaPlante (1992) suggests that assistive technological devices provide additional means for the disabled person to perform actions, tasks and activities. Shuster (2002) adds that these technologies will aid people living with disabilities to maximize their potential by making it possible for them to set and reach personal educational targets.

Information Technology (IT)-based assistive technology is computer hardware and software, including devices such as screen readers and voice recognition aids, which enable access to computers by users with visual, hearing, learning or physical impairment, and which could increase the achievement, participation and independence of those users.

2.1.2 Some Examples of IT-Based AT

Research in the field of assistive technologies for individuals with vision disabilities has led to the development of non-visual sensory methods to interact with computers such as the use of touch, speech recognition tools, screen readers, and Braille printers and displays. These features reduce reliance on visual interaction (Hakobyan et al., 2013; Kim et al., 2016). There are many examples of assistive technologies in use today by people with visual impairments. Some widely used assistive technologies that offer opportunities for users to overcome the barriers that their disabilities place in their path are described below.

The first and most important kind of visually impaired assistive technologies in current use are smartphone based assistive technologies. Rapid advances in technology have seen smartphones become necessities of life today. They support easy access and they can be used

anytime, anywhere. According to Hakobyan et al. (2013), smartphones have a range of features that serve people with visual impairments, which explains the growing use of these phones by people with disabilities in their daily lives. Additionally, smartphones offer many services to the visually impaired user so that they can use those services for their daily tasks without the need for help from others. Smartphones that support non-visible input and output have enhanced use by visually impaired people in dealing with their surroundings and in accessing large amounts of information. Kim et al. (2016) confirm that the development of assistive technologies for people with visual impairments is being focused on mobile devices. They state that screen readers are important assistive technologies available on smartphones. Their availability has led to a sharp rise in the use and accessibility of smartphones by visually impaired people.

The second example of assistive technology for the visually impaired is Braille Sense. The Braille Sense device can be considered to be a special laptop combining a screen reader with braille displays to allow visually impaired users to use both braille and speech when accessing web pages and digital material (Tatomir & Durrance, 2010). This helps visually impaired users to access materials they want to read. According to Tatomir and Durrance (2010), Braille Sense is a common assistive technology for visually impaired individuals. Furthermore, Braille Sense can help visually impaired students to read and modify documents on a PC without the need for a braille printer and, because of its small size, a student can use it at school as well as at home (Abubakar et al., 2013).

Screen readers are a widely used IT-based assistive technology for visually impaired individuals. Text-to-speech (TTS) or screen readers, including JAWS, BookWise (Elkind et

al., 1993) and Kurzweil 3000 (Laga et al., 2006) are devices that read aloud text appearing on a computer screen, such as documents, scroll-down menus, icons, dialog boxes, and web pages. Research conducted by Elkind et al. (1996) highlighted that adult users of TTS system readers achieved enhanced reading abilities, but this was conditional upon the severity of the disabled user's condition. Meanwhile research conducted by Farmer et al. (1992) into the use of TTS by teenagers with severe literacy disabilities found insignificant improvements resulting from the use of the system.

The use of assistive technology in Saudi universities is still it its beginning stages, with current use primarily focussed on well-established technologies such as those described above. Although emerging technologies such as artificial intelligence (AI), robotics, and virtual reality (VR) offer promise for assisting disabled users, they are not widely used in this context in Saudi Arabia and therefore fall outside the scope of this research.

In summary, research has shown that there are many types of assistive technologies for people with visual disabilities, with different characteristics for each type to suit the needs of users. It has been shown that assistive technologies can help visually impaired people overcome barriers to accessing information, thereby providing them access to more widely available information and services.

2.2 Adoption of Assistive Technology

The innovation-decision process put forward by Rogers (2003) identifies the steps an individual undertakes when deciding whether to adopt an innovation: knowledge, persuasion, decision, implementation, and confirmation. The process begins at the knowledge stage

where a person becomes acquainted with the technology. Later, the person progresses into the persuasion stage, which goes beyond simple awareness of the technology into evaluating its potential benefits. At the decision stage, the potential user decides whether to choose or reject the adoption of the technology. During the implementation stage, the device is incorporated into the user's daily routine. For example, during an assistive technology study conducted by Dawe (2006), parents reconfigured a memo-recording instrument as a communication aid for a non-verbal teenager with autism. The final phase is the confirmation stage where the person embraces using the technological device to its maximum potential, as applicable to their needs.

Rogers (1995) asserts that technologies must exhibit an obvious advantage over alternative options for them to be embraced. An adopted technological device ought to be compatible with the user's lifestyle and habits.

Despite their potential benefits, research has identified factors that hinder the adoption of assistive technologies. For example, Parette and VanBiervliet (2000) found that parents often are concerned that assistive devices will not overcome their children's disability or that they make their child look too different or even more handicapped than they really are. Several studies, such as those by Demiris et al. (2005) and Rahimpour et al. (2008), highlight the requirement for specific training to promote the adoption of assistive technologies. While some people with disabilities are uninterested in assistive technologies, others remain ignorant to the benefits and opportunities such devices can provide. Down and Stead (2007) state that there is inadequate awareness of how assistive technologies can provide an opportunity for independent living. Magnusson et al. (2004) are of the opinion that a barrier

to the use of ICT services by older people results from the challenges involved in training them to use IT, stemming from problems relating to the effects of ageing and the difficulties older people experience with information retrieval and learning.

2.2.1 Barriers To the Use and Adoption of Assistive Technology

Davis et al. (1992) claim that attitudes regarding the usage of, and the intent to use, assistive technologies can be inadequately formed, or the user can lack dedication in becoming proficient in the device's technology. Consequently, negative attitudes or a lack of enthusiasm about them can influence their actual usage. For example, while an assistive technology device is regarded as essential in providing a user with the means to achieve independence, a disabled user may hold a negative attitude towards the device because of their dependence upon it (Pettersson et al., 2007). Additionally, cultural baggage or stigmas, depending on the specific disability, also shape the disabled user's attitudes towards using technological aids (Cory, 2005; McDermott, 1993).

Sufferers of congenital disabilities typically embrace assistive technology without resistance to a greater degree than people who acquire disabilities as they readily acknowledge the device's potential to enhance their physical abilities. People with acquired disabilities, on the other hand, regard assistive technology devices as an unpleasant reminder of what they have lost or what they can no longer do independently (Scherer & Galvin, 1996). The target users for these new technological devices typically develop an attitude towards using them prior to receiving them, which also shapes their motivation to learn the technology required.

IT based devices can be complicated and often require perseverance on the part of the user to fully appreciate their potential, so the level of enthusiasm displayed by the user will be reflected in the device's successful adoption.

Dawe (2006) points out that assistive technology adoption research often considers a broad range of users from a variety of disabilities covering restricted mobility through to sensory and cognitive impairment. Adoption of AT devices requires a group effort involving the disabled person themselves, their caregivers, including family and guardians, as well as their broader community, the AT's technicians, and design and development staff.

Courtney (2006) points to privacy being a potential restriction to the adoption of assistance technology for older adults but points out that the necessity for the device can override concerns about privacy. As a restraint on technology adoption, privacy concerns derive from individual level factors together with community-wide factors.

Wanless et al. (2006) observe that users seldom understand the function that assistive technologies play in enabling self-management. Frequently, people who acquired their disabilities during their life are prematurely steered towards using assistive devices that they subsequently abandon (Scherer & Galvin, 1996).

According to Carlson et al. (2001), significant numbers of people with disabilities experience an inability to perform tasks, which leads others to make decisions in their place. There is a general assumption amongst caregivers and society that people with disabilities universally require assistance irrespective of their adoption of assistive devices. This frequently leads to the user abandoning their technological devices as other assistance options remain available.

In answer to this dilemma, Galvin and Scherer (2004) advises assistive technology specialists to educate both users and their caregivers in the device's capabilities so that both groups modify their behaviour in unison. Despite this, approximately one third of all users abandon their assistive technology devices (Scherer, 1996; Scherer & Galvin, 1996). An explanation for this high rate is that both users and caregivers developed unreasonable expectations about the benefits of the assistive technology aids, and when their performance does not reach these expectations, the users' disappointment lead them to discard the devices.

There is also a financial element to AT devices which shapes attitudes towards them. The technology is expensive to acquire and training both the user and caregiver is costly.

Several assistive technological devices have been designed with minimal consideration for their user's actual disabilities, which can lead to technology abandonment (Hakobyan et al., 2013). It may be that designers are unfamiliar with their target user's actual needs and existing abilities or they may be unaware of the protocols that measure the utility of their devices.

To produce higher rates of device adoption, Demirbilek and Demirkan (2004) propose combining two strategies: design *by* users together with design *for* users. Including people with disabilities at the design stage when developing new assistive technology devices is likely to result in a higher rate of successful adoption of the devices. Many assistive devices are complex and have written instructions that are difficult to comprehend. This is similarly a symptom of inadequate user participation during the design phase.

According to Scherer and Galvin (1996), if designers developed their devices for a specific purpose, the purpose must match the exact requirements of the disabled user. To be viewed as a success, such devices must be robust, match the user's aesthetic expectations, be easy to use and incorporate sufficient customizability to adjust to any specific requirement of the user.

2.3 The Saudi Arabia Context

2.3.1 Introduction

In 1932, the Kingdom of Saudi Arabia (KSA) was integrated by King Abdulaziz Al-Saud (KSA, 2018). The Kingdom is located in the heart of the Arabian Peninsula, an area of approximately 2,150,000 square kilometres, surrounded by the Gulf countries (Kuwait, Bahrain, the United Arab Emirates, Oman, and Qatar), Iraq and Jordan (see Figure 1). Arabic is the official language, and Islam is the official religion (Saudi Government, 2018). According to the Organization of the Petroleum Exporting Countries (OPEC (2018), KSA is the world's largest oil exporter, with 18% of the world oil resources. The country also has other important resources such as gold, iron, and copper.

Figure 1: Saudi Arabia's location and border

In 2016, the Government of the Kingdom of Saudi Arabia launched Saudi Vision 2030 as one of the most important pillars of the Saudi economy (Saudi Vision 2030, 2018). The vision has set a number of goals and it aims to achieve these objectives through strengthening and diversifying its economy and benefiting from resource workers and its strategic location (Saudi Vision 2030, 2018). One of the main objectives is e-governance and supporting digital transformation in all sectors of government, including education, in order to increase the efficiency of these sectors and the speed of development while reducing costs. Through the vision, the Saudi government seeks to expand the scope of electronic services to support important sectors such as health and education, as well as promoting the use of electronic applications such as cloud computing and assistive technologies to facilitate and diversify channels of communication for citizens (Saudi Vision 2030, 2018).

2.3.2 The Culture of Saudi Arabia

Saudi culture is similar to the culture of its counterparts in the Arabian Gulf countries, with an emphasis on community integration, helping others, and communicating with members of the society. The tribe, clan, and family all play key roles (Alfarraj, 2013).

Saudi Arabia is a religiously and socially conservative country that has a unique culture based on religion and tribalism (Al Alhareth et al., 2015). Indeed, Alfarraj (2013) and Al-Shehry (2009) point out that to know the Saudi culture it is important to know about Islam and the Arabic tribal customs and traditions. As Islam is the main religion in the Kingdom, it has had a great impact on the culture of Saudi society (Al-Rashid, 1986). Muslims derive their culture from the teachings of Islam obtained through the Holy Quran and Sunnah of the Prophet Muhammad (Aldraehim, 2013). Islam calls for many values that are considered key components of Islamic culture, such as good morals, honesty in business dealings, equality between people regardless of their gender, race or colour, as well as many other characteristics (Aldraehim, 2013; Kabasakal & Bodur, 2002). Islam also encourages family and community cohesion, cooperation among members of the society, and helping those who need help (Aldraehim, 2013). Saudis prefer to work in teams managed by a leader who is the decision maker (Brdesee, 2013). Tribal and family relationships are factors that may affect individuals in their work, either positively or negatively (Al-Shehry, 2009).

2.3.3 The Educational System of Saudi Arabia

The development of education has been one of the most important objectives of the Kingdom of Saudi Arabia since it was established (MOE, 2018). The first educational system in the Kingdom was established in 1925 with the creation of the first educational organization

named the Directorate of Knowledge. In 1951, the first Ministry of Knowledge was established and King Fahd bin Abdulaziz became the first Minister of Education. In 1975, the first Ministry of Higher Education was established. The Ministry of Higher Education was merged with the Ministry of Knowledge to become the Ministry of Education (MOE, 2018).

In 2018 there are five levels of education in the Saudi educational system: pre-elementary, elementary, intermediate, secondary, and higher education (MOE, 2018). Students in Saudi Arabia receive all levels of education at no cost (Al-Mousa, 2010). The Saudi Arabian government mandates parents enrol children aged over 5 years old in primary schools (Alquraini, 2011).

According to The General Authority for Statistics (GaStat) in Saudi Arabia, the population of the Kingdom of Saudi Arabia in 2017 was 32,552,336, of which 20,408,362 were Saudi citizens, with 50.94% male and 49.06% female (GaStat, 2017). The Saudi population aged between 20 and 35 in 2017 was 5,802,334, which is the approximate age of university students in Saudi Arabia. Also, more than half of the population aged over 24 years have completed at least secondary school education. Figure 2 illustrates that the total number of students enrolled in education for 2017 in any level was 6,412,128, of which 1,262,687 were university students (GaStat, 2017). There are currently 25 public universities and several private universities (Saudi Government, 2018).

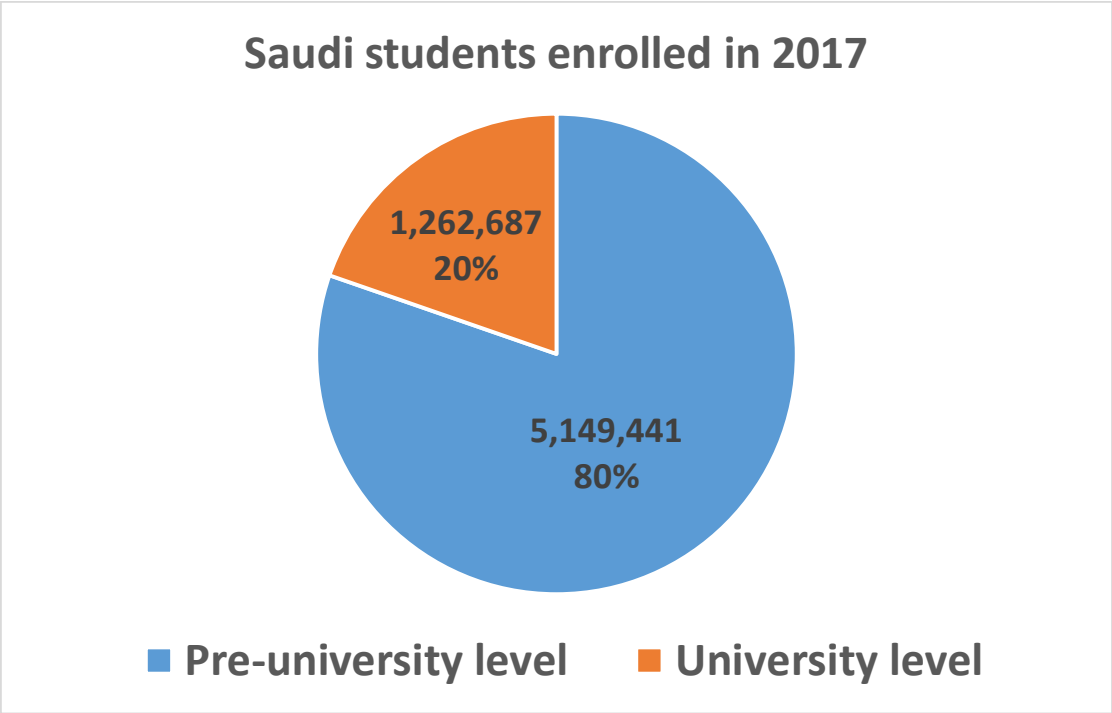


Figure 2: Overall Saudi students enrolled in 2017

2.3.4 Education for Disabled Students in Saudi Arabia

The first education for blind adults was in 1958 through a non-profit organization that provided a class to help blind adults to use the Braille language (Al-Kheraigi, 1989; Aldabas, 2015). The first official government institute for visually impaired students in Saudi Arabia was The Al-Noor Institute which was established in 1960 (Al-Hano, 2006). According to Al-Jadid (2013), government education policies promulgated in 1970 incorporated special education programs for disabled students.

The Saudi Arabian Ministry of Education supervises dedicated institutions catering for disabled children. According to Al-Jadid (2013), the ministry operates educational rehabilitation at specific educational facilities including the Amal Institute for the Deaf, Al-Noor Institute for the Blind, and the Institute for the Mentally Retarded.

The Al-Noor Institute of the Blind's 10 educational facilities serve 625 students with visual impairment. Their staff included 264 qualified teachers who hold special education diplomas (Battal, 2016). Each branch is equipped with curricula, modules and specialized assistive aids that match the requirements of the student's needs (Al-Jadid, 2013).

The Amal Institute for the Deaf operates 23 facilities together with a network of auxiliary units serving specific public schools. Their roll includes approximately 3000 hearing impaired students who are educated by 606 suitably qualified teaching staff. Intermediate and secondary school student curricula include relevant technical and vocational-oriented skills appropriate to their abilities or degree of hearing impairment (Al-Jadid, 2013).

In addition to these specialized institutions, the Saudi government operates Social Rehabilitation Centres plus dedicated organizations providing social welfare support to needy disabled people requiring educational rehabilitation (Al-Jadid, 2013).

2.3.5 E-learning for Visually Impaired Students in Saudi Arabia

According to Weber (2016), the actual use of the Internet in Saudi Arabia begun in 1999, and in 2008 Saudi Arabia was ranked 46th in the global e-readiness index. Saudi Arabia is investing heavily in the e-learning sector, with government expenditure on e-learning in 2008 reaching $125 million (Weber, 2016, p. 19). E-learning in Saudi Arabia can be one of the most important factors in decreasing the number of non-citizens working in Saudi Arabia (Weber, 2016). The Saudi government's expenditure on education in 2003 was 24% of the country's budget. E-learning may help improve efficiency of educational delivery and reduce government spending (Bosbait & Wilson, 2005, p. 533). According to Means et al. (2009), a study by the US Department of Education showed that the productivity of students who used

e-learning was better than students who used traditional methods of education. In addition, one of the most important benefits of e-learning is its contribution to reducing the costs of the educational institution, which motivates many educational institutions to adopt and invest in it (Weber, 2016). This is in line with the Saudi Vision 2030 goal to reduce government spending through the digital transformation of education sectors in Saudi Arabia. According to Weber (2016), the Gulf countries, including Saudi Arabia, are lagging behind in the application of e-learning for several reasons, including barriers to the implementation of assistive learning techniques.

Despite recent growth, there is still urgent need for Saudi Arabia to establish flexible and accessible electronic educational systems to help people with disabilities integrate their education through the use of assistive technologies (Weber, 2016). According to Abanumy et al. (2005, p. 1), more than 90% of Saudi e-government sites are inaccessible to the Saudi disabled who represent 4% of the Saudi population.

According to Russell et al. (2003), technology can be used to improve the quality of education, but studies suggest there are some challenges in technology adoption. There is, therefore, a need to make assistive techniques accessible to all students by integrating them into a comprehensive learning environment. According to Wong et al. (2008), one of the most important goals of technology in education is to raise the level of student competence. In addition, the dissemination of technology based on social models that adopt educational competencies can achieve educational goals (Alquraini & Gut, 2012).

In 2011, the Saudi Electronic University (SEU) was established to pioneer e-learning and distance learning in Saudi Arabia. The university uses the blended learning method which

adopts a mixed educational system that integrates e-learning and traditional face-to-face education. Although the university should be one of the most suitable environments for the students with visual impairment, it can't be included within the scope of this study because it has no specialized center for people with disabilities.

2.3.6 AT for Vision Impaired Students in Saudi Universities

Assistive technologies help people with disabilities interact with the environment in which they live. As such, assistive technologies can be considered a link between users and the environment around them. The technology helps disabled people improve their quality of life by enabling them to perform their daily tasks without the need of help from others (Hakobyan et al., 2013). One of the most important aspects of the lives of people with disabilities, which is expected to be improved through the use of assistive technologies, is education.

In 1996, the King Salman Centre for Disability Research was established to fill Saudi Arabia's gap in specialized scientific research on disability issues (KSCDR, 2018). The Centre supports research that contributes to the development of services for people with disabilities and works to improve the conditions of people with disabilities to become productive workers and to participate in community building (KSCDR, 2018).

The Kingdom of Saudi Arabia is witnessing rapid development in the education of people with disabilities, with the aim of developing their capabilities, helping them to integrate into society, and obtain real opportunities in the labour market, which will in turn benefit the Kingdom economically and socially (KSU, 2018). In 2008, the Kingdom signed the United Nations Convention on the Rights of Persons with Disabilities (CRPD), which stipulates that education services, including higher education, for individuals with disabilities must be

provided and that the necessary facilities for them to learn in an easy and accessible manner must be made available (KSU, 2018). To this end, many universities in Saudi Arabia have sought to provide educational services for individuals with disabilities and to provide a suitable and attractive educational environment for them.

King Saud University was one of the first Saudi universities active in the field of education for individuals with disabilities. The university established a centre to serve both male and female students with disabilities under the umbrella of the Deanship of Student Affairs (KSU, 2018). In 2008, a project was established by King Saud University to develop services for students with disabilities called the King Saud University Universal Access Program (UAP), which aims to provide an educational environment suitable for disabled students (KSU, 2018). The UAP supervises architectural and technical integration of the university's buildings and facilities to ensure suitability for disabled students (KSU, 2018). In addition, the UAP provides services for students with visual impairment through academic guidance services, psychological counselling and financial support, in addition to providing assistive technologies (KSU, 2018). For students with visual disabilities, the UAP provides assistive devices such as screen readers, electronic Braille displays, Braille Sense, and Kurzweil Reading Machines, as well as assistive software such as Zoomtext, JAWS, and Hal (KSU, 2018).

King Abdulaziz University (KAU) is also active in the field of service for disabled students. The university participates in many events and conferences related to disabled people (KAU, 2018). The university hosts many activities in the same context. KAU established a disabled services centre to serve disabled students by providing financial, moral and technical support

to students with disabilities through the provision of assistive technologies for use in their studies (KAU, 2018).

King Faisal University has also established a special needs unit for students with disabilities. The unit provides them with the requirements they need in the academic field in addition to providing support during the course of their studies (KFU, 2018). The University has also established the Al Noor Hall, which offers services for both students and staff with visual disabilities and provides them with the appropriate assistive technology to help them access information (KFU, 2018).

2.4 Summary

This chapter highlights the importance of assistive technologies in the daily life of visually impaired individuals, the most important obstacles facing individuals with visual disabilities, and factors that prevent adoption and acceptance of assistive technologies in various fields. As this research focuses on visually impaired students in Saudi universities, the educational system applicable to the visually impaired in Saudi Arabia has been highlighted. Multiple Saudi universities are providing services that facilitate visually impaired student's access to education, allowing them to continue their studies. This underlies the need for this research to examine the acceptability of assistive techniques and to explore the obstacles that prevent these techniques from being fully used by visually impaired students in Saudi universities.

Chapter 3 : Literature Review

This chapter reviews the literature on the uses of assistive technology (AT) in education and the benefits and barriers of using it. It also examines work on technology acceptance models to identify an appropriate model for this study.

As this research is concerned with attitudes and barriers to the use of assistive technology in Saudi universities, the focus of this review is on studies that relate to technologies and teaching methodologies that are currently in widespread use in Saudi Arabian universities.

3.1 Using Assistive Technology

As this study focuses on the use of AT in the education context, this section will review the previous literature in this field, including the benefits and barriers of the use of AT.

3.1.1 Using Assistive Technologies in Education for Visually Impaired Students

Silman et al. (2017) assessed the use of assistive technology in the learning process for visually impaired people. The paper examines the use of AT as well as how institutions have used this technology. The technology is not only used in educational institutions but also at the administrative level. A qualitative technique is used to collect and analyse the data. The study showed that the use of this technology among visually impaired people increased. The authors found that a technological limitation is the lack of automatic high-speed book scanners. The availability of such a device would improve the quality of the lives of visually impaired people.

Clouder et al. (2018) examined the role of AT in promoting inclusion of students with disabilities in the education environment. The main aim of this paper is to assess ways to increase access to learning through the use of AT. Different educational institutes working with AT have explored different ways of increasing the use of AT. By promoting individual and collective students' agency, the institutions have found that this technology has addressed the invisibility of disabled students. The authors used secondary sources to examine different projects for this research. The focus of the study is on the power and importance of AT; neither the effect nor the benefits of the AT were considered.

Wong and Cohen (2016) examined access to and challenges of using AT for visually impaired students in gaining higher education as well as becoming independent. The main aim of this paper is to examine the experience of teachers with visually impaired students. Teachers play an important role in facilitating the use of AT by impaired students. In this paper, a quantitative research technique was used, with the authors gathering data from six teachers. The authors concluded that AT is inadequate and inconsistently used by teachers. They also summarized the results of the study into four themes: making a decision, collaboration, increasing capacity and accessing the AT. They point out gaps in terms of assessment, knowledge and collaboration among the teachers related to the AT.

Ajuwon et al. (2016) examined the perceptions of teachers who have used AT to assist visually impaired students. The students' utilization and competency with AT were the primary focus for those teachers who assist visually impaired students. The authors conducted two studies in order to assess the reflections of the teachers on the use of AT. In the first study the authors gathered data from Texas and, in the second study, the data was

collected from all states of the US. The authors concluded that AT is a beneficial tool for teachers to assist visually impaired students.

3.1.2 Benefits of Using Assistive Technologies in Education

Perelmutter et al. (2017) assessed the benefits and effectiveness of ATs, such as smart pens and text-to-speech systems, for teaching disabled students. They found that the use of AT has increased, and that AT is helpful in supporting the learning of a disabled person, but that the intervention of this technology must be carefully customized to the individual. The authors used a combination of qualitative, quantitative and survey methods.

Alnahdi (2014) investigated whether or not AT is helpful for disabled people in a variety of fields, with a particular focus on the role and the benefits of the AT. Using secondary sources, the author found that AT is used in many fields and has improved the ability for disabled people to perform both academic and employment tasks. The paper reports that in general disabled people work effectively with AT, although the challenges of AT were not considered.

White and Robertson (2015) investigated the implementation of AT in the field of education, with a particular objective to assess the benefits of the AT for both students and teachers. Without AT, non-reading students from grades four to five did not have the ability to access the curriculum and information. The authors found that AT helps eliminate this reading gap by improving reading among non-reading students. The authors used a qualitative approach to collect data from teachers. The results of the study indicated that AT increased collaboration between teachers and students, although the paper did not discuss how the AT can improve the confidence level of non-reading students.

Erdem (2017) analysed secondary sources to investigate the need for AT and its use among special education students. The study highlights the increasing use of ATs in special education institutes and identifies different types of AT used in special education. The author concludes that AT has a positive effect on special education students and, with the help of this technology, that they can become more independent and live a more productive life. However, the disadvantages of the use of AT were not discussed.

A Qualitative study by Silman et al. (2017) examined the benefits of using AT in the Cyprus Turkish Blind Association. They found that using AT facilitated both the educational and administrative processes for visually impaired individuals within the organisation. Moreover, the authors found that using AT can also motivate the visually impaired individuals to learn and communicate with each other as well as with people outside their organisation.

Alnahdi (2014) asserts that the use of AT by visually impaired students can lead to several advantages such as helping them to be more independent, enhancing their participation in the classroom, and improving their abilities to complete difficult academic tasks.

3.1.3 Barriers to Using Assistive Technology

This section highlights the most important previous studies showing factors that have been found in some contexts to have a strong influence on disabled users' acceptance of the technology.

Dorrington et al. (2016) examined accessibility of assistive devices and how accessibility affected the user’s experience and independence. The authors found that in an institutional setting, poor personal access and poor institutional support for access can decrease

independence among disabled students as well as their ability to fulfil their aim. They conclude that it is the responsibility of educational institutions to enhance accessibility to AT among disabled people and to provide awareness about the benefits of AT devices.

Borg and Östergren (2015) investigated perspectives of AT users with a view to elaborating barriers to using AT. The authors found that the main barrier is cost; AT devices are expensive so not all disabled people can use them. Another barrier is awareness; many people are not familiar with AT or aware of its potential benefits. The authors concluded that to increase use of AT, affordability must be improved and awareness increased.

Edyburn (2015) studied how the self-efficacy of disabled learners expanded their use of AT. The authors found that specialized AT reduced the impact of disability on disabled people, and that AT can enable disabled people to learn, live and work independently. But they conclude that to use the technology effectively, enhancing self-efficacy of users is essential. Education institutions can have a positive effect on the use of AT by providing training in AT skills and fostering a belief among disabled students that they can fulfil their objectives and do what they want to do with the help of AT.

Löfqvist et al. (2016) examined how the attitude of people towards technology affects acceptance of AT. The authors gathered data from 371 individuals during home visits and also conducted interviews. They found that most people have a positive attitude towards the adoption and acceptance of AT and feel it can improve their quality of life, but that there are some barriers that can impede the use of the technology.

Orellano-Colón et al. (2016) also investigated the perception of people towards the use of AT and the barriers to using AT devices. The authors found that AT has enhanced the safety, quality of life and independence of disabled people. However, the lack of availability and high cost of the devices are the main barriers. The authors used a descriptive qualitative approach with semi-structured interviews and concluded that barriers to using AT can cause disparities in the degree to which disabled users can live independently. However, they did not discuss how barriers to using AT devices can be reduced.

Chaurasia et al. (2016) used secondary sources, such as published case studies, to investigate the effect of anxiety on the acceptance of AT by elderly people. AT can help deliver care to elderly or disabled people and enhance their quality of life, but some people become anxious about using technology. The authors found that anxiety can be a significant barrier when elderly people are adapting to the use of AT. However, the paper did not discuss how such anxiety can be reduced.

Ahmad (2015) assessed barriers for using AT in the field of education by gathering data from secondary sources. The study found that ineffective policies, limited support from government and insufficient training of teachers are the main barriers to using AT devices. The author concludes that effective use of technology can increase the ability for students to access information and improve communication, but there is a need for educational institutes to provide proper training to teachers as well as students on how the devices can be used.

Holzberg and O'Brien (2016) assessed AT accessibility to educational institution web pages using a social accessibility tool. Many educational institutions are working to increase the accessibility of AT for disabled students. The authors found that the technology is available

to improve web accessibility, but the institutions often lack resources to use it. Poor accessibility increases learning difficulties for disabled students and teaching difficulties for special education teachers. The paper recommends that in this situation the government should provide necessary facilities to educational institutions, for example by providing additional funding.

Hoffman et al. (2017) studied visually impaired adults suffering from anxiety about the use of assistive devices. Although the use of AT can help overcome problems faced by visually impaired people, if those people are scared of the technology they will hesitate to use it. The authors gathered primary research data from visually impaired adults and recommended the use of different techniques that can reduce anxiety and improve the acceptance of AT.

Hughes et al. (2014) investigated the perception of people towards the barriers and opportunities of AT in education using a questionnaire organized around several themes. The authors found that lack of knowledge about AT and awareness of its benefits is a significant barrier, as are limited access to the technology and inadequate education about its use. They point out that there is a need to develop cost-effective assistive devices to ensure that most disabled people can use it and that most institutions can provide the facility to their students.

Wu et al. (2016) used focus group discussions to investigate the attitude of people with cognitive impairment towards the adoption of assistive devices. The main purpose of this paper was to explore the difficulties that older adults face with the use and acceptance of assistive devices. The authors found that most of the people with cognitive impairment believe that they have a reduced ability to use the technology, which results in a negative attitude towards the adoption of AT. However, those people who do have the capacity to use

the technology are more likely to have a positive attitude and see that the technology can change their outlook on life.

Alves et al. (2009) conducted a study to investigate the use of assistive technology by visually impaired students in education from the teachers' perspective. The researchers asked 134 teachers of public schools in Brazil about the use of assistive technology in the classroom. The study found that the most important causes that prevent the use of AT in schools from the teachers' perspective are limited training courses, poor infrastructure and insufficient pedagogical support.

Shinohara and Wobbrock (2016) used a diary study for two groups including disabled individuals and non-disabled individuals for four weeks to explore their perceptions and interactions about the use of AT. The authors conclude that disabled individuals feel self-conscious and self-confident when using AT. Also, they found that there is a strong relationship between the form and the function of AT and the self-efficacy and self-confidence of the AT users.

Abner and Lahm (2002) conducted a study of teachers of visually impaired students in Kentucky to verify the AT used and the needs of teachers. The study found that teachers needed more training and support to be able to help visually impaired students.

Constantinescu (2015) also identified barriers that teachers face which can prevent the effective use of assistive technologies by disabled students. The study found that the most important barriers from the point of view of teachers are the inadequate professional

development, lack of appropriate assistive technologies, insufficient financial resources, and insufficient time to prepare curricula compatible with assistive technologies.

Burgos (2015) conducted a study to examine the competence of specialists in assistive techniques in schools in Florida. The study found that there is a shortage of specialists who are competent in the field of assistive technologies because of limited access to continuous training and the difficulty of keeping abreast of the development of assistive technologies. The study recommended the need for training for specialists in assistive technologies to meet the needs of their students with disabilities.

Desideri et al. (2016) examined the cost of implementation of AT and the effect of cost on accessibility to AT. High cost relative to available resources limits availability of assistive devices and hence has a negative effect on accessibility. The problem is particularly severe for disabled people who are in remote areas and who may have no awareness about the use of AT. The authors conclude that there is a need for both educational institutions and the employment sector to enhance the accessibility to AT.

Bhowmick and Hazarika (2017) used a statistical survey to investigate the attitude of visually impaired and blind people towards the adoption of AT. The authors found that most visually impaired and blind people have a positive attitude towards the adoption of AT and have the perception that the AT creates a positive impact on their lives, which enhances their ability to live independently.

Fakrudeen et al. (2017) considered the use of technology by school students in Saudi Arabia. The study found that students with disabilities in the primary stage of schooling use

technology less than students who do not have a disability, but by the intermediate and secondary stage, disabled students were using technology more, and their confidence in using technology had increased. By the time they reached secondary school, disabled students were able to interact widely through social media applications and the technology had become a part of their lives.

3.1.4 Summary and Discussion

Table 1 summarises factors that have been found in some contexts to present barriers to the use of assistive technology. The table categorises the barriers into three groups: user factors, teacher factors, and institutional factors.

Table 1: Summary of barriers to AT use investigated in previous studies.

	User factors				Teacher factors				Institutional factors					
Study	Accessibility	Self-efficacy	Attitude towards AT	Anxiety	Awareness	Time to prepare	Teacher training	Specialists training	Government support	Institutional policies	Pedagogical support	Infrastructure	Cost	Availability
Dorrington et al. (2016)	*													
Borg and Östergren (2015)					*								*	
Edyburn (2015)		*												
Löfqvist et al. (2016)			*											
Orellano-Colón et al. (2016)													*	*
Chaurasia et al. (2016)				*										
Ahmad (2015)							*		*	*				
Holzberg and O'Brien (2016)	*								*					
Hoffman et al. (2017)				*										
Hughes et al. (2014)	*				*								*	
Wu et al. (2016)			*											
Alves et al. (2009)							*				*	*		
Shinohara and Wobbrock (2016)		*												
Abner and Lahm (2002)							*							
Constantinescu (2015)						*		*	*					*
Burgos (2015)								*						

Desideri et al. (2016)	*												*	
Bhowmick and Hazarika (2017)			*											
Fakrudeen et al. (2017)		*	*											

- User factors are those that may affect a disabled student's acceptance of AT for use in their study, and include the accessibility of the AT in the university context, their self-efficacy in learning and using new technology, their attitude towards the technology, and feelings of anxiety in using AT for their study.
- Teaching factors are those that may affect teachers or administrators working with disabled students, and include their level of awareness of visual disability and AT, the extra time teachers need to prepare curriculum materials for use with AT, teacher training requirements, and the expertise of specialist support staff,
- Institutional factors are those that are the responsibility of universities or governments. In Saudi Arabia, the government is responsible for financial support to the universities and overall policy directions. Universities are responsible for institutional policy determination and implementation, for the provisional of infrastructure and human resources, and for facilitating pedagogical support.
- The table lists two other factors that have been considered in previous studies: the cost of AT devices, and their availability to users. In some contexts, these factors are the responsibility of users; in others, they are the responsibility of institutions. The Saudi government makes AT available to all disabled university students free of charge, so they are effectively institutional factors in the context of this study.

For this study the focus is on acceptance of AT by Saudi university students, using the University Theory of Acceptance and Use of Technology (UTAUT). UTAUT takes into account factors that have been found to influence technology acceptance in a wide range of technology contexts but is not specifically designed for use with assistive technology. Consequently, for this study the UTAUT model was extended to include the factors identified by previous studies to present barriers to user acceptance of AT: accessibility, self-efficacy, attitude to AT, and anxiety. An introduction to UTAUT and its background is covered later in this chapter, and the extended UTAUT model is discussed in detail in Chapter 4.

3.2 Technology Acceptance Theories and Models

3.2.1 Introduction

Many studies have investigated factors that affect the acceptance of technology in an information systems environment, and many acceptance models have emerged, each with its own set of acceptance determinants. There has been a lot of effort in validating and extending the models over the years, which has resulted in their evolution and refinement. Recent studies using current models have helped highlight reasons for poor acceptance of particular technologies and pointed to potential suggestions for overcoming problems.

The focus of this thesis – use of assistive technology by visually impaired Saudi university students – is an area where acceptance is currently lower than expected. This section reviews the development of acceptance models, and their limitations, with a view to determining the best model to use as the basis for this study.

3.2.2 Theory of Reasoned Action (TRA)

Ajzen and Fishbein (1980), working in the social psychology field, developed the Theory of Reasoned Action (TRA), which was one of the first models used to explain technology acceptance. This theory uses a systematic theoretical orientation framework based on beliefs, attitudes, subjective norms, intention and behaviours. The theory was developed with the objective that it will be able to predict, explain and impact human behaviour across many domains. According to the authors, TRA is a suitable model for studying determinants of user behaviour.

The TRA states that the main determinant of behaviour is not the attitude of the person towards that behaviour but the intention to perform that particular behaviour. There are two factors which determine behavioural intention: the person's attitude towards that behaviour, and subjective norms based on perceived social pressures that relate to the behaviour. Attitude towards behaviour depends on the person's unfavourable and favourable evaluation of the behaviour in question. The belief here is that a person will be inclined to perform a behaviour if they perceive that there is a chance that it will lead to a valued outcome. Normative beliefs are based on the perceived social pressure from different factors, and the person's motivation to obey these factors. The Figure 3 below explains the theory.

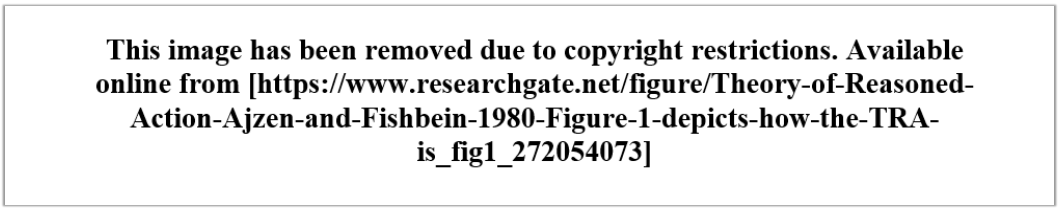


Figure 3: Theory of Reasoned Action

(Ajzen & Fishbein, 1980)

The main limitation of TRA is the correspondence between variables, as stated by Ajzen (1985). For example, there are five things that attitude and intention must agree on if TRA is to predict a particular behavior: target, context, action, time frame and specificity (Sheppard et al., 1988).

Another limitation is that TRA attempts to explain only volitional control; the theory applies only to behaviour that is decided before it takes place. This means that the decisions that people take on impulse, the actions that result out of habit, and other natural behaviours are not covered by this theory.

3.2.3 Theory of Planned Behaviour (TPB)

To address the incomplete volitional control limitation of TRA, an extension was proposed by Ajzen (1985), which created the Theory of Planned Behaviour (TPB). Like TRA, TPB is a model used for predicting and explaining human behaviour and focuses on the roles of individual organizational members and the social systems that are found in the process (Ajzen, 1991). However, according to its author TPB was designed with the objective of also predicting those behaviours that were not fully under volitional control. To accommodate

these situations, TPB includes a factor for perceived behavioural control (PBC), which takes into account the situation where behaviour is not fully under the control of the individual.

Ajzen (1991) stated that this can be different in terms of situations and actions, and placed PBC into a general framework of relationships between beliefs, attitudes, intentions and behaviour. As it is shown in Figure 4, PBC can impact both intention and behaviour. The impact of PBC on behaviour can either be direct or indirect through behavioural intention. TRA implies that when a situation or behaviour gives an individual complete control over their behavioural performance, behaviour can be predicted using only intention. Ajzen's argument here is that there are conditions where behavioural intention would account for only a little variation in behaviour, while with the addition of PBC the model should be able to more fully predict behaviour (Ajzen, 1991).

Figure 4: Theory of Planned Behaviour.

(Ajzen, 2002)

The role of intention and PBC is very important for the purpose of predicting behaviour. However, different conditions result in different levels of importance of one factor over the other. TPB deals with extant behaviour when it is explaining and predicting behaviour; it also

deals with subjective norms and perceived behavioural control. Behaviour is considered to be a function of salient beliefs that are relevant to a specific behaviour. The salient beliefs here refer to the determinants of a person's actions and intentions, and affect the person's attitude to the behaviour, response to norms, and control of non-volitional behaviour.

TPB has been criticized because it fails to investigate the relation between intention and behaviour, resulting in large amounts of unexplained variance in behaviour. In addition, it doesn't take into account demographic variables and makes the assumption that everyone will have the same experience with the process of the model. Instead, Armitage and Conner (1999) argue that, as a psychological model, its focus should be on internal processes.

According to Taylor and Todd (1995), TBP uses PBC as a variable to group all elements of behaviour that are not controllable. They suggest that the reason why the salient beliefs behind PBC were collected into a cluster was simply to come up with a measure for it, and criticize the model for aggregating factors that should be able to predict behaviour, which creates a lack of neutrality.

3.2.4 The Social Cognitive Theory (SCT)

Bandura (1989) is the psychologist most credited with pioneering the social cognitive theory (SCT). According to SCT, the acquisition of learning and knowledge results from social interaction, environmental factors, biological and affective incidents and the emulation of patterns of experienced behaviour. At the core of SCT is the premise that human behaviour, represented by individual actions and personal conduct, is determined and regulated both by personal internal dispositions and environmental external influences (Bandura, 1989).

According to his theory, learning is the consequence of observing other people's actions and through personal experience of these actions.

Bandura (2011) defines SCT's focal constructs as reciprocal causation (triadic determinism), outcome expectation, self-efficacy, and self-regulation. Triadic reciprocal causation postulates that observed behaviour is shaped through bidirectional interaction within three spheres: personal and cognitive, environmental and behavioural inputs. Personal and cognitive inputs indicate an individual's self-efficacy, representing confidence in their own capabilities and strengths (Bandura, 1977). SCT's second premise is outcome expectations; the consequences inherent with participating in specific behaviour. SCT's remaining construct is self-regulation of behaviour, which takes place when personal actions and thoughts are employed to accomplish an objective (Bandura, 2011).

3.2.5 Technology Acceptance Model (TAM)

Davis (1989) proposed the Technology Acceptance Model (TAM), which is one of the most widely known and influential theories about acceptance and behaviour in the information systems domain. TAM is based on the work by Ajzen and Fishbein (1980) on the Theory of Reasoned Action; it attempts to explain why technology is used and accepted by users, and the factors that have an impact on the process.

The Figure 5 shows that TAM represents two user perceptions: perceived usefulness and perceived ease of use (Davis, 1989, p. 30). Perceived usefulness can be defined as a person's belief that if they use a system, it will improve their performance. Perceived ease of use can be defined as the degree to which a person thinks that using a system would not require effort.

TAM attempts to show the factors that influence system usage with the help of beliefs about these two factors (Davis et al., 1992).

Figure 5: Technology Acceptance Model

(Davis, 1989)

Like TRA and TPB, TAM considers intention as determining system usage. In TAM, intention is determined by both the attitude of the person using the system and its perceived usefulness. As Figure 5 shows, either a positive attitude or perceived usefulness can impact intention to use a system. This means that if a person believes that their performance will be enhanced by using a system, they may form an intention to use the system despite negative feelings about it (Davis et al., 1992). The external variables in the model are the objective system design characteristics, the nature of the implementation process, training, computer self-efficacy, and the user's involvement in the design (Davis & Venkatesh, 1996).

According to Legris et al. (2003), a limitation of TAM is that application of the model relies on a respondents' self-reporting their usage and assumes that the usage reported reflects actual usage. In addition, the model is influence by sample choice, examined systems and the specifications of the respondents. For example, in a study using samples from professional users and students it would be difficult to generalize the findings to other

contexts. Further, Venkatesh (2000) points out that another limitation of TAM is that it doesn't give much guidance on how usage can be impacted with the help of design and implementation. For example, although it may help in understanding or explaining acceptance, it provides little help in guiding development beyond the suggestion that the system characteristics make it easier to use.

3.2.6 Extension of the Technology Acceptance Model (TAM2)

To overcome some of the limitations of the original TAM, Venkatesh and Davis (2000), extended the model to create TAM2, which included important determinants of perceived usefulness and user intention in terms of the social impact and the cognitive instrumental processes. Social influence processes include subjective norms, voluntariness and image. Cognitive instrument processes include job relevance, output quality, result demonstrability and perceived ease of use. The TAM2 model is shown in Figure 6.

In the TAM2 model, experience is a factor that is not categorized as a social influence process but rather is a moderating factor that is connected with the influence of subjective norms on other processes (Venkatesh & Davis, 2000). For example, the model assumes that an organization mandating use of a system will rely on the subjective norm having a direct impact on a user's intention to use the system in the early stages of deployment, but that the impact of the subjective norm on intention will decrease over time as the user gains experience, and that perceived usefulness will take over as the factor influencing use of the system.

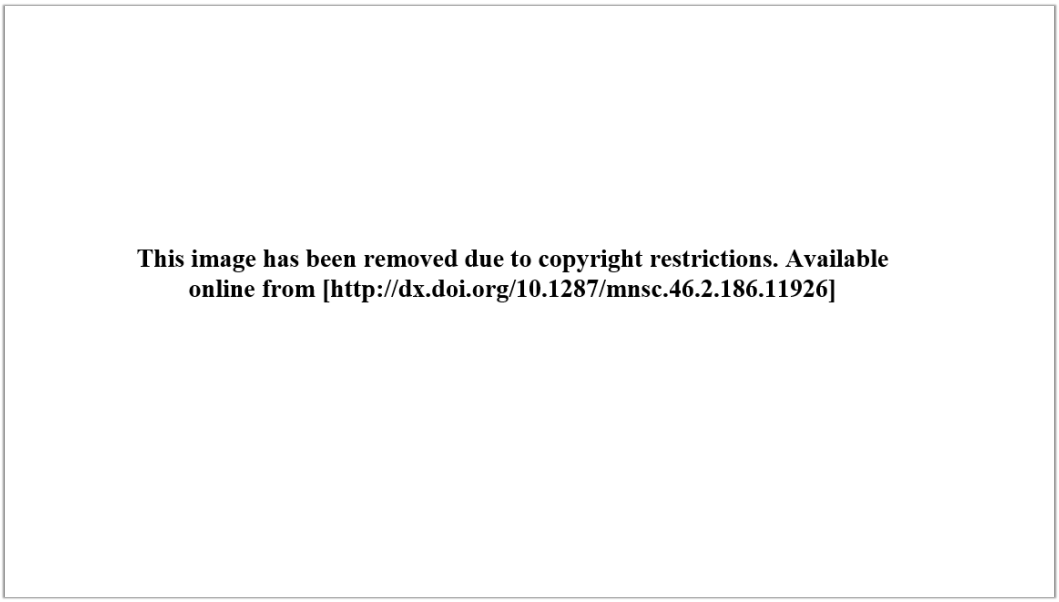


Figure 6: Extended Technology Acceptance Model (TAM2)

(Venkatesh & Davis, 2000)

Similarly, Venkatesh and Davis (2000) consider that mandatory use of a computer system affects the influence of subjective norms on intention. In TAM2, this is represented by the moderating variable voluntariness, which is used to differentiate between mandatory and voluntary usage in an organizational setting. The model states that subjective norms can have a direct impact on intention if use of a system is mandatory, or an indirect effect (via perceived usefulness) if use is voluntary. The authors point out that first path leads to usage through compliance, whereas the second path leads to usage through internalization.

3.2.7 Extension of the Technology Acceptance Model (TAM3)

TAM3 was launched in 2008 as an update and adaptation of TAM2. It incorporated new features including perception of external control, computer self-efficacy, computer anxiety,

computer playfulness, objective usability and perceived enjoyment (Venkatesh & Bala, 2008). TAM3 was used to study the adoption of workplace IT and achieved a 54 % success rate in predicting behavioural intention and a 31–36 % accuracy for anticipating actual use factors. TAM3 is illustrated in Figure 7.

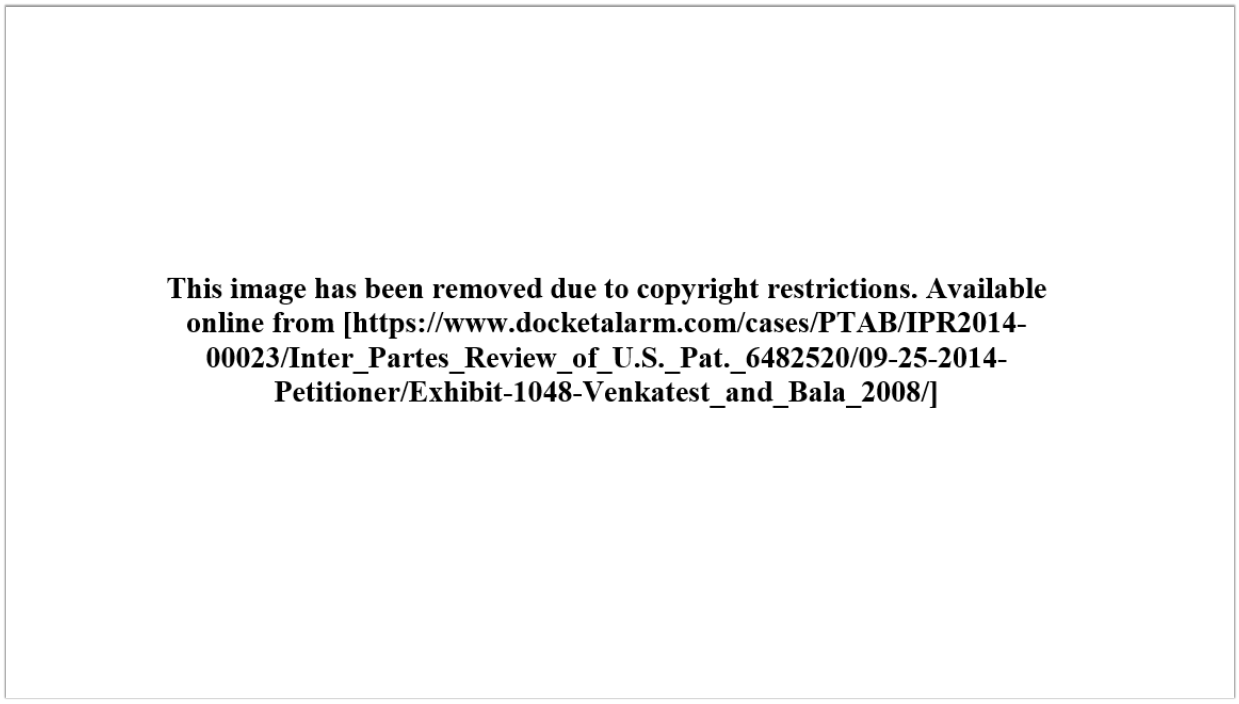


Figure 7: Technology Acceptance Model (TAM 3)

(Venkatesh & Bala, 2008)

Other uses for TAM 3 have included its use in researching behavioural intentions for mobile entertainment usage (Leong et al., 2013), mobile technology for hedonic scenarios (Abad et al., 2010), payment services through mobile devices (Jaradat & Al-Mashaqba, 2014), and mobile commerce technology (Faqih & Jaradat, 2015).

3.2.8 Diffusion of Innovation Theory (DOI)

According to Rogers (2003), the Diffusion of Innovation (DOI) model describes how innovations are diffused within society and how organizations and individuals adjust to new innovations. Rogers provides an explanation of how the diffusion process and the adoption process are different from each other. The diffusion process takes place in a society and is a group process. On the other hand, the adoption process is related to an individual. As per Rogers (2003, p. 474), diffusion can be described as a process where an innovation is communicated over channels to the members in the social system, whereas adoption is a process by which an innovation can be fully utilized only when the best course of action is present.

Rogers (2003) considers that there are four factors present in the diffusion of innovation theory: innovation-decision process, innovation characteristics, adopter characteristics, and opinion leadership. The DOI model of the innovation decision process has five stages, and is shown in Figure 8. The model shows the different stages that an individual or someone making a decision should go through in the process of adopting or rejecting an innovation.

1. Knowledge: An individual or someone making a decision learns about the existence of an innovation and then makes sense about how it functions.
2. Persuasion: The characteristics of the innovation give rise to favourable or unfavourable attitudes on the part of the potential adopter.
3. Decision: The individual takes part in activities that lead to either adopting the innovation or rejecting it. This also includes confronting forces who support the influence or oppose the process.

4. Implementation: An individual decides to use an innovation. This happens due to overt behaviour change when a new idea is implemented.
5. Confirmation: The decision is adopted or rejected. The user reflects on the innovation and can even change the decision if problems occur.

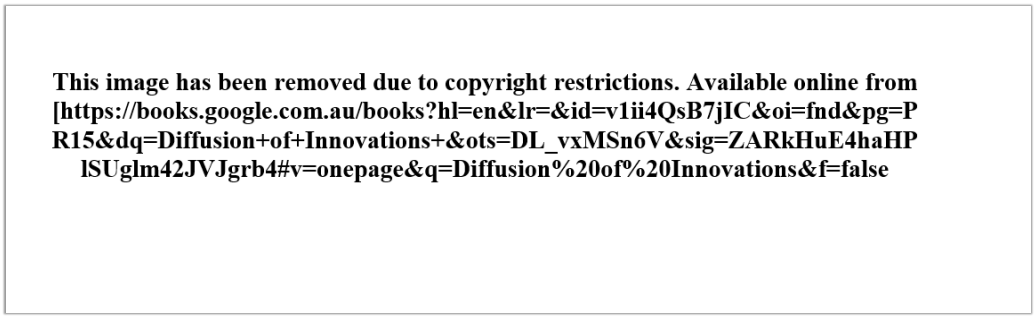


Figure 8: The Innovation-Decision Process Model

(Rogers, 2003)

Many researchers have emphasized the limitations of the DOI theory. For example, the DOI theory, in terms of the information systems discipline, is mainly a descriptive tool. Its explanatory power is weak and in particularly it is not very useful when it comes to predicting outcomes and giving guidance to speed up the rate of adoption (Clarke, 1999). Further limitations are the extent to which DOI theory can generate refutable hypotheses, and a concern that many elements of the theory are culturally specific to North America in the 1960s, making this theory less relevant in other countries (Clarke, 1999).

Attewell (1992) points out that the DOI theory focuses on innovation demand, whereas it should focus on innovation supply. The demand-oriented view assumes that adoption will occur at a rate monitored by the spread of knowledge about the innovation, which is governed

by the time it takes for the adopters to hear about the adoption benefits. However innovation suppliers will also have an impact on diffusion because their marketing and educational initiatives target specific businesses, which doesn't give other firms the chance to adopt it.

3.2.9 Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh et al. (2003) drew on several previous models to develop the Unified Theory of Acceptance and Use of Technology (UTAUT), which has become a popular framework for general technology acceptance models. As compared to the acceptance models explained earlier, UTAUT attempts to explain both a user's intention to use an information system and the use behaviour that follows from that intention. The model has been produced in such a way that it gives a more complete picture of the acceptance process than was possible with the previous individual models (Venkatesh et al., 2003).

Eight models used in the information systems field were integrated to create UTAUT. All of these models had their foundation in psychology, sociology and communications. The models include TRA, TPB, TAM, TAM2, Motivation Model (MM), Model of PC Utilization (MPCU), DOI and SCT. Previous models used a variety of variables to model user behaviour. UTAUT uses the conceptual and empirical similarities of the previous models to create a unified set of four external variables: performance expectancy, effort expectancy, social influence and facilitating conditions. In addition, the model includes four moderating factors: gender, age, experience, and voluntariness. Figure 9 shows the model.

Figure 9: UTAUT model

(Venkatesh et al., 2003)

Venkatesh et al. (2003, pp. 447-453) describe the four UTAUT predictors as follows:

1. **Performance expectancy** is the belief of an individual that when they use the system, it will benefit them in job performance.
2. **Effort expectancy** is the ease of using a system for an individual.
3. **Social influence** is as an individual's perception that others feel it is important that they make use of the system.
4. **Facilitating conditions** is an individual's belief that the organizational and technical infrastructure exists to support system usage.

In the UTAUT model, performance expectancy (PE) encompasses constructs from previous models such as perceived usefulness, extrinsic motivation, job-fitness, relative advantage, and outcome expectations. In validation studies (Venkatesh et al., 2003), PE was found to be the strongest predictor of intention of behavioural intention (BI), and was moderated by

gender (stronger for male workers) and age (stronger for young workers) but not by experience or voluntariness.

Effort expectancy (EE) in the UTUAT model captures the notions of perceived ease of use and complexity. In validation studies, EE was moderated by gender (stronger for female workers), age (stronger for older workers), and experience (stronger during earlier adoption and weaker as practice increases and users become more comfortable with the system). Voluntariness was not important during early stages of system use and is not considered a moderator.

Social influence (SI) in the UTAUT model includes concepts from previous models such as subjective norm, social factors and image. It is influenced by consideration of the person's perception of the opinion of others, the reference group's subjective culture, interpersonal agreements with other people, and the degree of perceived use of an innovation to enhance the status of a person in a social system (Venkatesh et al., 2003). In the validation tests, social influence was moderated by gender (stronger for female workers), age (stronger for older workers), experience (its influence was greater when in the early stages of adoption) and voluntariness (its influence was greater when use was voluntary).

Facilitating conditions (FC) in the UTAUT model includes organization support, perceived behavioural control, facilitating conditions and compatibility from prior models. Note that, unlike earlier models such as TAM, FC is modelled as influencing use behaviour (UB) rather than behavioural intention. The model validation results showed that the effect of FC on UB was moderated by age (stronger for older workers), and experience (stronger during advancer

stages of system use), but not by gender. Voluntariness was not important in the initial system usage period and is not considered a moderator.

Venkatesh et al. (2003) report that the UTAUT model was able to account for 70 % of the variance found in usage intention, which is considerably better than earlier models.

3.3 Summary

A review of the literature shows that ATs are important for visually impaired students in education. However, there are barriers to extensive use and adoption of such technologies. Therefore, it is necessary to examine the potential factors that influence the use of AT for those visually impaired students in order to increase AT adoption. Although many have studied use of assistive technology in education and identified technological or systemic barriers to its adoption, few have considered the role that student attitudes play in acceptance of the technology, and none have explicitly examined the Saudi context, where specific community and cultural factors are in play. This research addresses that gap.

UTAUT is a widely used technology adoption and acceptance model that can be used to examine factors affecting the acceptance of the technology. It has been used in many studies in the e-learning field as a basic theoretical model for investigating the behaviour of students in technology usage, and has also been reported to explain more variance in usage intention than other models. Therefore, UTAUT has been selected as the most suitable model for examining the students' behaviours towards AT. However, there is a need to expand the UTAUT model in order to examine AT-specific factors identified in the literature: accessibility, self-efficacy, anxiety and attitude.

Chapter 4 : Research Model and Hypotheses

4.1 Introduction

A variety of models have been developed to explain the factors that promote or hinder the acceptance of assistive technology. The literature review chapter reviewed these models, including the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1975), the Technology Acceptance Model (Davis, 1989), the Diffusion of Innovations Theory (Rogers, 1995) and the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003).

The research model employed in this research was based on the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The UTAUT model is used as a theoretical driver for this study. The original model, measurements, and analyses of Venkatesh et al. (2003) will be followed as closely as possible in terms of reliability, validity, correlations, factor analysis, and structural equation modelling. However, an amended version of the UTAUT will be used to suit the context of the study and to achieve its aim.

4.2 Research Conceptual Model

A theoretical framework is used to establish the relationships connecting variables. A systematic framework can be specifically designed to test any hypotheses with an ability to draw inferences linking study participants to actual populations (Creswell, 2009). According to VanderStoep and Johnson (2008, p. 4), theoretical models are “sets of organizing principles that help researchers describe and predict events”.

The first widely used technology adoption model was Davis's Technology Adoption Model (TAM) (Davis, 1989; Davis et al., 1989). Davis's model was developed for broad application including cultural (Straub et al., 1997) and social (Malhotra & Galletta, 1999) spheres. TAM 2 was developed in response to TAM by Venkatesh and Davis (2000). Suebsin and Gerdsri (2009) described TAM 2 as a validation of the original model with the addition of factors pertinent for cognitive instrumental processes and social influences. Following the expansion of additional factors, Venkatesh et al. (2003) merged all existing versions of the original model and formulated them into the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT incorporates four behavioural intention and usage factors: performance expectancy, effort expectancy, social influence, and facilitating condition. Additionally, four moderator factors are included: gender, age, experience, and voluntariness of use. The unified model has been successfully used and tested, including in research undertaken by Anderson and Schwager (2004) and Wills et al. (2008).

The UTAUT framework was chosen as the basis of this study because of its widespread and successful use in modelling technology acceptance. According to its authors (Venkatesh et al., 2003), UTAUT is one of the most successful theories to explain variance in the intention to use technology, in that it can explain 70% of the variance in technology usage intention whereas the best of the earlier theories on which it is based can explain only 53% of the variance. Moreover, many studies have proven its validity and reliability in the acceptance of technology in various fields (AlAwadhi & Morris, 2008).

However, although UTAUT has been used to study technology acceptance in a range of contexts it is not specifically designed for investigating acceptance of assistive technology

(AT). It is likely that acceptance of AT would be at least partially explained by a general-purpose model such as UTAUT, but it is also likely that such a model could not take into account the specific needs of disabled users and the particular characteristics of assistive technology. Indeed, as discussed in Chapter 3, previous studies have found that barriers to successful use of AT often arise from user-acceptance factors that are not explicitly modelled in UTAUT.

For this reason, this study uses an extended version of the UTAUT framework, adapted to suit the context of the study. Specifically, the moderating factor voluntariness of use was omitted as using Assistive Technology (AT) is voluntary in Saudi universities, and additional factors were added to broaden the perspective of UTAUT to acceptance of AT: accessibility, self-efficacy, anxiety, and attitudes relating to technology usage. Figure 10 shows the conceptual model of this research, named Acceptance for Visually Impaired Students in Saudi Arabia (AVISSA). Since the added factors relate to characteristics of users themselves, they are modelled as influencing behavioural intention (BI).

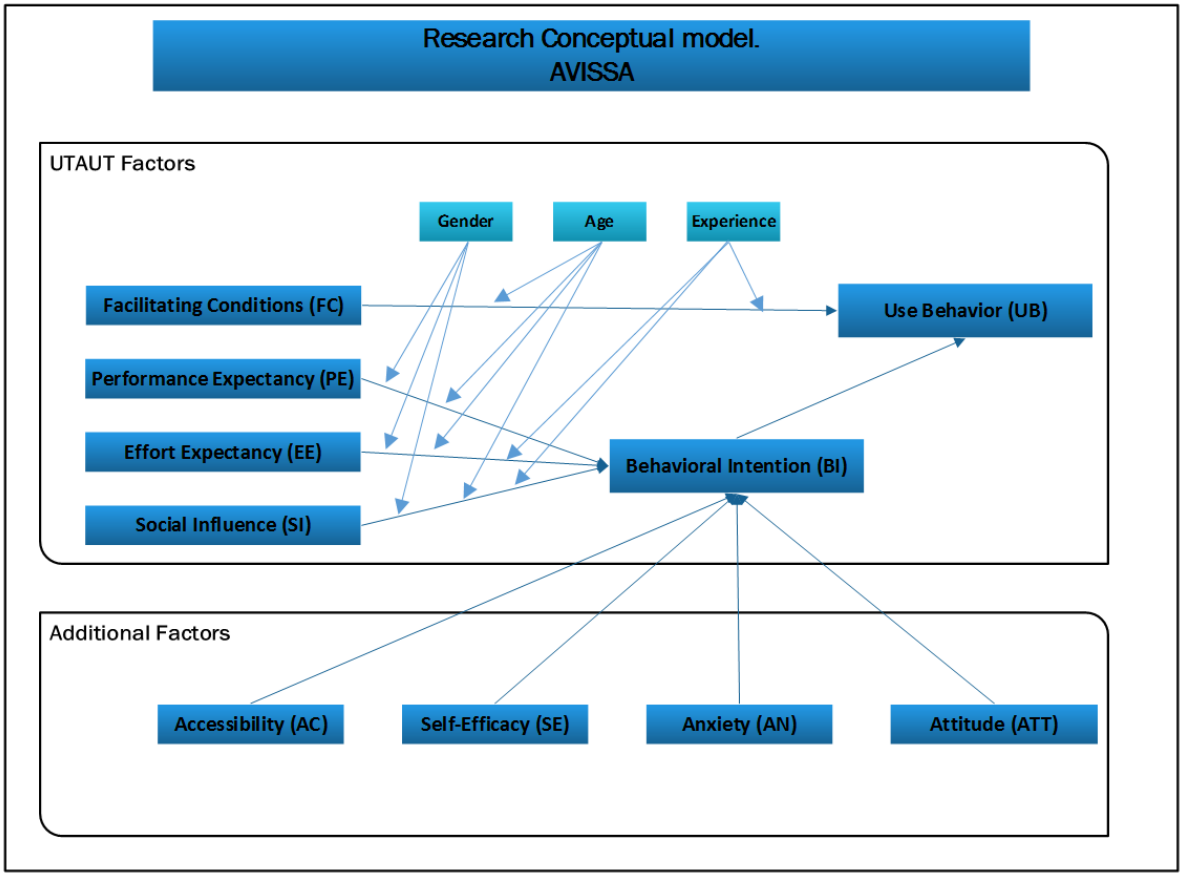


Figure 10: Conceptual research model

4.2.1 Original UTAUT Factors

Use Behaviour (UB)

Use Behaviour (UB) is defined as a user's actual use of a specific system (Ong et al., 2008). According to Ajzen and Fishbein (1980), the use behaviour is dominated by behavioural intention (BI). In the UTAUT model, the direct influence of behavioural intention on use behaviour has been tested and validated during the development of the UTAUT model (Venkatesh et al., 2003).

Behavioural Intention to Use AT (BI)

Behavioural intention (BI) is defined as "the person's subjective probability that he or she will perform the behaviour in question" (Ajzen & Fishbein, 1975, p. 288). As confirmed in many research studies, the behavioural intention to use technology have a positive and direct influence on usage behaviour (Venkatesh & Brown, 2001; Venkatesh et al., 2003). Also, Irani et al. (2009) state that the majority of technology adoption research has used behavioural intention to predict technology adoption. In addition, the relationship between the behavioural intention to use a technology and actual usage is well established and both could be used to measure technology acceptance (Ajzen, 1991; Mathieson, 1991; Sheppard et al., 1988; Taylor & Todd, 1995; Venkatesh & Morris, 2000).

Performance Expectancy (PE)

Performance expectancy (PE) describes an individual's perception of the degree to which they believe technology usage will aid them in task performance (Venkatesh et al., 2003).

PE is measured using items originating from the Diffusion of Innovation Theory (Rogers, 2003), Social Cognitive Theory (Compeau & Higgins, 1995) and the Model of PC Utilization (Thompson et al., 1991). However, PE's four items are very similar to the six items comprising TAM (Davis (1989). Consequently, this makes UTAUT's PE essentially equivalent to TAM's degree of perceived usefulness.

Most research using UTAUT, such as studies by Al-Gahtani et al. (2007), Venkatesh and Zhang (2010), and Chu (2013), confirm that PE is significantly related to behavioural

intention. However, there have been a few studies involving UTAUT that have not found PE to be a determinant of behavioural intention (Isabelle & Sandrine, 2009).

UTAUT has hypothesised that age and gender, particularly young men, moderate PE and behavioural intention (Venkatesh et al., 2003).

Effort Expectancy (EE)

Effort expectancy (EE) is defined by Venkatesh et al. (2003) as the degree of ease linked to technology usage.

EE's four measurement items originate in TAM (Davis (1989). The same measurement items are common to Rogers (2003) qualitative Theory of Diffusion of Innovation. Consequently, UTAUT's EE's measurement items are essentially equivalent to TAM's perceived usefulness.

While several studies, including (Al-Gahtani et al., 2007), Venkatesh and Zhang (2010), and Chu (2013), have supported EE as a behavioural intention determinant, some studies involving UTAUT have not supported EE as a behavioural intention (Isabelle & Sandrine, 2009; Schaupp et al., 2009).

UTAUT has hypothesised age, experience and gender, particularly less experienced younger women, moderate EE and behavioural intention (Venkatesh et al., 2003).

Social Influence (SI)

Social influence (SI) is defined by Venkatesh et al. (2003) as "the degree to which an individual perceives that important others believe he or she should use the new system". Its

four measurement criteria originate in the two-item subjective norm within the Theory of Planed Behaviour (Ajzen & Fishbein, 1975) together with PC Utilization's four social factors (Thompson et al., 1991).

While several studies, including Al-Gahtani et al. (2007), Venkatesh and Zhang (2010), and Chu (2013), support SI as a behavioural intention determinant, some studies involving UTAUT reported that SI was not a determinant of behavioural intention (Martins et al., 2014).

UTAUT has hypothesised age, experience, and gender, particularly less experienced older women in mandatory settings, moderate SI and behavioural intention (Venkatesh et al., 2003).

Facilitating Conditions (FC)

Facilitating conditions (FC) are defined by Venkatesh et al. (2003) as the degree to which a person perceives that an organisation and its technical infrastructure is committed to supporting technology usage.

UTAUT's final scale consists of four items drawn from the PC Utilization model (Thompson et al., 1991), and the Theory of Planned Behaviour (Ajzen, 1991). This highlights the similarity in scales between UTAUT's facilitating conditions and TPB's perceived behavioural control.

FC was incorporated into modelling as a direct factor affecting behavioural intention and usage in the DTPB theory, which anticipated that FCs, represented by resource facilitating

conditions and technology facilitating conditions, ought to attract management attention to potential barriers obstructing technology usage (Taylor & Todd, 1995).

While several studies, including Al-Gahtani et al. (2007), Venkatesh and Zhang (2010), and Chu (2013), have identified FC as a determinant of actual behaviour, some research has reported FC as a determinant of behavioural intention (Martins et al. (2014). In UTAUT the FC determinant was not found to be a significant predictor of intention but was notable in deterring usage (Venkatesh et al., 2003). Researchers have suggested inadequate or non-existent facilitating resources are a barrier to usage and, therefore, negatively impact intention and usage, while the existence of facilitating resources does not in itself promote usage (Taylor & Todd, 1995). Nevertheless research has found FCs do measurably impact internet-based teaching usage (Limayem & Hirt, 2000). In the light of this it is theorised that FCs are a direct determinant and can be expected to be reflected in usage behaviour.

UTAUT hypothesised that moderating factors shaping the relationship between FC and actual behaviour exist in the form of user's age and experience, with notable influence seen in technology users who are older and have more technology experience (Venkatesh et al., 2003).

4.2.2 Additional Factors

Although some of the AVISSA additional factors have been incorporated in previous technology adoption models (for example, attitude to technology was included in TRA and TAM, and self-efficacy was included in TAM3), none of them appear in UTAUT. However, the current study is concerned with AT acceptance and these factors have previously been

found to have a strong effect on the disabled users' intention to use the assistive technology as discussed in the literature review.

Accessibility (AC)

According to Culnan (1984), usage behaviour is influenced by a potential user's perception that the device is physically accessible to them in tandem with the degree to which they believe they will be able to access the desired information. Culnan identifies two separate dimensions that must coexist: physical accessibility, and information accessibility. Together, these factors shape users' attitude to new technology. Physical accessibility describes the user's physical access to the device, such as a computer, phone, tablet and internet access, or their technical expertise or assistive technology for those with specific electronic requirements, such as visually impaired users. Information accessibility defines the degree to which the user is able to obtain information. This includes skills such as finding and navigating websites and using digital features that they may discover, such as audio and formatted files.

Culnan's research is supported by other academic findings that have demonstrated the degree to which accessibility affects user behaviour. Examples include Karahanna and Limayem (2000), who found that email usage was influenced by information accessibility. Similarly, (Teo et al., 2003) found that virtual learning community engagement was influenced by information accessibility. Yuan et al. (2011) similarly demonstrated that the ease of online resource access was linked to an employee's decisions to retrieve work related information. Furthermore Ilie et al. (2009) highlighted information accessibility together with physical

accessibility of online resources affected the degree to which a physician referred to electronic medical health records.

Although Culnan's accessibility variables have been demonstrated to affect users' perceptions regarding usefulness and/or usability (Karahanna & Limayem, 2000; Teo et al., 2003), these variables have not yet been tested for visually impaired users. Moreover, accessibility can be an important variable affecting the acceptance of AT. In instances where digital information is not easily accessible for sighted readers, it is likely to be even more difficult for visually impaired users. Consequently, this may discourage them from even trying to use technology and dampen their enthusiasm accordingly. Therefore, Culnan's accessibility variables (Culnan, 1984) have the potential to provide a more detailed insight into the acceptance behaviour of users with visual impairments.

Physical accessibility was found to also influence the acceptance and usage of electronic messaging systems (Rice & Shook, 1988). Karahanna and Straub (1999) claimed physical accessibility of electronic messaging systems was also determined by the ease of usage. These studies' findings suggest that the inclusion of information accessibility sub-dimensions within our model as independent constructs may result in the provision of more useful explanations for user behaviour.

Self-Efficacy (SE)

Self-efficacy (SE) relates to a user's own perception of competence in relation to performing a specific behaviour (Bandura, 1977). Venkatesh and Bala (2008, p. 279) define computer SE as "the degree to which an individual believes that he or she has the ability to perform a

specific task/job using the computer". SE as a construct is of relevance to the IT sector based on concepts expounded in Bandura's Social Learning Theory (Bandura, 1977).

It is widely appreciated that SE represents a notable predictor of computing behaviour leading to it shaping a user's behavioural intention (Downey, 2006; Hwang & Yi, 2002). SE interests researchers and IT professionals alike owing to its ability to motivate end-users, particularly in relation to training and acquiring new skills (Downey, 2006). Higher rates of SE are anticipated to manifest in higher degrees of behavioural intention and overall IT usage (Compeau & Higgins, 1995). This belief is evident in Taylor and Todd (1995) who state in the Decomposed Theory of Planned Behaviour (DTPB) that self-efficacy is an observable contributor of perceived behavioural control while simultaneously being a notable behavioural factor influencing both intent to use and actual usage. Training is one of this determinant's focus points with an apparent emphasis on SE, as it is an obvious significant contributor towards the acceptance of technology. Venkatesh et al. (2003) found computer SE influenced behavioural intention to an insignificant degree. Meanwhile, several studies, including those of Venkatesh and Davis (1996), Abbad et al. (2009), Davis (1989), Park (2009), concluded SE was a significant behavioural intention determinant, owing to its influence over perceptions on ease of use. Contradicting these studies, SE was found to represent no significant influence over behavioural intention in research by Motaghian et al. (2013), Ong et al. (2004), and Park (2009).

However, academic research has linked computer SE to behavioural intention across a spectrum of technological domains. For example, Al-Gahtani (2016) concluded computer SE was a notable predictor of perceived ease of use relating to e-learning. According to Faqih

and Jaradat (2015), improved SE leads to higher perceptions of ease of use by mobile-commerce customers. Within the medical sphere, research by Chang and Im (2014) concluded computer SE is a factor that indirectly influences the behaviour of professionals sourcing digital health information owing to perceptions of ease of use.

Almazroi (2017) found that a student who is highly self-confident in his or her use of cloud computing in learning could lead to increases in his or her adoption of cloud applications. Therefore, it is expected that students highly self-confident in their abilities to use AT in their study will lead to increases in their adoption of AT.

Anxiety (AN)

Computer anxiety is an important variable that can affect behavioural intention through its effect on shaping perceptions of a technology's ease of use. (Venkatesh, 2000). Venkatesh (p. 349) defines computer anxiety as "an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers". Negativity towards computers in general affects an individual's willingness to use various digital technologies. While computer anxiety has been the subject of significant psychological and information system (IS) research (Anderson, 1996; Elasmar & Carter, 1996; Igbaria & Chakrabarti, 1990), before its incorporation into TAM, Venkatesh (2000) continued to see a need for further studies owing to the ubiquitous use of computers for both professional and private use. Because anxiety is generally regarded as an unwelcome psychological state of mind, its connection to computer usage may potentially negatively impact the adoption and usage of technology. Computer anxiety is likely to have various causes including lack of confidence in computer skills and preferences for more traditional teaching methods.

TAM3 incorporated Venkatesh's hypothesis that computer anxiety represents a negative influence over perceived ease of use. The hypothesis appeared to confirm that computer anxiety negatively impacted perceived ease of use. In addition, Al-Gahtani (2016) confirmed these conclusions in an e-learning environment. Additionally, other studies also identified computer anxiety as a notable determinant shaping behavioural intention owing to its influence over perceived ease of use.

Consequently, it should be expected that the psychological discomfort felt by students who experience computer anxiety may overflow into diminished preparedness to use technology. As a result, this research postulates that computer anxiety will negatively impact the behavioural intention of students in regards to using assistive technology.

Attitude toward Using Technology (ATT)

Venkatesh et al. (2003) describes attitude towards using technology as the individual's personal affective reaction regarding a technological system's usage. Attitude represents a person's positive or negative feelings towards specific behaviour (Klopping & McKinney, 2004; Krishnan & Hunt, 2015). TRA and TAM both suggest that attitudes represent a notable predictor of behavioural intent, which consequently represents a predictor of behaviour (Davis et al., 1989; Krishnan & Hunt, 2015).

Asianzu and Maiga (2012) extended TAM's model with identified attitude as a significant factor in regulating the relationship connecting perceptions of usefulness and ease of use in relation to behavioural intention. This study also evaluated other constructs such as trust and

perceptions relating to security, based on their identification as important influencers of attitude in numerous studies such as those of Colesca (2009) and Khalil (2014).

Taylor and Todd (1995) found attitude towards technology usage played a significant and direct role in shaping behavioural intent. However, more specifically, Venkatesh et al. (2003) considered attitudes relating to technology usage were specific to individual systems. According to Taylor and Todd, users typically apply specific criteria to innovations when evaluating indirect benefits of technology usage before considering the individual properties of specific technology. It was found that individuals who harboured negative attitudes towards technology typically viewed new technology negatively, while those who were generally positive towards technology regarded it positively. Similarly, Tan and Teo (2000) concluded that attitude influences actual system usage by shaping behavioural intention. Other studies including those of Asianzu and Maiga (2012) and Colesca (2009) arrived at a similar conclusion.

4.3 AVISSA Factors and Hypotheses

This section defines the factors of the AVISSA conceptual model and the hypotheses to be tested by the model. The "visually impaired student" in the following definitions refers to a visually impaired student studying in a Saudi university.

Use Behaviour (UB): a visually impaired student's actual use of an assistive technology.

Behavioural Intention (BI): The subjective probability of a visually impaired student performing the behaviour of using AT.

The hypothesis relating UB and BI is as follows:

#	Hypothesis
H9	*Behavioural intention (BI) will have a significant positive influence on use behaviour (UB).*

Performance Expectancy (PE): the degree to which a visually impaired student believes that using assistive technologies will help attain gains in study performance.

Hypotheses related to PE are as follows:

#	Hypothesis
H1	*Performance expectancy (PE) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*
H1a	*PE-BI will be stronger for younger users than older users.*
H1b	*PE-BI will be stronger for males than females.*

Effort Expectancy (EE): the degree of ease associated with the use of the assistive technologies for a visually impaired student.

The hypotheses related to EE are as follows:

#	Hypothesis
H2	*Effort expectancy (EE) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*
H2a	*EE-BI will be stronger for older users than younger users.*
H2b	*EE-BI will be stronger for females than males.*
H2c	*EE-BI will be stronger for inexperienced users than experienced users.*

Social Influence (SI): the degree to which a visually impaired student perceives that most people are important to him or her think he or she should use the assistive technologies in their study.

Hypotheses related to SI are as follows:

#	Hypothesis
H3	*Social influence (SI) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*
H3a	*SI-BI will be stronger for older users than younger users.*
H3b	*SI-BI will be stronger for females than males.*
H3c	*SI-BI will be stronger for inexperienced users than experienced users.*

Accessibility (AC): the degree to which a visually impaired student has the ability to access and use assistive technology.

Hypothesis related to AC are as follows:

#	Hypothesis
H4	*Accessibility (AC) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*

Self-Efficacy (SE): the degree to which a visually impaired student believes that he or she has the ability to perform a specific task using AT.

The hypothesis related to SE is as follows:

#	Hypothesis
H5	*Self-efficacy (SE) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*

Anxiety (AN): the degree of a visually impaired student's apprehension, or even fear, when he or she is faced with the possibility of using AT.

The hypothesis related to AN is as follows:

#	Hypothesis
H6	*Anxiety (AN) will have a significant negative influence on behavioural intention to use assistive technologies (BI).*

Attitude Toward Using Technology (ATT): a visually impaired student's positive or negative attitude about using an AT.

The hypothesis related to ATT is as follows:

#	Hypothesis
H7	*Attitude toward using technology (ATT) will have a significant positive influence on behavioural intention to use assistive technologies (BI).*

Facilitating Conditions (FC): the factors in the environment that facilitate the use of ATs by a visually impaired student. This is measured by the perception of being able to access required resources, as well as the ability to obtain knowledge and the necessary support to use the AT.

The hypotheses related to FC are as follows:

#	Hypothesis
H8	*Facilitating conditions (FC) will have a significant positive influence on use behaviour (UB).*
H8a	*FC-UB will be stronger for older users than younger users.*
H8b	*FC-UB will be stronger for experienced users than inexperienced users.*

4.4 Summary

The model developed for this study was built using the UTAUT model with modifications derived from previous theories in the field of acceptance of technology. The modifications were made in order to suit the context of the study: the acceptance of AT by visually impaired students in Saudi universities. The suitability of this model for the context will be verified through data collected and analysed using precise statistical steps, as described in Chapter 5.

Chapter 5 : Research Methodology

5.1 Introduction

The research methodology of this study endeavours to develop and validate a modified UTAUT procedure tailored to the adoption of assistive technology in the Saudi Arabian context. This chapter explores this study's adopted research methodology in greater detail. Muthuviknesh and Kumar (2014) defines the term research method as "A systematic way to solve a problem. It is the science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology". Contained in this chapter is a presentation of this study's research paradigm, research design structure, the approach taken to research, data collection methods, data analysis procedures, validation and verification studies and considerations relating to data validity and ethics.

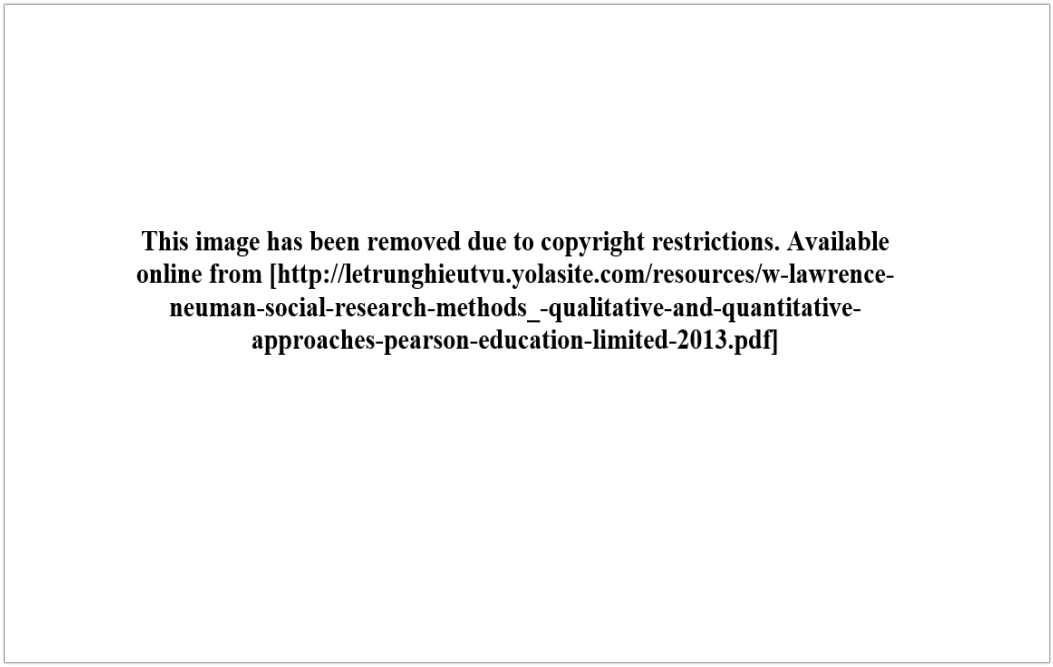
5.2 Research Paradigm

Deshpande (1983, p. 101) defines research paradigm as "a set of linked assumptions about the world which is shared by a community of scientists investigating that world". Kuhn (2012, p. 175), has defined a research paradigm as "a set of values and techniques which is shared by members of a scientific community, which acts as a guide or map, dictating the kinds of problems scientists should address and the types of explanations that are acceptable to them". In summary, research paradigms encompass a study's core issues, hypotheses and the methods employed to generate the data and reach findings (Neuman, 2014). Effective implementation of a research paradigm can be expected to produce results where "the

empirical data is connected in a logical sequence to a study's initial research questions and to its conclusion" (Al-Busaidi, 2012, p. 61).

Within the sphere of information systems (IS), empirical studies incorporate three principle research paradigms: (1) positivism, (2) interpretivism, and (3) critical social theory (Galliers, 1991; Orlikowski & Baroudi, 1991). According to Neuman (1997), few IS studies incorporate critical social theory. Therefore, this section relates to positivism and interpretivism exclusively. Positivist studies employ quantitative methods when testing hypotheses and seek to discover factors of an external nature or fundamental laws relevant to the research. Interpretivist studies employ qualitative methods in order to comprehend the phenomenon under study (Al-Hadidi, 2010). Regarding its status as a research philosophy, positivism presumes the subject or behaviour under study genuinely exists and external observers are physically able to measure them (Pervan, 1994). In contrast to positivism, interpretivism, according to Al-Hadidi (2010), addresses human opinions regarding social life. Table 5 shows the principle differences between these paradigms presented by Neuman.

Table 5 Main differences between positivism and interpretivism (Neuman, 1997, p. 83)



In order to guide and justify a study's chosen research procedures, researchers are required to identify the research paradigm best suited to achieving the desired outcomes (Creswell, 2009). Within IS research positivism is commonly used. As an example 97% of IS studies during the 1980s incorporated the positivist paradigm (Orlikowski & Baroudi, 1991). Phillips and Burbules (2000) outline the following specific assumptions which positivist studies incorporate:

1. Positivist research does not confirm a hypothesis; it finds that the hypothesis cannot be refuted.

2. Positivist research frequently begins with testing the theory.

3. Positivist studies use instruments to collect participant data.

4. Positivist research focuses on relationships linking factors and challenges them with hypothesis and questions.

5. Positivist studies seek to achieve unbiased accuracy through an emphasis on validity and reliability.

This research aims to study and assess specific factors which influence the acceptance of AT by Saudi Arabian university students who possess a visual impairment. Due to the nature of the study, seeking to directly observe a phenomenon by studying its individual components, a positivist paradigm was adopted (Krauss, 2005). Despite it being normal for positivist studies to utilise quantitative methods, this research employed a mixed methods approach. The data collection procedure commenced with quantitative research constituting participants completing a questionnaire. As this form of quantitative research is less open to interpretation, it is considered to carry more weight than qualitative methods of data collection. The next phase of data collection was qualitative, involving semi-structured interviews designed to confirm, interpret, justify, explain and expand on answers to allow a more comprehensive understanding of results than those produced through quantitative approaches. A mixed methodology can potentially provide an opportunity to delve into and elaborate on unexpected results which are frequently the consequence of people expressing opinions based on personal perceptions.

5.3 Research Approach

5.3.1 Mixed Methods

As mentioned previously, this research uses a mixed-methods approach in order to accomplish the study's objectives. Creswell (2014) describes mixed-methods inquiry as an approach which utilises both quantitative and qualitative data collection methods. He describes how it integrates both sets of data and uses distinctive designs which require philosophical assumptions and theoretical structures.

The significant advantages of using mixed-method designs over the exclusive use of quantitative or qualitative methods on their own, have led to its popularity in recent times (Creswell, 2014). Utilising only one research method in a study may restrict understanding of the topic under study (Babbie, 2007). Numerous academic researchers including Creswell (2009), Mertens (2010) and Saunders et al. (2007) advocate the adoption of mixed methods as a means to overcome the limitations imposed through single-method designs. By combining elements of both quantitative and qualitative research methodologies, mixed-methods designs strengthen the findings` validity and have the potential to improve the researcher's understanding of the results they arrived at (Al-Hadidi, 2010; Alsaghier, 2010).

Mixed-methods designs typically have greater in-built strength than single method designed studies, owing to the use of multiple data collection methods enabling researchers to obtain more data, of varying types, which may enable understanding the research problem to a greater extent. Armed with a deeper insight into the research problem, the researcher has an improved chance to satisfactorily answer the study's research questions (Creswell & Clark, 2011). Creswell (2009) believes that the ultimate advantage of mixed-methods approaches is

the ability for the researcher to select the best aspects of both quantitative and qualitative methodologies. Doing so enables the researcher to conduct their study with a wider range of data originating from different sources collected through different means (Bonoma, 1985). Nevertheless in addition to the advantages of mixed-methods research, there are also obstacles caused by this approach, which depend on the precise nature of the approach taken but may include the researcher`s needing to possess different skill sets, the need for possible resources and that it may be more time consuming (Creswell & Clark, 2011).

According to Creswell (2009), mixed-methods designs include a variety of research strategies, including sequential explanatory strategies, sequential exploratory strategies, sequential transformative strategies, concurrent triangulation strategies, concurrent transformative strategies and concurrent embedded strategies. Sequential strategies use the different methods in sequence, with the first method providing primary data and the second providing an opportunity to follow up on results from the data. Concurrent strategies use the methods alongside each other, allowing the researcher to compare results obtained from two different perspectives.

Cresswell suggests that the sequential explanatory strategy is most appropriate where an existing model is being tested in a new context; a quantitative approach is used to gather data about the performance of the model and a qualitative approach is used to explore findings obtained from the quantitative study. Conversely, the sequential exploratory strategy is most appropriate where the emphasis is on developing a model for an area about which little is currently known; a qualitative study is used to gather data from which a model can be devised, and a quantitative study is used to investigate the accuracy of the proposed model.

In principle, this study could have used either the sequential explanatory approach (since it is based on applying the existing UTAUT model to a new context) or the sequential exploratory approach (since little work has previously been done that focusses specifically on acceptance of assistive technology). The decision was made to use the explanatory approach because it was felt that UTAUT model, augmented by adding factors that had been found in previous research to influence use of AT, provided a solid foundation for the investigation and would enable the effect of the new factors on AT acceptance in the study context to be determined. Creswell suggests that this approach provides a highly structured method to confirm hypotheses about a specific phenomenon (Creswell, 2009).

In line with the sequential explanatory strategy, the initial quantitative study was designed to gather data about the performance of the extended UTAUT model. Initially, the plan for the subsequent qualitative study was to validate conclusions about the findings of the quantitative study. However, as will be discussed in Chapter 6 the quantitative study produced unexpected results, so the qualitative study was reoriented to seek explanations for these unexpected results and to provide a deeper insight into the study participants' perspectives. Indeed, one reason why a sequential explanatory strategy is frequently used is because it is particularly helpful when results are unexpected in nature (Creswell, 2009).

5.4 Research Design

A research design can be defined as a progression of choices that, in general, represent a methodology for providing answers to the research inquiries and testing the theories. Backing this manner of consideration, Cavana et al. (2001) perceives research design as an organized arrangement of objective decision-making alternatives, or rules, to help with creating valid

and dependable research outcomes. A research design in a positivist context encompasses choices as regards the selection of data accumulation approaches, and concerning scaling and measurement strategies, tests, instruments, and data assessment (Cavana et al., 2001). An appropriate research design ought to ensure that the data acquired is significant to the research issue, and that an objective strategy was used to gather them. According to Creswell (2009), research design is "a plan or proposal to conduct research, which involves the intersection of philosophy, strategies of inquiry, and specific methods". Bryman and Bell (2015, p. 49) adds that "a research design provides a framework for the collection and analysis of data". As already explained this research employs a positivist paradigm with a mixed methods data collection approach, utilising quantitative methods in the form of questionnaires and a qualitative method, being a semi-structured interview. This reflects a sequential explanatory design.

Figure 11 illustrates this study's research design which involved four stages:

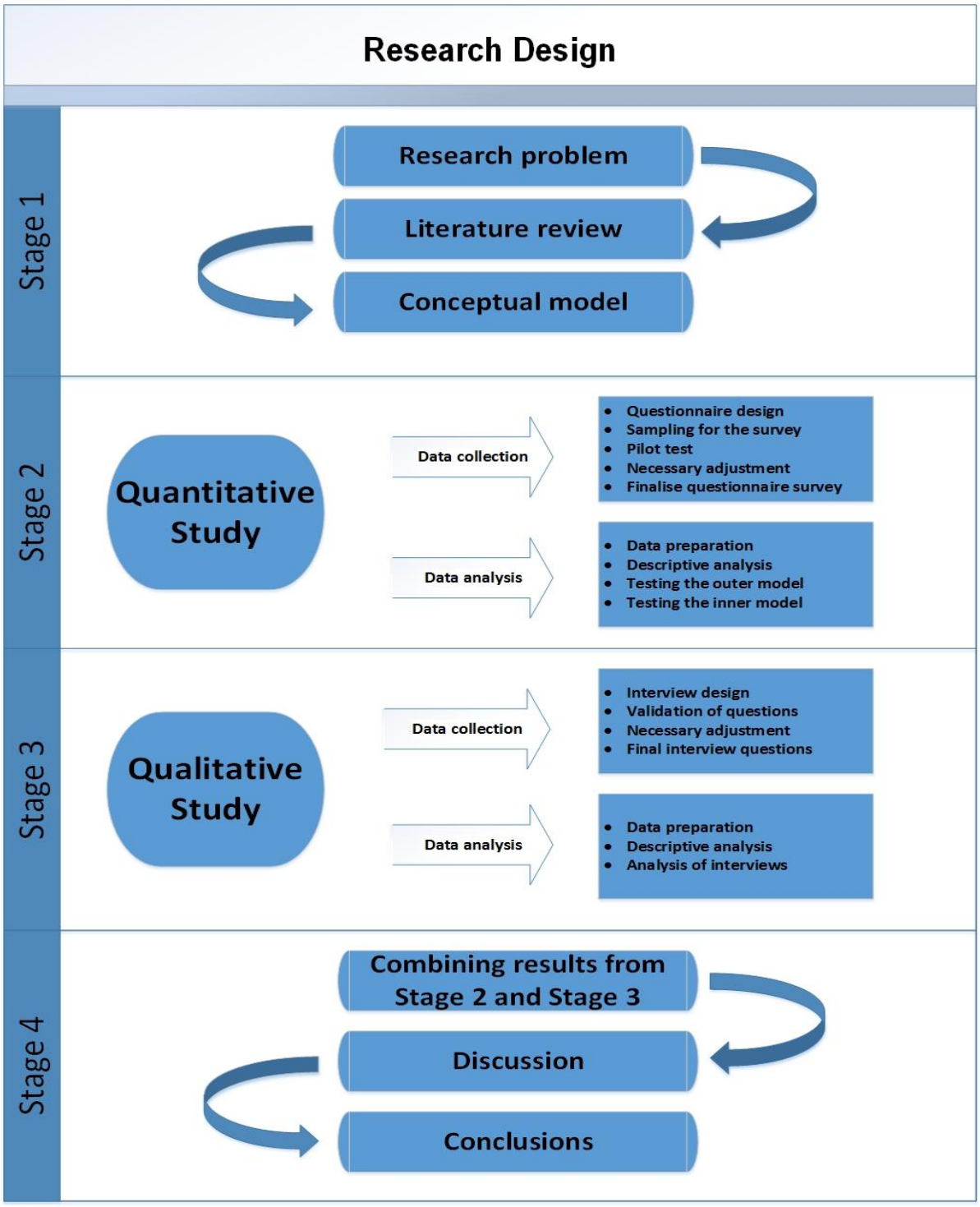


Figure 11: Research Design

5.4.1 Stage 1

Stage 1 was to conceptualise the study's topic. By completing a research background and literature review, a researcher gains knowledge which earlier studies have discovered, preventing duplication of results and helping to identify gaps in research in order to build on existing knowledge. The literature review helped decide the determining factors which may influence the acceptance of assistive technology (AT) by Saudi Arabia's visually impaired university students. These factors allowed the identification of the research problem and guided the design of the central research questions, which aided in building the conceptual model that incorporates the main components which influence the acceptance of AT. This in turn leads to the hypothesis expressed in the research model.

5.4.2 Stage 2

Stage 2 included the first study, which was a quantitative study to help examine the relationship between the proposed model's factors by collecting survey responses from visually disabled student in Saudi universities. This stage aimed to measure the extent of the factors' influence on AT acceptance in Saudi Arabia. Data collection included questionnaire design, sample determination for the survey, a pilot test, and finalisation of the questionnaire survey. Data analysis included data preparation, descriptive analysis, and testing the model.

5.4.3 Stage 3

Stage 3 included the second study which was a qualitative study in order to gain a deeper understanding of the results of the quantitative study. The researcher conducted semi-structured interviews with Saudi AT users and experts to collect data to confirm, interpret, explain and provide a deeper understanding of the stage 1 data, especially results that did not

agree with previous research. Data collection procedures included interview design, validation of questions and the necessary adjustment, and finalisation of interview questions. Data analysis procedures included data preparation, descriptive analysis, and analysis of interviews.

5.4.4 Stage 4

Stage 4 involved collecting, comparing and merging the results obtained from the quantitative and qualitative studies, in order to give a clear picture and clearer interpretation of the final results. The results were compared with the results of the previous studies, thus identifying the contributions made by this study to the research community. The final step was to suggest some solutions for overcoming the factors affecting the acceptance of the AT through the recommendations made. The future work and the restrictions were mentioned in this stage as well.

5.5 Quantitative Study

In its broadest definition, quantitative research aims to generate numerical or statistical data (Al-Hadidi, 2010). According to Creswell (2012, p. 120), "A theory in quantitative research explains and predicts the probable relationship between independent and dependent variables". Research carried out within a positivist paradigm, uses quantitative data collection methods to gather data from participants (Abunadi, 2012). This results in numerical data which researchers subject to quantitative analysis seeking to identify relationship factors which explain the emerging phenomena (Neuman, 1997). As a consequence quantitative methodologies demonstrate a deductive process (Creswell, 2009; Kanaan, 2009). According to Creswell (2009, p. 120), studies conducted using quantitative research aim " to specify

how and why the variables and relational statements are interrelated." Owing to the capability of quantitative data to be carried out with sizeable samples and its ability to be statistically analysed through computer programming, researchers are able to generalise their findings and apply them to larger populations with a high degree of accuracy (Aldraehim, 2013). In summary, studies carried out using quantitative methods to test hypotheses are capable of demonstrating relationships connecting variables, document and count frequency of occurrence, and generate descriptive data (Alotaibi et al., 2014). While quantitative methodologies are ideal for focusing on specific phenomena, particularly in comparison to qualitative methods (Aldraehim, 2013), they are unable to enlighten upon research questions involving 'why' or 'what' is happening (Kanaan, 2009). Quantitative research can describe how often a phenomena occurs, but cannot necessarily explain why it occurs.

5.5.1 Survey Design

There are many techniques which can be employed in gathering the surveys such as mail surveys, personally administered surveys (telephone or face-to-face), or online surveys (Fink, 2012; Sekaran, 2003). Every technique comes with its share of benefits and impediments. No single techniques is the best for all research circumstances, and the choice of an appropriate technique is dependent upon the qualities of participants, cost, the capability of the scientist, and the time available (Sekaran, 2003).

An online survey (questionnaire) hosted by Survey Monkey was the method used for the quantitative study. Alomari (2011) describes a questionnaire as a pre-formulated set of questions requesting respondents to record answers typically from a set of closely related alternatives. Research conducted regarding the adoption and acceptance of new technology

frequently uses questionnaires when seeking to identify influencing factors. Questionnaires for this purpose are typically inexpensive and require minimal preparation (Abunadi, 2012). Additionally, particularly where questionnaires conceal the respondents` identity, they are likely to generate truthful and forthright answers which may be particularly valuable for the researcher (Al-Hadidi, 2010). When considering the questionnaire's content, Balnaves and Caputi (2001) emphasise that attention should be paid to the fact that the wording of the question can influence responses. Consequently, researchers ought to pay particular care with their vocabulary and choice of words. In order to facilitate participant's responses, questions should be unambiguous, be direct and wherever possible use simple language, while also avoiding oversimplification of the questions (Al-Hujran & Al-Dalahmeh, 2011). Cavana et al. (2001), summarised what they believed to be the sound principles for effective question design in order to avoid measurement errors. These principles, which have been incorporated into this study's research, will be elaborated upon later. In summary they relate to a question's content, wording and structure which had the following influence on this research:

1. Question content was minimised with only essential questions designed to solicit relevant data. Sensitive questions were omitted and there was no repetition of the same question in a different format. Questions were designed to enable respondents to provide as brief an answer as possible and not require too much effort on their behalf.

2. Words with multiple or ambiguous meanings were avoided, as were double negatives. Leading or bias words and phrases were omitted. There were no abbreviations or incomplete sentences. To minimise confounding effects, questions required participants to respond to

directions of the form “Please describe how you feel about the following statements - 1 = Strongly Disagree, 5 = Strongly Agree”.

3. All questions followed a clear and similar structure with two types used; multiple choice questions and scale questions.

4. In order to minimise the introduction of measurement error in the questionnaire design, questionnaires were pre-tested and where necessary adjusted accordingly.

According to Hair et al. (2006), Likert scales can be the most suitable tool to use for online surveys. In addition, Churchill Jr (1979) asserts that Likert scales help researchers to measure an individual's opinions and attitudes about many social and scientific research issues. Likert scales were chosen for this study because a scale of this kind can indicate responses from strongly positive to strongly negative, with a middle score depicting a neutral reaction. Because of their suitability for research of this kind, Likert scales are the most commonly utilized scales in data systems research (Sekaran, 2003).

On the Likert scales, the most highly utilized scales are the five and seven-point scales (Naresh, 2006). For this study a 5-point scale was chosen because, participants find it less demanding reading out the entire list of scale descriptors (Agree, strongly agree, and so on). (See Figure 12)

This image has been removed due to copyright restrictions. Available online from [https://www.conversion-uplift.co.uk/glossary-of-conversion-marketing/likert-scale/]

Figure 12: 5-point Likert scale

The questionnaire's cover page begins with an invitation to participate in the study. The study's aims and objectives are summarised while there is also the obligatory ethics disclosure relating to participants rights concerning their consent. To legitimise the questionnaire, the university, researcher and supervisor were identified as the study's sponsors.

The questionnaire contained three components. The first part contained questions relating to demographics, the second part related to the UTAUT model constructs and external factors. The third part provided an opportunity for participants to make comments and invited them to receive results if so desired, by leaving their email address.

Table 2 shows the measurement items which are adapted from previous studies to suits this study's context, along with the sources that these items have adapted from. For example the first item of the variable performance expectancy is: "Using Assistive Technology is useful for my study", while it used in the original model as "I would find the system useful in my job". To reduce the impact of passive consent and extreme predisposition, some questions contain inverted responses. Appendix A shows the final draft of the Instrument design.

Table 2: Measurement items

Variable	Item	Adapted from
Performance expectancy	Using Assistive Technology is useful for my study.	Davis (1989), Venkatesh et al. (2003)
	Using Assistive Technology enables me to accomplish tasks more quickly.	
	Using Assistive Technology increases my productivity.	
	If I use Assistive Technology, I will increase my chances of getting a good grade.	
	Using Assistive Technology wastes my time.	
	Using Assistive Technology decreases the time needed for my important study responsibilities.	
Effort Expectancy	My interaction with Assistive Technology would be clear and understandable.	

Variable	Item	Adapted from
	It would be easy for me to become skilful at using Assistive Technology.	Davis (1989), Venkatesh et al. (2003)
	I would find Assistive Technology easy to use.	
	Learning to operate Assistive Technology is easy for me.	
	I find it easy to use Assistive Technology to get the knowledge that I want.	
	I find flexibility when dealing with Assistive Technology.	
Social influence	People who influence my behaviour think that I should use Assistive Technology.	Venkatesh et al. (2003)
	People who are important to me think that I should use Assistive Technology.	
	The staff of the university have been helpful in the use of Assistive Technology.	
	In general, the university has supported the use of Assistive Technology.	
	I would use Assistive Technology if my friends used them.	
	The university lecturers are very supportive of the use of Assistive Technology for my study.	
Facilitating conditions	I have the necessary resources to use Assistive Technology.	Venkatesh et al. (2003)
	I have the necessary knowledge to use Assistive Technology.	
	Assistive Technology is compatible with other systems I use.	
	A specific person (or group) is available for assistance with Assistive Technology difficulties.	
	I have enough experience to use Assistive Technology.	
	I think that Assistive Technology fits well with my learning style.	
Attitude toward using technology	Using Assistive Technology is a good idea.	Venkatesh et al. (2003)
	Assistive Technology makes study more interesting.	
	Studying with Assistive Technology is fun.	
	I like studying with Assistive Technology.	
	Using Assistive Technology is boring.	
	Using Assistive Technology is pleasant.	
Behavioural intention to use the AT	I intend to use Assistive Technology frequently.	Davis (1989), Venkatesh et al. (2003)
	I predict that I will use Assistive Technology in the future.	
	I predict I will continue to use Assistive Technology on a regular basis.	
	I plan to use Assistive Technology in my study.	
	I will do my study activities using Assistive Technology.	
Self-efficacy	I could complete a task using Assistive Technology if there was no one around to tell me what to do as I go.	Compeau and Higgins (1995), Venkatesh et al. (2003)
	I could complete a task using Assistive Technology if I could call someone for help if I got stuck.	
	I could complete a task using Assistive Technology if I had a lot of time to complete it.	
	I could complete a task using Assistive Technology if I had just the built-in help facility for assistance.	
	I will be able to successfully overcome many study challenges by using Assistive technology.	
	I am confident that I can perform effectively on many different tasks by using Assistive Technology.	
	Compared to other vision impaired students who don't use Assistive Technology, I can do most tasks very well.	
Anxiety	I feel apprehensive about using Assistive Technology.	

Variable	Item	Adapted from
	It scares me to think that I could lose a lot of information using Assistive Technology by hitting the wrong key.	Heinssen, Glass, and Knight (1987), Venkatesh et al. (2003)
	I hesitate to use Assistive Technology for fear of making mistakes I cannot correct.	
	Assistive Technology is somewhat intimidating to me.	
	I would be reluctant to use Assistive Technology because I'm not too familiar with it.	
Accessibility	I have easy access to Assistive Technology devices in the university.	AlMohaimmeed (2012)
	Easy access to Assistive Technology devices in many locations in the university will help me.	
	The installation of Assistive Technology devices in my classroom is important for my success.	
	Easy access to Assistive Technology devices at home and university is helpful.	
	Mobile and portable Assistive Technology devices that I can bring anywhere will be useful.	
Use behaviour	I want to use Assistive Technology to perform my study activities.	Venkatesh et al. (2003)
	I frequently use Assistive Technology.	
	I use Assistive Technology on a regular basis.	
	Most of my study tasks were done using Assistive Technology.	

5.5.2 Sample Determination

In order to gain a genuinely representative sample, sample determination is critical (Cavana et al., 2001; Zikmund, 2003). Otherwise, the ability to generalise results is compromised (Sandelowski, 2000). Sampling is a mechanism by which researchers choose a questionnaire`s respondents (Alsahli, 2009). The sampling methods and the choice of sample used in any study is an important factor that will impact on the validity of methods used and subsequently the results obtained (Balnaves & Caputi, 2001).

This research employed probability sampling more generally known as random sampling, as it produces an outcome whose results can be generalised for an entire population (Creswell, 2014). Probability sampling is defined as a technique where “each unit (for example persons, cases) in the accessible population has an equal chance of being included in the sample, and the probability of a unit being selected is not affected by the selection of other units from the accessible population (that is, the selections are made independently)” (Teddlie & Yu, 2007).

For this study, target participants were visually impaired students studying at Saudi Arabian universities. Due to the nature of this study, a factor which complicated the sampling process was that not all Saudi Arabian universities were able to specifically identify visually impaired students. To include the broadest selection of students an investigation of all Saudi universities was conducted to determine which institutions had a disability support unit, and then all visually impaired students registered with each such unit were targeted. In addition, to try to get as many participants as possible a "snowball" procedure (Guba & Lincoln, 1985), was used in which participants were asked to nominate other potential participants who had similar status and who may not have been invited to participate in the questionnaire for any reason. Using these techniques, the number of participants reached can be considered as the maximum number that satisfy the requirements of the study. Consequently, it is believed that this study is in a position to generalise the results to the entire target population in the Saudi context. Nevertheless, given the small size of the target population, the number of participants is unavoidably small, which can be considered as one of the most important limitations of this study. The effect of sample size on the validity of results is addressed in Section 6.1, and limitations of the study are discussed in section 9.7.

To distribute the survey, disability support units at the selected universities were emailed a link to an online survey, and the head administrator of each of these units then forwarded the link to potential survey participants, who were identified as visually impaired from their academic enrolment records. Altogether, the survey was sent to approximately 300 students in 6 Saudi universities.

5.5.3 Validity (Pilot Test of the Questionnaire).

Instrument validation is one of the first and fundamental approaches in confirmatory observational research (Straub, 1989). Usually, people with more experience or expertise in the field are asked to judge the questionnaire and advise whether the scale items used in the study have face validity (Bryman, 2008). In this study, the questionnaire was tested in a pilot study in order to confirm the reliability of the items and the clarity of the questions. Ten Saudi visually impaired students were asked to answer the online survey. After that, they answered questions on whether they had any issues in comprehending the survey. In light of this input, some questions had their wording altered to enhance understanding. Finally, three Saudi PhD students were asked to critically analyse if the survey questions would precisely gauge each construct. Alterations were then made to the instrument to resolve the criticism gotten from the researchers.

5.5.4 Instrument Translation

Sekaran (2003) focused on the significance of picking a survey language that balances the level of comprehension of the respondents. He said that any questionnaire wording ought to take into account the educational capability, the use of sayings in the culture, the cultural background of the respondents. Thus, it is important to phrase the questions in a manner that could be comprehended by the participants. Erroneous answers will be gotten if a few items are translated wrongly or not comprehensible to the respondents, and thus answers will be incomplete. Therefore, the wording and language of the questions asked in any survey must be appropriate to tap respondents' discernments, dispositions, and emotions.

Due to the fact that most Saudis are fluent in the Arabic language, survey items were translated into Arabic. The questionnaire was prepared in English and was translated into Arabic dialect by a certified translator with over ten years expertise in this field. The translated document was inspected by the researcher who is a native Arabic speaker. Appendix B is a facsimile of the Arabic version of the questions contained in the questionnaire.

5.5.5 Ethical Considerations

Ethical practices make sure that, while respondents are encouraged to answer, they are not under any pressure to respond in an offensive manner, their confidentiality is guaranteed, and they are protected from any form of exploitation and misrepresentation (Cavana et al., 2001; Fink, 2012).

This study adheres to strict ethical guidelines laid out by the Social and Behavioural Research Ethics Committee (SBREC) of Flinders University. An application for human ethics approval was submitted and approval was given before the study was started. (Approval No. 7261). Appendix C shows the final ethics approval and both Arabic and English information sheets. The application included copies of all survey materials and details of the nature and purpose of the project, the research procedures and plan, participant recruitment, the disposal and storage of data, privacy of the participants and the protection of confidentiality.

Saudi universities from which participants were recruited gave their approvals before the survey was distributed. Additionally, before the first communication to prospective participants started, an information document explaining the aim of the project and what would be required from them was given to them. The document guaranteed voluntary

participation as well as confidentiality and mentioned the possibility of respondents withdrawing from the research whenever they like without any penalty. Participants were not offered any financial incentive, and all participants were told that completing the online survey would be regarded as agreement. All information that might reveal identity was taken out before subsequent analysis. Any computer-based data and completed questionnaires were securely saved during this study.

5.6 Qualitative Study

Qualitative methods permit researchers to explore and elaborate on the opinions and statements of study participants, allowing them to focus on issues most relevant to their research (Hennink et al., 2010). According to Creswell (2012, p. 300), qualitative research can be defined as "An inquiry process of understanding based on a distinct methodological approach to inquiry that explores a social or human problem. The researcher builds a complex, holistic picture, analyses words, reports detailed views of participants, and conducts the study in a natural setting." Essentially, qualitative methods can be considered to focus on the respondent's perspective, exploring specific phenomena and enabling an understanding of this phenomena to determine its importance and relevance to that person in the context of the research (Hennink et al., 2010; Murray, 1998). Qualitative methods are a tool which equip researchers with a means to explore specific phenomena to a deeper level (Gill et al., 2008). According to Green (1999) the majority of qualitative studies address human behaviour and focus on cultural factors which shape human behaviour and systems of belief.

During the course of this research, qualitative methods were used during the stage 3 as a means to confirm, interpret and explain the quantitative study results in order to gain a deeper understanding of the observed behaviour. Owing to the fact qualitative research involves focusing on descriptive data in contrast to statistical data (Punch, 2013), this makes it a particularly valuable tool in extracting value from questions where 'why' and 'what' are involved (Hennink et al., 2010; Khan, 2014; Murray, 1998).

5.6.1 Interview Design

Important and rich information can result from research interviews that may help in explanation of the quantitative results (Al-Busaidi, 2012), justifying their role as an excellent tool in comprehending participant behaviour and attitudes (Punch, 2013). As a result interviews are one of the most frequently employed qualitative research tools used by researchers (Alfarraj, 2013; Myers & Newman, 2007). Jupp (2006) categorises three types of interviews used for researchers: (1) unstructured interviews, (2) structured interviews, and (3) semi-structured interviews. Myers and Newman (2007) are of the opinion that the popularity of semi-structured interviews for studies relating to information systems is because they equip researchers with the opportunity to examine topics to a greater depth through the use of both pre-prepared questions and spontaneous ones arising from respondent's answers. Semi-structured interviews enable interviewers to solicit responses from interviewees concerning their personal opinions and experiences relating to specific issues raised, or relevant to the research (Rabionet, 2011). As well as their usefulness, semi-structured interviews are also regarded as possessing significant reliability, validity and are relatively easy to conduct (Copeland et al., 1976).

There were two justifications why this study incorporated semi-structured interviews. First, owing to the complex nature of the phenomena being studied, it was considered appropriate to examine the respondents` personal perceptions and opinions to a greater depth than that available from other research approaches. Second, the nature of semi-structured interviews eliminated the necessity of having the same interview schedule with all participants, providing the researcher with the flexibility to specifically select interviewees and/or issues which needed elaboration, as they arose (Louise & While, 1994). Another aspect of the semi-structured interview is that they are often popular with the interviewees themselves as the participant is given an opportunity to express themselves freely and feel that their opinions are listened to by someone who regards them as important (Witzel, 2000).

In this study, the researcher conducted semi-structured interviews with members of two groups: visually impaired students in Saudi Arabian universities (users) and staff associated with disability support units at Saudi universities (domain experts). Users will be very familiar with the specific technology that they use on a day-to-day basis and can provide insights about its particular strengths and weaknesses. Domain experts will have a broader perspective and are better placed to address big-picture issues. Interviewing both groups would help to identify solutions to problems and strategies to enhance the acceptance of AT in the Saudi university sector and in the broader context. Other potential stakeholders, such as university administrators and teachers, or classmates and friends of visually disabled students, were not targeted because it was felt that they would not have sufficient knowledge about visual disability or AT characteristics to provide insight into the factors affecting acceptance of the technology. Alsaghier (2010) suggests interview lengths be capped at 45

minutes to prevent interview fatigue. In this study, each interview needed around 45 minutes to be completed.

During the course of interviews, the researcher used three means to record interviews: taking hand written notes, electronic recording and following pre-set interview guidelines. The combination of note taking and recording is an important part of the semi-structured interview process. Notes alone may not document all important points while recordings similarly may not contain all information. Additionally the pre-written interview guidelines enable interviewers to remain on track and to cover questions they desire answers to, while also providing flexibility, permitting the interviewee straying off-topic. Frequently off-topic answers may convey important information, so the interviewing guidelines can bring the interview back on track.

In the course of this research, interview questions were open-ended for the purpose of confirming, interpreting, explaining and providing a deeper comprehension of the results which emerged from the quantitative phase of the study. Interview questions were designed to follow up the quantitative results. To verify the validity of the interview questions, an actual interview was conducted with 3 Arabic PhD students and the questions were adjusted based on their follow-up. Appendix D shows the interview questions in English.

5.6.2 Sample Determination

Every interview process requires researchers to select participants from their desired target demographic (Murray, 1998). For this study, the targeted respondents were visual disability experts and visually disabled students registered with disability support units at Saudi universities. The original plan was to target 14 participants by interviewing the first 7 users

and 7 experts who accepted the invitation to participate in the interviews. However, only 5 users and 4 experts responded by the closing date. This sample size was deemed adequate as Dworkin (2012) points out that many academics believe sufficient numbers can range from five to 50 for qualitative studies such as this.

Invitations to participate were distributed using a process similar to that used in the quantitative study. A package of materials was prepared, including an information sheet about the project, a brief report that described the research methodology and summarised the findings of the quantitative study, a copy of the interview questions, and a consent form. The package was emailed to the head of disability support units in the same universities as for the quantitative study, with a request to forward the invitation to all visually disabled students registered with the unit and to visual disability experts affiliated with the unit. Interviews were conducted by Skype or by telephone. Users and experts who were interested in participating were invited to respond directly to the researcher to arrange a suitable time and method for the interviews.

5.6.3 Validity

Validating qualitative studies is difficult to achieve (Whittemore et al., 2001). To strengthen the study's reliability and validity, researchers frequently employ consultants as neutral examiners as a means of preventing bias by either the researcher or participants. The use of a disinterested party in this process strengthens the research's reliability and validity (Brink, 1987). As Oluwatayo (2012, p. 399) points out "validity and reliability are related." In addition, according to Brink (1987), to avoid researcher bias, external reviewers need to be consulted to ensure qualitative research reliability and validity. In this study, three Arabic

PhD students were asked to review the procedure and questions of interviews and their feedback was followed when producing the final interview draft. Moreover, actual interviews were conducted with 3 Arabic speakers to ensure that the questions were clear, to make sure they were free of errors, and to determine the expected time for each interview. The interview's questions were updated based on observations obtained from the pilot interviews.

5.6.4 Instrument Translation

As this study was conducted at Saudi Arabian university where the Arabic language was the medium of instruction, the interview questions were translated into Arabic, with the completed version proofread by a professional translator. Appendix E is a facsimile of the Arabic version of the questions contained in the interviews.

5.6.5 Ethical Considerations

This study adheres to strict ethical guidelines laid out by the Social and Behavioural Research Ethics Committee (SBREC) of Flinders University. An application for human ethics were submitted and an approval was given by the University's Human Research Ethics Committee before this study was started (Approval No. 7950). Appendix F shows the final ethics approval, both Arabic and English information sheets, and both Arabic and English quantitative reports.

Ethical issues were discussed during the human ethics application process. These issues included information relating to the nature and objective of the study, research procedures and strategy, the rights and obligations of voluntary participants, eventual data disposal, data storage security, participant privacy protection and the safeguards relating to confidentiality. At the commencement of participant involvement, all prospective study candidates were

provided with a written explanation of the research's aims and objectives. This document included information relating to their voluntary participation, confidentiality provisions and also outlined what would happen if they chose to withdraw from the study before its completion. Participants were not offered financial incentive, and all who chose to be involved were required to complete and sign a consent form before the start of interviews, and thanked for their participation.

5.7 Summary

This chapter presents the study's research paradigm, research design and approach, methods of data collection, data analysis procedures, validation studies, issues relating to validity and finally ethical considerations.

This research utilises a mixed-methods approach employing an explanatory sequential design in order to provide answers to the research questions to satisfy the goals of the study. The core of this study's data collection method was quantitative in the form of a questionnaire, while qualitative semi-structured interviews were used to confirm, interpret and justify what was identified in the initial part of the research. The qualitative component of the study was designed to add to the quantitative component's results to provide greater understanding.

Chapter 6 : Quantitative Data Analysis and Results

6.1 Introduction

This chapter presents the analysis, using diverse quantitative procedures and tools, of the data collected through the online survey. The first section of this chapter discusses data preparation including data coding, dealing with missing data and outliers, and normality. The next section describes how the reliability and the validity of the research measurements were tested through many steps. Finally, the results are discussed in relation to the hypotheses of this thesis.

Data gotten from the quantitative approach was statistically analysed. In the statistical tests, the logical sequence was adopted from best practice in IT adoption studies (Carter & Bélanger, 2005; Chang et al., 2005; Phang et al., 2005). Firstly, descriptive statistics were employed in summarising the demographic variables. The next stage was to evaluate the validity and reliability of the instruments employed in this research. According to Sekaran (2003) the objective of this assessment is to verify that the scale to measures consistently and accurately what it ought to measure.

In this research, unit dimensionality and scale validity were evaluated using exploratory factor examination analysis of the correlation coefficient. Also, discriminant and convergent validity of these scales was evaluated via confirmatory factor analysis. After this, Structural Equation Modelling (SEM) was used to examine the whole model. According to Belanger and Ca1ter, 2008, it is very important to test the relative capability of the fitting model before testing the individual path coefficients equivalent to the research hypotheses. Over the course

of the research, SEM was applied using the Partial Least Square (PLS) method with the Smart PLS package. According to Hair et al. (2011), PLS can minimize the residual variances of the dependent variables more than SEM, and it is suitable for small size samples. According to Chin and Newsted (1999), the recommended range of sample size for PLS is between 30-100 cases, whereas the recommended range of sample size for CBSEM is between 200-800 cases. Moreover, the study of the UTAUT model by Venkatesh et al. (2003) used PLS as an analysis technique for their study.

The data will be analysed using structural equation modelling (SEM). According to Gefen et al. (2000), there are two phases to SEM analysis. The first is the assessment of the measurement model (outer model). This is presented in Section 6.4. The second is the structural model (inner model), which is presented in Section 6.5.

6.2 Data Preparation

Examining data is an important first step in data analysis. According to Hair et al. (2010), data should be examined by the researcher to make sure it is complete and consistent prior to analysis. For any study, a precise method must be followed to get data ready for analysis. This study required several data preparation steps.

The data obtained from the online survey were inspected and eligible submission were identified through validation of genuine and complete responses. Responses lacking any form of variation would indicate that the response was not genuine. Responses where only part of the survey was answered would indicate incompleteness. All of the responses were complete and appeared genuine, so all were considered eligible.

6.2.1 Data Coding

Data were coded according to the item codes and measurement variables, as shown in Table 3, Positively worded questions were coded with "strongly agree" given a rating of 5 and "strongly disagree" a rating of 1. Negatively worded questions (for example item PE5) were coded with "strongly disagree" scoring 5 and "strongly agree" scoring 1.

The derived data was entered into IBM-SPSS for standard analysis and then Smart PLS software was used for advanced analysis. Prior to initiating the analysis, the data were examined to confirm they had been accurately entered. This process involved manually checking random sample rows of the dataset with the matching survey. Frequencies were calculated for every one of the matching factors to check whether any omitted data or anomalies occurred in the inputted dataset. Moreover, since the data collected from the online survey site were sent directly to Smart PLS and SPSS, all possible errors were avoided.

Table 3: Constructs and measurement variables coding

Variable	Item	Item code
Performance expectancy	Using Assistive Technology is useful for my study.	PE1
	Using Assistive Technology enables me to accomplish tasks more quickly.	PE2
	Using Assistive Technology increases my productivity.	PE3
	If I use Assistive Technology, I will increase my chances of getting a good grade.	PE4
	Using Assistive Technology wastes my time.	PE5
	Using Assistive Technology decreases the time needed for my important study responsibilities.	PE6
Effort Expectancy	My interaction with Assistive Technology would be clear and understandable.	EE1
	It would be easy for me to become skilful at using Assistive Technology.	EE2
	I would find Assistive Technology easy to use.	EE3
	Learning to operate Assistive Technology is easy for me.	EE4

Variable	Item	Item code
	I find it easy to use Assistive Technology to get the knowledge that I want.	EE5
	I find flexibility when dealing with Assistive Technology.	EE6
Social influence	People who influence my behaviour think that I should use Assistive Technology.	SI1
	People who are important to me think that I should use Assistive Technology.	SI2
	The staff of the university have been helpful in the use of Assistive Technology.	SI3
	In general, the university has supported the use of Assistive Technology.	SI4
	I would use Assistive Technology if my friends used them.	SI5
	The university lecturers are very supportive of the use of Assistive Technology for my study.	SI6
Facilitating conditions	I have the necessary resources to use Assistive Technology.	FC1
	I have the necessary knowledge to use Assistive Technology.	FC2
	Assistive Technology is compatible with other systems I use.	FC3
	A specific person (or group) is available for assistance with Assistive Technology difficulties.	FC4
	I have enough experience to use Assistive Technology.	FC5
	I think that Assistive Technology fits well with my learning style.	FC6
Attitude toward using technology	Using Assistive Technology is a good idea.	ATT1
	Assistive Technology makes study more interesting.	ATT2
	Studying with Assistive Technology is fun.	ATT3
	I like studying with Assistive Technology.	ATT4
	Using Assistive Technology is boring.	ATT5
	Using Assistive Technology is pleasant.	ATT6
Behavioural intention to use the AT	I intend to use Assistive Technology frequently.	BI1
	I predict that I will use Assistive Technology in the future.	BI2
	I predict I will continue to use Assistive Technology on a regular basis.	BI3
	I plan to use Assistive Technology in my study.	BI4
	I will do my study activities using Assistive Technology.	BI5
Self-efficacy	I could complete a task using Assistive Technology if there was no one around to tell me what to do as I go.	SE1
	I could complete a task using Assistive Technology if I could call someone for help if I got stuck.	SE2
	I could complete a task using Assistive Technology if I had a lot of time to complete it.	SE3
	I could complete a task using Assistive Technology if I had just the built-in help facility for assistance.	SE4
	I will be able to successfully overcome many study challenges by using Assistive technology.	SE5

Variable	Item	Item code
	I am confident that I can perform effectively on many different tasks by using Assistive Technology.	SE6
	Compared to other vision impaired students who don't use Assistive Technology, I can do most tasks very well.	SE7
Anxiety	I feel apprehensive about using Assistive Technology.	AN1
	It scares me to think that I could lose a lot of information using Assistive Technology by hitting the wrong key.	AN2
	I hesitate to use Assistive Technology for fear of making mistakes I cannot correct.	AN3
	Assistive Technology is somewhat intimidating to me.	AN4
	I would be reluctant to use Assistive Technology because I'm not too familiar with it.	AN5
Accessibility	I have easy access to Assistive Technology devices in the university.	AC1
	Easy access to Assistive Technology devices in many locations in the university will help me.	AC2
	The installation of Assistive Technology devices in my classroom is important for my success.	AC3
	Easy access to Assistive Technology devices at home and university is helpful.	AC4
	Mobile and portable Assistive Technology devices that I can bring anywhere will be useful.	AC5
Use behaviour	I want to use Assistive Technology to perform my study activities.	UB1
	I frequently use Assistive Technology.	UB2
	I use Assistive Technology on a regular basis.	UB3
	Most of my study tasks were done using Assistive Technology.	UB4

6.2.2 Missing Data

There must be no missing data when using Structural Equation Modelling (SEM) (Kaplan, 2008). This is of particular importance when SEM is used as a data analysis technique (Hair et al., 2010; Kline, 2011).

Ten responses (11.49 %) to the survey questionnaire had missing data. It was crucial that these missing data were carefully checked and treated, before performing analysis, due to the sensitivity of Smart PLS to missing data. Generally, treatment of missing data is done through SPSS by replacing any missing data with the mean or the median of nearby points, or via

linear interpolation. Consequently, in the current study, the missing data of ten respondents were replaced by the median of nearby values, as suggested by Hair et al. (2010) and Tabachnick and Fidell (2007).

6.2.3 Outliers

Outliers are values that significantly differ from the rest of a given dataset (Byrne, 2016; Hair et al., 2010; Kline, 2011; Pallant, 2013). It is critical to identify outliers since they can modify the results of data analysis. Hair et al. (2006, p. 73) argue that 'problematic outliers are not representative of the population, are counter to the objectives of the analysis, and can seriously distort statistical tests'.

In the current study, Mahalanobis distance D2, calculated using SPSS, was employed to identify outliers. It measures how far data points are from the mean of the predictor constructs (Hair et al., 2010). The regression procedure for the study constructs was applied to compute D2, and a Mahalanobis distance with $p \leq 0.001$ was set as the criterion for multivariate outliers. The calculation of the Mahalanobis distance on the study data revealed three cases with a number of univariate outliers. Removal of these three cases left 84 responses for further analysis.

6.2.4 Normality

Overall, PLS-SEM does not make assumptions with regard to data distribution. Nevertheless, it is recommended that distribution be taken into account when using PLS-SEM (Hair et al., 2014).

The study explored multivariate normality of the sample data to fulfil the data analysis requirements. According to Hair et al. (2010), all items should have a normally shaped distribution. In this study, skewness and kurtosis tests were used to analyse the variables' normality (Hair et al., 2010). The purpose was to detect whether the values of variables were normally distributed in order to employ statistical techniques such as SEM.

The applicability of SEM analysis depends on kurtosis and skewness values being within standard ranges (Byrne, 2016; Hair et al., 2010). Kurtosis is employed to compute variance and covariance (Byrne, 2016). The skewness of a dataset adversely impacts the algorithms employed for testing the mean (Byrne, 2016). Hence, these tests must be performed before SEM analysis.

In many studies, less strict criteria, as suggested by (Byrne, 2016); Kline (2005), are followed. Skewness values should not exceed 3.0 while kurtosis values should be less than 7.0 (Byrne, 2016; Kline, 2011). As outlined in Appendix G, the investigation of the skewness and kurtosis values in this study revealed that they are within the recommended ranges. Accordingly, the data is considered to be normally distributed.

6.3 Descriptive Statistics

The fundamental components and qualities of the data were examined with the help of descriptive statistics. The descriptive statistics provide a powerful summary to enable the different groups' comparisons. This comparison can give an overview description of all sample characteristics. In this section, the demographic information will be analysed and described.

6.3.1 Demographic Information Analysis

Survey questionnaire invitation were disseminated by email to around 300 visually impaired students in Saudi universities, and 87 (29 %) questionnaires were returned. As discussed above, three responses were removed due to the presence of outliers. That left N=84 as the dataset entered into SPSS and analysed. Table 4 gives demographics frequency statistics for the respondents and the following sections provide the findings of this analysis.

Table 4: Demographic characteristics

Variable		Frequency	Percent
Gender	Male	45	53.6
	Female	39	46.4
Age	18-21	17	20.2
	22-25	34	40.5
	26-29	15	17.9
	30-33	14	16.7
	More than 33	4	4.8
Disability Duration	Since birth	62	73.8
	More than 10 years	15	17.9
	9-5 years	4	4.8
	Less than 5 years	3	3.6
Level of disability	Moderate visual impairment	14	16.7
	Severe visual impairment	37	44
	Blindness	33	39.3
Use of AT	A few times a month	5	6
	A few times a week	8	9.5
	Once a day	2	2.4
	Several times a day	69	82.1
Experience using computers	Beginner	23	27.4
	Intermediate	40	47.6
	Advanced	21	25
Educational level	Diploma degree	7	8.3
	Bachelor degree	60	71.4
	Master degree	15	17.9
	Doctorate	2	2.4
Type of Assistive Technology used	Screen Readers	67	79.8
	Braille Technologies	51	60.7
	Optical Character Recognition	5	6
	Electronic Dictionaries	7	8.3

Variable		Frequency	Percent
	Text to Voice Technologies	35	41.7
	Smart phone applications	74	88.1

6.3.1.1 Gender

Figure 13 shows that, out of the 84 participants who took part in the study 45, or 53.6 %, were males and 39, or 46.4 %, were females. This indicates that the gender ratio for respondents in this study is close to 50:50, which is the general gender ratio in the broader population.

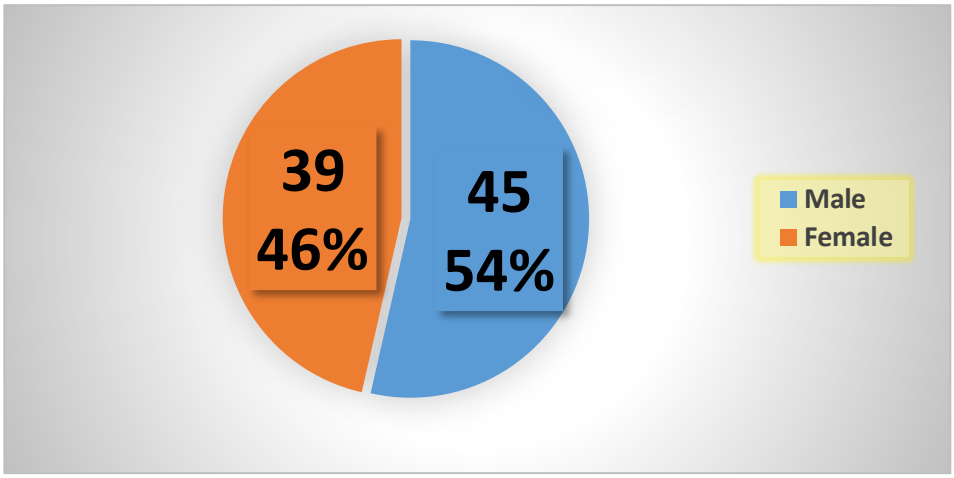


Figure 13: Gender of participants

6.3.1.2 Age

Figure 14 illustrates that the study sample is mainly comprised of young and very young individuals. Only four respondents (4.8 %) were aged over 33. Most respondents, 34 (40.5 %), were between the ages of 22 and 25. The distribution can be said to be somewhat skewed.

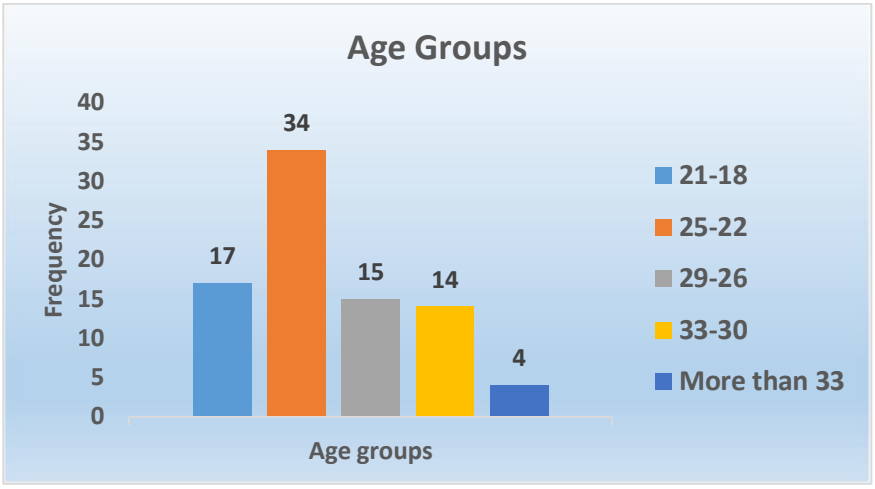


Figure 14: Age groups of participants

6.3.1.3 Disability Duration

As Figure 15 illustrates, most of the participants in the study have been visually impaired for a relatively long time. The vast majority of respondents, 73.8 %, have been visually impaired since birth. Also, a significant minority, around 18 %, have been visually impaired for more than 10 years.

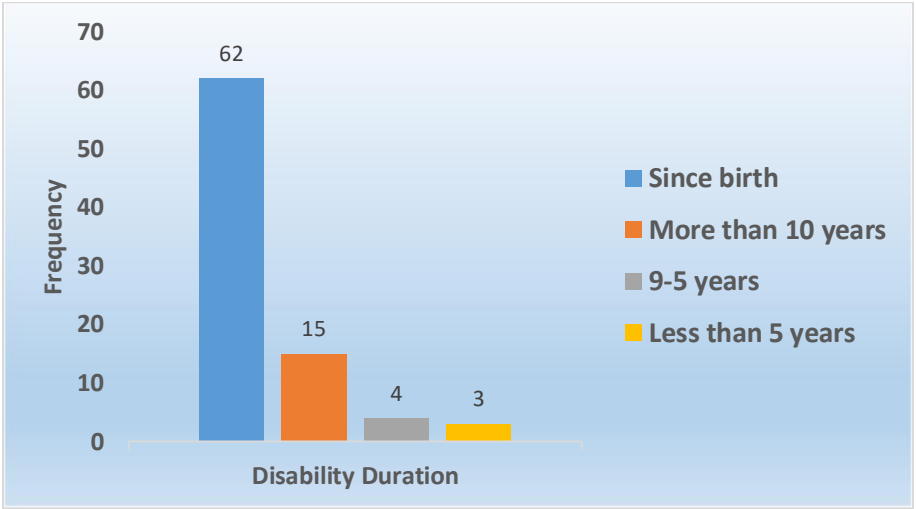


Figure 15: Disability duration of participants

6.3.1.4 Level of Disability

Figure 16 depicts that 70 (83.3 %) participants have severe visual impairment or are blind. Severe visual impairment accounts for 37 (44 %) respondents while 33 (39.3 %) are blind.

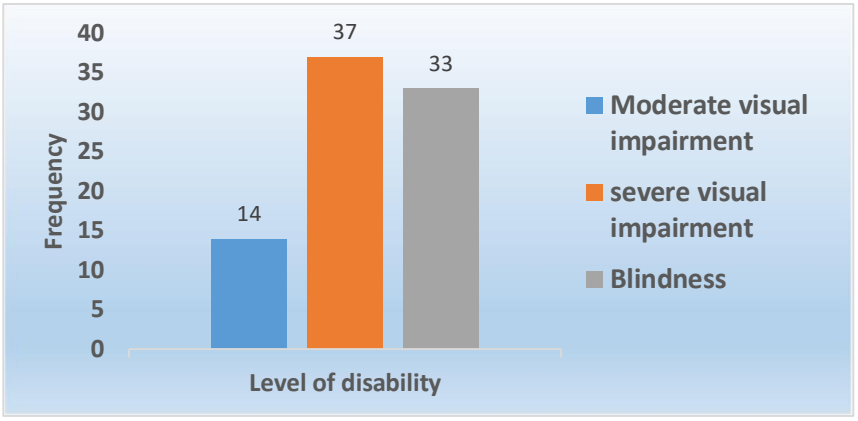


Figure 16: Level of disability of participants

6.3.1.5 Use of AT

Figure 17 illustrates that most participants use assistive technology very often, with 69 (82 %) doing so several times a day. These results are not surprising since, as we saw earlier, most participants had severe visual impairments or were blind.

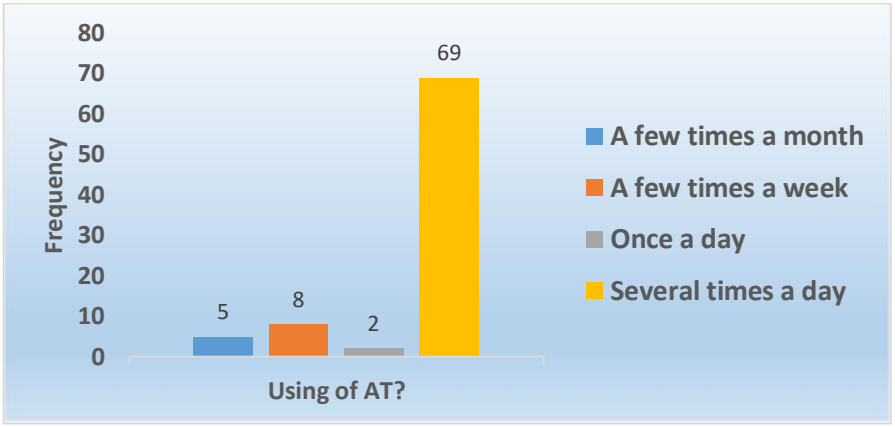


Figure 17: Participants' experience of using AT

6.3.1.6 Experience Using Computers

Figure 18 reveals that computer skills are fairly evenly distributed, although most respondents (40, approximately 40 %) said they have intermediate skills. This indicates that use of AT may not depend on computer skills since most respondents use AT even though computer skills vary.

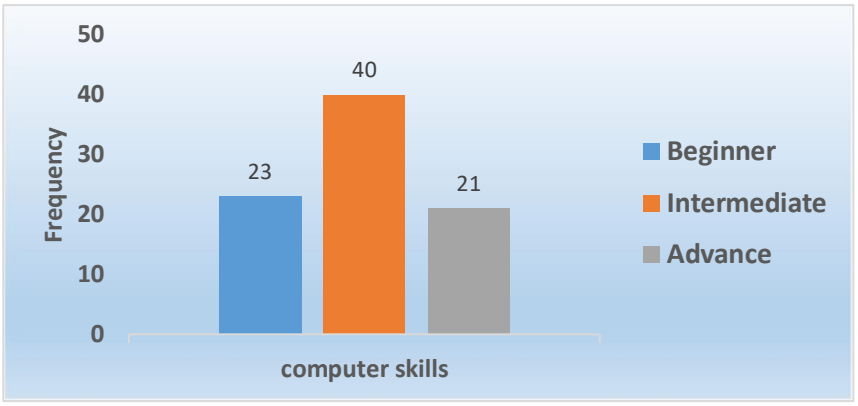


Figure 18: Participants' experience of using computers

6.3.1.7 Educational Level

Figure 19 shows that the majority of respondents are Bachelor degree students (60 or 71.4 %) and 15 (around 18 %) are Master's students.

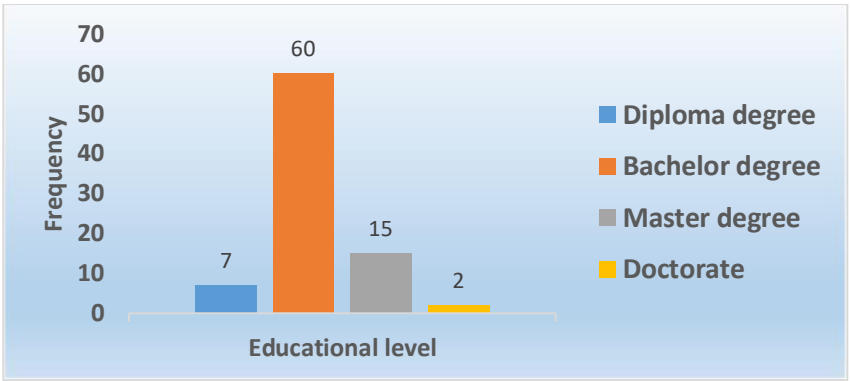


Figure 19: Participants' educational level

6.3.1.8 Type of Assistive Technology Used

Figure 20 shows that most respondents (88.1 % or 74 of 84) use smartphone based assistive technology. This could be due to the wide spread use of smartphones nowadays, and because they are easy and accessible to use.

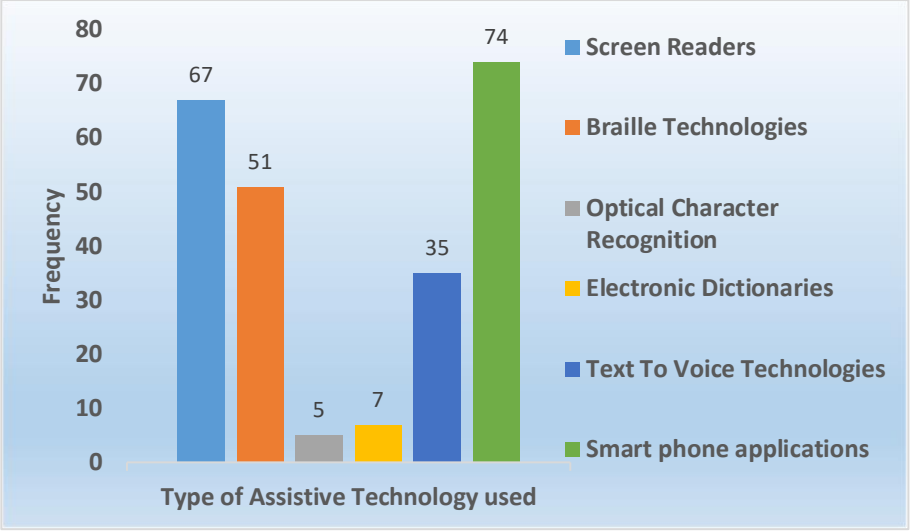


Figure 20: Type of assistive technology used by participants

6.3.2 Summary

Demographic data show that the majority of the participants are aged in their twenties, which is not surprising as this study is of university students. Also it shows that the majority of participants have a disability since birth, and most of them have severe visual impairment or total blindness. Moreover, the majority of the participants use assistive technology several times a day, and the smartphone-based assistive technology is the most used.

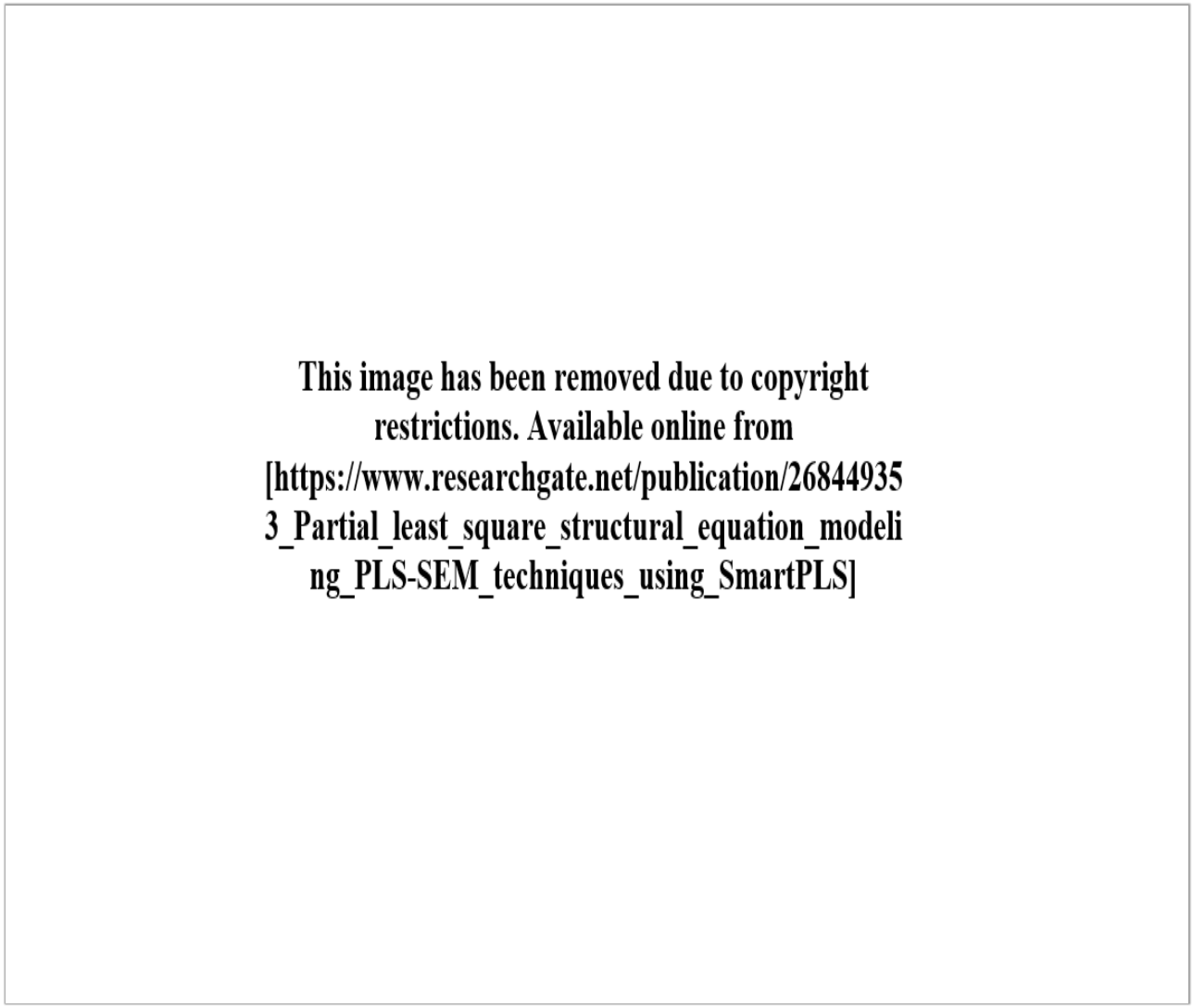
6.4 Testing the Goodness of the Measurement Model (Outer Model)

This section describes the instrument testing steps. Two main observational tests were performed: reliability and validity. It is necessary to make sure that indicator reliability,

internal consistency reliability, convergent validity, and discriminant validity of the reflective measurement model are adequately assessed and proven satisfactory before setting the path coefficients in the structural model (Wong, 2013). Validity and reliability items that should be checked and reported when performing a PLS-SEM are given in Table 5.

Table 5: Checking reliability and validity

Source: Wong (2013)



6.4.1 Reliability

Reliability refers to the extent to which a research instrument produces consistent results (Sekaran, 2003). According to Khawaja et al. (2012), a reliable research instrument demonstrates internal consistency and produces outputs that are stable over time. This section will examine the internal consistency reliability and the indicator reliability to make sure that they are satisfactory.

6.4.1.1 Indicator Reliability

The loadings and indicators correlations with respective latent variables are used to assess the reliability of an individual item. As Carmines and Zeller (1979) argue, the manifest variable must have a loading of at least 0.7 to be accepted as an indicator. Moreover, as per Hair et al. (2010) indicator loadings are required to be greater than 0.70 to obtain a satisfying analysis results. If this is satisfied, there is less error variance than the shared variance of the construct. Accordingly, the inclusion of poor indicators is likely to result in an inadequate fitting in the covariance-based SEM analysis.

Loadings for all indicators were computed and indicators that had a loading less than 0.70 were deleted. As a result of this, 23 indicators were removed, leaving the 32 indicators shown in Table 6.

Other researchers suggest that indicator reliability should be used. For example, Hulland (1999) recommends an indicator reliability of at least 0.70, although 0.4 and higher is accepted in exploratory research. Since reliability is computed as the square of loading, a loading of 0.7 or greater will correspond with a reliability of 0.49 or greater, which falls in

the acceptable range. The indicator loadings and reliabilities items used in further analysis are shown in Table 6.

Table 6: Indicator reliability

Indicators	Loading	Reliability (loading^2)
AC3	0.781	0.610
AC4	0.902	0.814
AC5	0.896	0.803
AN1	0.896	0.804
AN2	0.747	0.557
AN3	0.808	0.653
AN4	0.874	0.763
ATT1	0.754	0.568
ATT2	0.729	0.532
ATT3	0.843	0.711
ATT4	0.864	0.746
BI1	0.741	0.550
BI2	0.836	0.699
BI3	0.839	0.704
BI4	0.882	0.777
EE3	0.724	0.524
EE5	0.899	0.808
EE6	0.907	0.822
FC2	0.801	0.642
FC5	0.852	0.726
FC6	0.877	0.769
PE1	0.812	0.660
PE2	0.816	0.666
PE4	0.805	0.648
SE5	0.865	0.749
SE6	0.885	0.782
SE7	0.646	0.417
SI3	0.830	0.688
SI4	0.993	0.986
UB2	0.897	0.805
UB3	0.885	0.783
UB4	0.817	0.667

6.4.1.2 Internal Consistency Reliability

Cronbach's alpha was used to measure internal consistency for study factors in regard to the survey sample measurement. Some researchers argue that the acceptable cut-off is 0.7, others claim that any value above 0.6 can be accepted (Fornell & Larcker, 1981; Hair et al., 1998; Nunnally & Bernstein, 1994).

Cronbach's alpha has been regularly used in social science research to measure internal consistency reliability. However, its measurement tends to be conservative in PLS-SEM. The literature review has revealed that instead of Cronbach's alpha, a Composite Reliability of 0.7 and higher can be used (Bagozzi & Yi, 1988; Hair et al., 2012). In the case of exploratory research, a value of 0.6 and higher is accepted (Bagozzi & Yi, 1988).

Values shown in Table 7 indicate that both Composite Reliability and Cronbach's alpha are at acceptable levels. Accordingly, high levels of internal consistency reliability have been exhibited by all reflective latent variables.

Table 7 : Cronbach's alpha and Composite Reliability

Variable	# Items	Cronbach's Alpha	Composite Reliability
Accessibility (AC)	**3**	**0.824**	**0.896**
Anxiety (AN)	**4**	**0.865**	**0.900**
Attitude toward using technology (ATT)	**4**	**0.810**	**0.876**
Behavioural intention to use the AT (BI)	**4**	**0.845**	**0.896**
Effort Expectancy (EE)	**3**	**0.810**	**0.883**
Facilitating conditions (FC)	**3**	**0.807**	**0.881**
Performance expectancy (PE)	**3**	**0.743**	**0.852**
Self-efficacy (SE)	**3**	**0.721**	**0.845**
Social influence (SI)	**2**	**0.863**	**0.911**
Use behaviour (UB)	**3**	**0.837**	**0.901**
Total	**32**		

6.4.2 Validity of Scales

Discriminant validity and convergent validity of the reflective measurement models was examined to make sure that they are satisfactory. Moreover, the unidimensionality and validity of the scales were subjected to exploratory factor analysis and examined for correlation coefficients. In addition, corroborative factor analysis was used to assess merged and discriminant validity of the estimation scales. Confirmatory factor analysis (CFA) assessed the construct validity of the scales employed in the study. Each of these is discussed in the following subsections.

6.4.2.1 Convergent Validity

Convergent validity is the model's capacity to explain the indicator's variance. Evidence for convergent validity is provided by the Average Variance Extracted (AVE) value (Fornell & Larcker, 1981). According to Bagozzi and Yi (1988), an AVE threshold value of 0.5 should be regarded as evidence of convergent validity. As shown in Table 8, all constructs in this study have values higher than this threshold. Accordingly, convergent validity is confirmed.

Table 8: Average Variance Extracted (AVE)

Variable	Average Variance Extracted (AVE)
AC	**0.742**
AN	**0.694**
ATT	**0.639**
BI	**0.683**
EE	**0.718**
FC	**0.712**
PE	**0.658**
SE	**0.650**
SI	**0.837**
UB	**0.752**

6.4.2.2 Discriminant Validity

Discriminant validity refers to the degree of differentiation of items among constructs (Hair et al., 2014), in addition, Discriminant validity can be considered as a statistical measure used to examine the degree to which items differentiate among constructs. According to Hair et al. (2010), a high discriminant validity for a construct means it is more suitable to examine a phenomenon than other constructs. Discriminant validity in this study was verified by measuring overlap in variance to ensure that measurements for every group were correlate to the construct itself more than other constructs, and also to ensure there were no issues in cross-loading for the measured items. Two different criteria were used to measure the discriminant validity of this study: the Fornell-Larcker criterion and the cross-loading criteria.

The Fornell-Larcker criterion represents a standard and conservative approach for evaluating discriminant validity (Hair et al., 2016). By this criterion, for establishing discriminant validity it is necessary that the self-correlation of a latent variable (which is equivalent to the square root of the AVE value) be greater than its correlation with all other latent variables As shown in Table 9, all latent variables in the model meet this criterion as the values on the main diagonal (the self-correlations) are higher than all other values in the same row and column.

Table 9: Latent variable correlations

	AC	AN	ATT	BI	EE	FC	PE	SE	SI	UB

AC	0.862									
AN	0.150	0.833								
ATT	0.438	0.318	0.800							
BI	0.432	0.293	0.584	0.826						
EE	0.366	0.308	0.612	0.449	0.847					
FC	0.312	0.382	0.544	0.549	0.649	0.844				
PE	0.644	0.141	0.478	0.467	0.377	0.413	0.811			
SE	0.603	0.272	0.559	0.548	0.481	0.457	0.480	0.806		
SI	-0.011	0.003	-0.019	0.126	-0.004	0.024	0.023	-0.066	0.915	
UB	0.580	0.164	0.479	0.659	0.514	0.589	0.690	0.619	0.116	0.867

The second test used to measure the discriminant validity is the cross-loading examination. According to Chin (2010), the loading value for each item with its related latent variable should exceed its loading with other latent variables. As shown in the matrix of cross loading presented in Table 10, all items satisfy this test. For example, the loading for item AC3 with indicator variable AC is higher than its loading with other variables.

Table 10: Matrix of cross loadings

	AC	**AN**	**ATT**	**BI**	**EE**	**FC**	**PE**	**SE**	**SI**	**UB**
AC3	**0.781**	-0.046	0.322	0.337	0.254	0.210	0.429	0.514	-0.033	0.440
AC4	**0.902**	0.133	0.341	0.378	0.344	0.282	0.570	0.501	0.070	0.527
AC5	**0.896**	0.275	0.460	0.398	0.342	0.308	0.649	0.543	-0.064	0.527
AN1	0.171	**0.896**	0.336	0.364	0.276	0.315	0.177	0.311	-0.006	0.193
AN2	0.088	**0.747**	0.212	0.133	0.270	0.287	0.048	0.098	-0.042	0.068
AN3	0.101	**0.808**	0.271	0.169	0.275	0.375	0.076	0.178	-0.016	0.098
AN4	0.095	**0.874**	0.181	0.179	0.213	0.327	0.098	0.218	0.070	0.124
ATT1	0.449	0.332	**0.754**	0.496	0.391	0.418	0.434	0.470	-0.030	0.374
ATT2	0.484	0.166	**0.729**	0.463	0.374	0.341	0.435	0.526	-0.092	0.488
ATT3	0.207	0.190	**0.843**	0.427	0.518	0.436	0.324	0.329	0.065	0.285
ATT4	0.238	0.316	**0.864**	0.468	0.673	0.537	0.321	0.443	0.003	0.371
BIUS1	0.405	0.111	0.440	**0.741**	0.295	0.233	0.317	0.414	0.035	0.490
BIUS2	0.293	0.278	0.459	**0.836**	0.310	0.402	0.246	0.393	0.087	0.359
BIUS3	0.333	0.275	0.477	**0.839**	0.451	0.585	0.452	0.497	0.151	0.665
BIUS4	0.391	0.289	0.542	**0.882**	0.394	0.532	0.472	0.485	0.122	0.596
EE3	0.297	0.251	0.335	0.212	**0.724**	0.458	0.282	0.376	0.010	0.342

	AC	AN	ATT	BI	EE	FC	PE	SE	SI	UB
EE5	0.334	0.259	0.605	0.412	**0.899**	0.540	0.313	0.420	-0.140	0.447
EE6	0.313	0.281	0.556	0.452	**0.907**	0.634	0.360	0.434	0.114	0.494
FC2	0.252	0.327	0.446	0.423	0.548	**0.801**	0.318	0.298	0.015	0.388
FC5	0.175	0.281	0.364	0.365	0.485	**0.852**	0.194	0.303	0.020	0.390
FC6	0.328	0.350	0.531	0.555	0.594	**0.877**	0.466	0.496	0.023	0.636
PE1	0.560	0.162	0.393	0.400	0.316	0.261	**0.812**	0.380	-0.001	0.529
PE2	0.490	0.084	0.451	0.303	0.375	0.409	**0.816**	0.355	0.009	0.520
PE4	0.509	0.090	0.336	0.413	0.244	0.351	**0.805**	0.423	0.046	0.617
SE5	0.501	0.254	0.547	0.491	0.511	0.446	0.375	**0.865**	-0.185	0.565
SE6	0.555	0.183	0.520	0.462	0.396	0.391	0.483	**0.885**	-0.115	0.576
SE7	0.389	0.222	0.242	0.361	0.218	0.244	0.291	**0.646**	0.205	0.325
SI3	0.058	-0.037	-0.017	0.029	0.012	0.068	0.109	-0.088	**0.830**	0.137
SI4	-0.025	0.011	-0.019	0.141	-0.007	0.013	0.005	-0.058	**0.993**	0.107
UB2	0.467	0.209	0.416	0.636	0.451	0.507	0.533	0.571	0.037	**0.897**
UB3	0.571	0.121	0.446	0.639	0.512	0.556	0.632	0.582	0.065	**0.885**
UB4	0.466	0.083	0.378	0.396	0.353	0.461	0.651	0.436	0.242	**0.817**

6.5 Testing the Structural Model (Inner Model)

6.5.1 Coefficient of Determination (R^2)

The Coefficient of Determination, also referred to as R-Square (R^2), represents one of the primary criteria for the assessment of the structural model by PLS-SEM. To be more precise, the R^2 value is the part of the variation in the endogenous variable to be described by one or more exogenous variables. According to Hair et al. (2011), R^2 measures have a fundamental role along with path coefficients significance level, as both can be considered as the central assessment of the structural model. They assert that it is necessary that primary target constructs have high values of R^2, as the goal of the PLS-SEM approach is to explain the endogenous latent variables variance.

As argued by Chin (1998), R^2 values less than 0.19 are unacceptable, values between 0.19 and 0.33 are weak, values between from 0.33 and 0.67 are moderate, while values greater than 0.67 are high. Hence, the values of R^2 are the basis of the quality of the structural model. According to the study results, all values of R^2 meet the Chin (1998) criteria. R^2 values of the endogenous latent variables are shown in Table 11.

Table 11: R^2 Value of the endogenous latent variables

	R2	Result
BI	0.463	**Moderate**
UB	0.508	**Moderate**

As shown by the results in Table 11, the R^2 value for UB is 0.508, which mean that the ability of the model's factors to explain UB are moderate, with 50.8 % of the variance in UB. Similarly, the ability of the model's factors to explain BI are moderate with 46.3 % of the variance in BI.

6.5.2 The Effect Size (f^2)

Following the evaluation of R^2, the effect of variables on R^2 was determined by assessing the effect size (f^2) to investigate whether the impact of a particular exogenous variable on an endogenous variable is substantial. As recommended by Hair et al. (2014), the following formula was used to compute f^2:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

Here, $R^2_{included}$ represents the case where the predictor exogenous latent variable is a part of the structural model, whereas $R^2_{excluded}$ refers to values when this particular exogenous latent

variable is removed from the structural model. The operational definition of multiple regression used by Cohen (1992) was employed as a criterion to decide if an exogenous predictor variable has large, medium, small, or no effect size (f^2). By this definition, any values less than 0.02 are regarded as having no effect, values between 0.02 and 0.15 are taken as having a small effect, values ranging from 0.15 to 0.35 are considered to have a medium effect, whereas values higher than 0.35 are regarded to be a large effect size. The f^2 values for this study are given in Table 12.

The values presented in Table 12 indicate that factors EE, AN, and AC do not have a sizeable effect on BI, whereas, the effect size of PE and ATT on BI is medium. Moreover, the effect size of FC and BI on UB was medium.

Table 12: The effect size results.

	BI	UB	Results
AC	**0.000**		**No effect**
AN	**0.012**		**No effect**
ATT	0.086		**Small effect**
BI		**0.327**	**Medium effect**
EE	**0.003**		**No effect**
FC		**0.150**	**Medium effect**
SE	0.063		**Small effect**
SI	0.039		**Small effect**
PE	0.024		**Small effect**

6.5.3 Predictive Relevance of the Model (Q^2)

Another criterion for assessing the quality of the structural model is predictive relevance, Q^2 (Chin, 2010). Predictive relevance is based on the assumption that the model must have the capacity to predict all indicators of an endogenous latent variable (Hair et al., 2011).

Accordingly, the blindfolding procedure was carried out to determine Q^2 by calculating the cross-validity commonality (cv-comm) and cross-validity redundancy (cv-red).

Blindfolding procedures use a predetermined distance value D to remove data from the data set. The D can take any value from 5 to 10 (Chin, 2010). It is required that the sample size, n, divided by D be a whole number. Therefore, the model parameters are estimated by the assumption of removing certain amounts of data and subsequently treating them as missing values. Nevertheless, blindfolding applies only in a case, such as this study, when the endogenous latent variables have reflective measurements (Hair et al., 2011; Henseler et al., 2009).

Cross-validity redundancy is supported by Hair et al. (2011) as it estimates both the measurement model and the structural model for data prediction, which is compatible with the PLS-SEM approach. Bagozzi (1994) argues that a value of cross-validity redundancy greater than zero ($Q^2 > 0$) implies predictive relevance. On the contrary, a value of Q^2 less than zero indicates a lack of predictive relevance of the model. As shown in Table 13, all cross-validity redundancies (Q^2) of the endogenous latent variables were greater than zero. Accordingly, this study model has an appropriate capacity for prediction.

Table 13: Cross-validity redundancies results.

	Q^2	Results
BI	0.241	**Q2 > 0 Explanatory variable provides predictive relevance**
UB	0.327	**Q2 > 0 Explanatory variable provides predictive relevance**

6.5.4 Goodness of Fit of the Model (GoF)

According to (Tenenhaus et al., 2005), goodness of fit (GoF) is a global fit measure. It denotes the geometric mean of the average of R^2 and AVE of the endogenous variables. Its purpose is to analyse the structural and measurement of study's model, while the focus is on the model's overall performance (Chin, 2010; Henseler & Sarstedt, 2013). As recommended by Hair et al. (2014), the following is the calculation formula for GoF:

$$\boldsymbol{GOF} = \sqrt{(\overline{\boldsymbol{R^2}} * \overline{\boldsymbol{AVE}})}$$

$$\boldsymbol{GOF} = \sqrt{(\boldsymbol{.485 * .709})} = \boldsymbol{0.586}$$

Table 14 provides criteria of GoF for determining if its values are regarded as small, medium, or large. Those criteria were proposed by Wetzels et al. (2009). The value of the GoF of this study is 0.586, which is sufficiently large to ensure global PLS model validity.

Table 14: GOF standard criteria.

GOF level	Value
Small	**0.10**
Medium	**0.25**
Large	**0.36**

6.5.5 Structural Model Analysis

Researchers can explore the relationships between dependent and independent constructs extracted from the measurement models (CFA models) using a structural model. Nevertheless, a relational or a hypothetical model must be developed for testing the relationships between the constructs before the analysis. The hypothetical model was proposed following real-world observations and the literature review. A path analysis was

performed on the hypothetical model to estimate the coefficients and significance of the relationships. Lastly, model fit indices were compared with recommended, standard fit indices to confirm model fit.

6.5.5.1 Collinearity Assessment

It is necessary to evaluate the structural model before coming to a conclusion. Collinearity can be a problem in the structural model. More precisely, a variance inflation factor (VIF) value of 5 and greater implies that there might be a problem (Hair et al., 2011). Table 15 summarizes the collinearity assessment results. As all VIF values are less than 5, it can be concluded that there is no indication of collinearity between sets of predictor variables.

Table 15: Collinearity statistics (VIF)

	BI	UB
AC	2.114	
AN	1.154	
ATT	2.014	
BI		1.432
EE	1.712	
FC		1.432
PE	1.873	
SE	1.981	
SI	1.009	

6.5.5.2 Structural Model Result

Previous sections have demonstrated that the measurement model has sufficient validity and reliability. In this section, the testing results of the proposed research model will be presented via structural equation modelling (SEM). The literature review has shown that the use of SEM in behavioural sciences research, and especially in the IT/IS field, is widespread (Gefen

et al., 2000). This is due to SEM researchers being able to examine the overall structural model as a whole.

This study used the Partial Least Square (PLS) method and the Smart PLS package to apply SEM. Fornell et al. (1990) points out that PLS is suitable for exploring complex relationships, and Wold (1985, p. 950) argued that PLS is the best method for exploring complex models with latent variables.

6.5.6 Hypothesised Structural Model

Following the literature of AT, the hypothesis of this study was that the independent constructs shown in Chapter 4 (Accessibility, Anxiety, Attitude toward using technology, Facilitating conditions, Effort Expectancy, Performance expectancy, Self-efficacy, Social influence) yielded nine relationships.

6.5.6.1 Hypothesis Testing

In the prevision sections, the results obtained when the model was tested as a whole were presented. Nevertheless, it is necessary to test the hypothesised conceptual model, as well as the relationships between factors, to explore the unique contribution of each variable to its related dependent variable. The aim of the hypotheses testing is to identify which independent variables (predictors), together or separately, meaningfully contribute to the explanation of the dependent variables. Figure 21 shows the path coefficients and *p*-values (in parentheses) for the relationship between model factors, which will be discussed in detail in the next section.

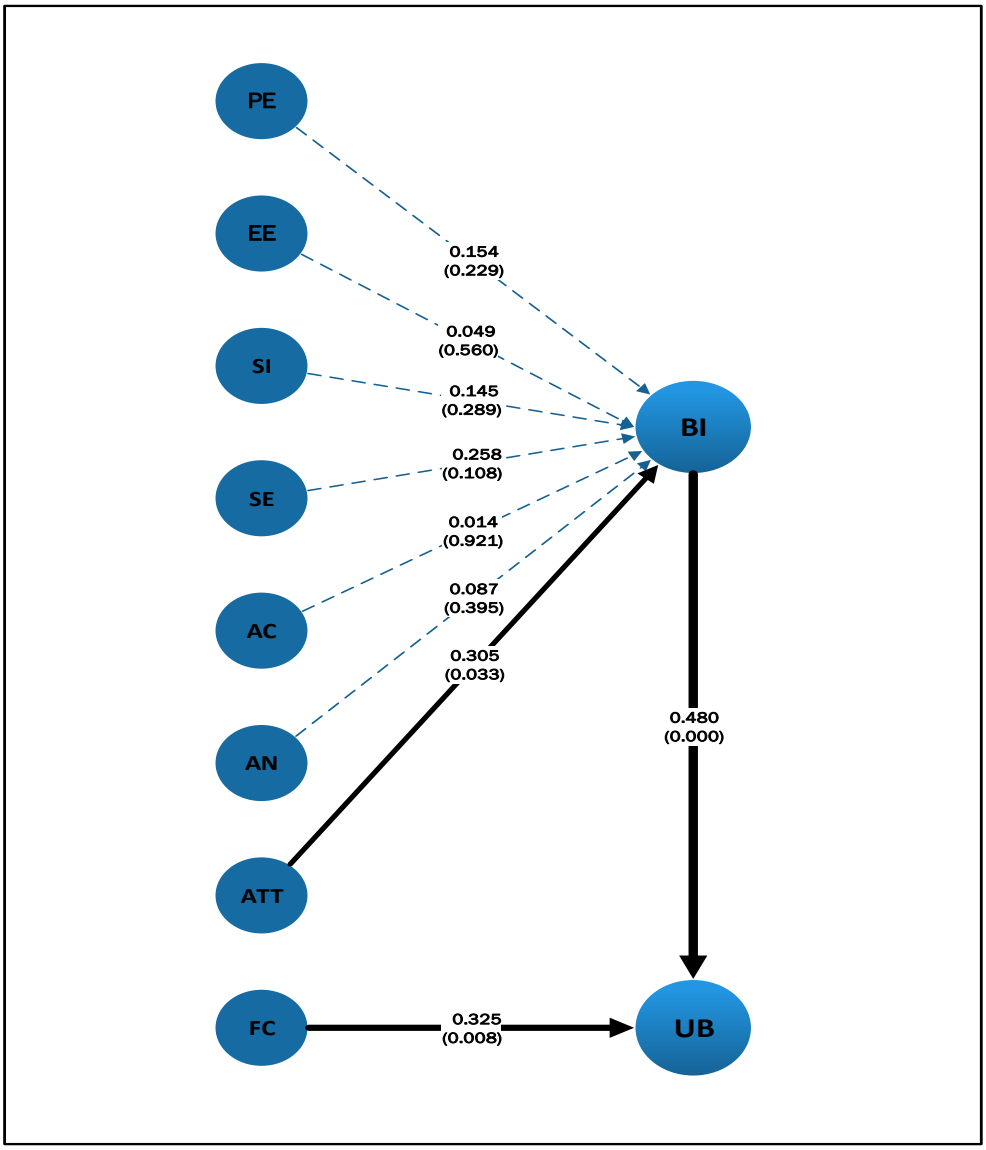


Figure 21: Inner model testing result

6.5.6.2 Inner Model Path Coefficient Sizes and Significance

Having established that the structural model is a good fit to the data, standardised path coefficients and p-values were examined to establish a basis for accepting or rejecting the hypothesised relationships. Table 16 summarises the inner model testing results shown in Figure 21 and the hypothesis associated with each model path. Hypotheses for which the p-

value of the corresponding path is greater than 0.05 are supported at the 5% confident level (Hair et al., 2016). By this test, the only hypotheses that are supported are H3, H4, and H6. In other words, the effect of both BI ($p<0.05$) and FC ($p<0.001$) on UB is significant, but the only variable that has a significant effect on BI is ATT ($p<0.01$).

Table 16: Hypothesis testing result

	Path (hypothesis)	Coefficient	*p* Value	Hypothesis testing result
H1	**AC -> BI**	0.014	0.921	Not supported
H2	**AN -> BI**	0.087	0.395	Not supported
H3	**ATT -> BI**	0.305	* 0.033	Supported
H4	**BI -> UB**	0.480	*** 0.000	Supported
H5	**EE -> BI**	0.049	0.560	Not supported
H6	**FC -> UB**	0.325	** 0.008	Supported
H7	**PE -> BI**	0.154	0.229	Not supported
H8	**SE -> BI**	0.258	0.108	Not supported
H9	**SI -> BI**	0.145	0.289	Not supported

*** Correlation is Significant at <0.001
** Correlation is Significant at <0.01
* Correlation is Significant at <0.05

6.5.7 Moderator Variables

The demographic factors, such as gender and age, can be important factors with statistical significance, as was found in the original UTAUT acceptance model by Venkatesh et al. (2003). They found that age, gender, and experience had significant influence in their model. The SmartPLS application analyses data without considering what the data means or represents, such as gender and age, which may result in misleading results (Hair et al., 2018). Hair et al. (2018) consider variables such as gender as heterogeneous data that needs to be analysed. Moreover, they suggest carrying out a multi-group analysis (MGA) to check the significant differences between groups. As this study has three moderator demographic

variables (gender, age, and experience) an analysis has been done to check the effects of these variables on the model relationships as discussed in the model chapter.

To check the differences between groups of data using SmartPLS 3 software, an approach has been implemented as recommended by Hair et al. (2016). First, the measurement invariance is established to ensure the invariability of measurement models across the groups.

A procedure called the measurement invariance of composite models (MICOM), described by Henseler et al. (2016), was used in SmartPLS 3 software to check measurement invariance. This procedure includes three steps: checking configural invariance, assessing compositional invariance, and assessing the equality of composite mean values and variances. These three requirements for checking measurement invariance were done per Hair et al. (2018). First, the configural invariance is established using the MICOM procedure by identifying groups. Second, compositional invariance is assessed by ensuring that the Permutation *p*-Values are greater than 0.05. Finally, the equality of composite mean values and variances are checked via Permutation *p*-Values being greater than 0.05.

In the second stage, the MGA approach is used to check for significant differences between groups. The p-value in the parametric test is checked and needs to be greater than 0.05 as per Hair et al.

The result of the moderator variables for this study are detailed in the following subsections.

6.5.7.1 Gender

Table 17 shows the result of the measurement invariance to check the invariability of measurement models across the groups. The result shows that the mean values of variables is not significantly changed across the two gender groups, which is confirmed by the *p*-value of all variables being greater than 0.05. This means that the measurement is invariant across gender groups.

Table 17: Summary of the MICOM results for gender.

MICOM Step 1				
Configural variance established?				Yes
MICOM Step 2				
Composite	**Correlation c**	**5 % quantile of the empirical distribution of cu**	**P-value**	**Compositional invariance established?**
PE	0.978	0.920	0.452	Yes
EE	0.976	0.933	0.383	Yes
SI	0.978	0.959	0.217	Yes
MICOM Step 3				
Composite	**Difference of the composite's mean value (= 0)**	**95 %. Confidence interval**	**P value**	**Equal mean values?**
PE	-0.051	[-0.427; 0.433]	0.819	Yes
EE	-0.035	[-0.430; 0.453]	0.915	Yes
SI	-0.235	[-0.425; 0.430]	0.272	Yes
Composite	**Logarithm of the composite's variances ratio(= 0)**	**95 %. Confidence interval**	**P value**	**Equal variances?**
PE	0.317	[-0.981; 0.978]	0.949	Yes
EE	0.481	[-0.635; 0.681]	0.941	Yes
SI	0.311	[-0.638; 0.633]	0.539	Yes

Table 18 shows the multi-group analysis results that indicate there are no significant differences between the two groups (male and female), as P-values for both PLS-MGA and

parametric tests are greater than 0.05. This means that there are no significant differences between male and female across relationships between variables.

Table 18: PLS multi-group results for gender.

PLS Multi-group Results Across methods				
Path Coefficient	**PLS-MGA**		**Parametric Tests**	
	Path Coefficient diff. (Male - Female)	**p-value (Male vs. Female)**	**Path Coefficient diff. (Male - Female)**	**p-value (Male vs. Female)**
PE → BI	0.115	0.687	0.115	0.613
EE → BI	0.126	0.674	0.126	0.655
SI → BI	0.216	0.829	0.216	0.323

6.5.7.2 Age

Five age groups were created during the instrument design to check for differences across different age ranges. However, the small size of the sample led to difficulty in implementing multi-group analysis across those five groups. According to Hair et al. (2014), a rule of thumb is to require the minimum sample size for each group to be equal to 10 times the number of groups. This would require a sample size of 50 in each group needed to implement the MGA, which is not the case for the survey data. Therefore, to evaluate the effect of age, age groups were merged to create two groups: Age $\leq$ 25; Age > 25.

Using the same multi-group analysis procedure used for gender, the differences between the two age groups was measured and the results are reported in the tables below. Table 19 shows that all P-values are greater than 0.05 across the two age groups, which means that the mean values of variables have not significantly changed across groups.

Table 19: Summary of the MICOM results for age.

MICOM Step 1				
Configural variance established?				Yes
MICOM Step 2				
Composite	**Correlation c**	**5 % quantile of the empirical distribution of c_u**	**P-value**	**Compositional invariance established?**
PE	0.991	0.928	0.758	Yes
EE	0.997	0.939	0.811	Yes
SI	0.985	0.951	0.376	Yes
FC	0.997	0.990	0.442	Yes
MICOM Step 3				
Composite	**Difference of the composite's mean value (= 0)**	**95 %. Confidence interval**	**P value**	**Equal mean values?**
PE	0.191	[-0.424; 0.480]	0.412	Yes
EE	0.206	[-0.424; 0.429]	0.360	Yes
SI	-0.275	[-0.406; 0.443]	0.194	Yes
FC	-0.218	[-0.425; 0.442]	0.306	Yes
Composite	**Logarithm of the composite's variances ratio(= 0)**	**95 %. Confidence interval**	**P value**	**Equal variances?**
PE	-0.121	[-0.635; 0.676]	0.617	Yes
EE	-0.088	[-0.771; 0.875]	0.649	Yes
SI	0.149	[-0.632; 0.624]	0.438	Yes
FC	0.380	[-0.747; 0.798]	0.597	Yes

Table 20 shows the result of MGA for the two age groups. Because the P-value for both PLS-MGA and parametric tests are greater than 0.05, there are no significant differences between the two groups. Therefore, there are no significant differences between participants aged 25 years old or younger and those participants aged older than 25 years.

Table 20: PLS multi-group results for age.

PLS Multi-group Results Across methods				
Path Coefficient	**PLS-MGA**		**Parametric Tests**	
	Path Coefficient diff. (Age1- Age2)	**p-value (Age1-Age2)**	**Path Coefficient diff. (Age1- Age2)**	**p-value (Age1-Age2)**
PE → BI	0.127	0.649	0.127	0.696
EE → BI	0.243	0.079	0.243	0.184
SI → BI	0.108	0.287	0.108	0.617
FC → UB	0.244	0.843	0.244	0.356

6.5.7.3 Experience

This variable contains 3 items including beginner, intermediate and advanced. Because these elements are discrete, they cannot be redistributed to create groups with sample sizes large enough (at least 30 as per rule of Thumb) to satisfy the MGA procedure in SmartPLS. Therefore, since two of these groups (beginner and advanced) contained less than 30 participants, it was not possible to perform MGA.

6.6 Summary

The quantitative results showed that as expected there were significant relationships between ATT and BI, BI and UB, as well as between FC and UB. In addition, they showed some unexpected results. It was expected that the data would show strong relationships between BI and each of PE, EE, SI, AC, AN, SE, but those relationships were not significant. Therefore, as explained in Section 5.3.1, the qualitative study was re-oriented to follow up these results and obtain explanations of the unexpected results, as well as to further provide a deeper understanding of the quantitative results. The next chapter describes the qualitative study in detail.

Chapter 7 : Qualitative Data Analysis and Results

7.1 Introduction

A qualitative study was conducted to supplement the quantitative results and to obtain deeper insight and explanations. This approach can help explain unexpected and interesting results obtained from the quantitative study, such as when the data contradicted the hypotheses.

Nine semi-structured interviews were conducted with both visually impaired students in Saudi universities (users) and individuals who work in the disability units of Saudi universities and who have experience in dealing with visually disabled students (experts). Participants were affiliated with five of the six universities that were identified as having disability units. Targeting both groups enabled perspectives to be obtained from a wider spectrum: users can provide insights about the particular strengths and weaknesses of the AT they personally use on a daily basis, and domain experts are better placed to address big-picture issues.

Attempts were made to obtain more participants in the interviews by sending follow up e-mails to the heads of disability centres in Saudi universities asking them to encourage potential participants to participate in the interviews and pointing out that outcomes of this study are expected to benefit disabled students in Saudi universities. The time period for conducting the interviews was extended to give the opportunity for the largest possible number of participants to participate.

Table 21 shows demographic information for the nine interviewees.

Table 21: Interviewee demographics

Participant	User / Expert	Experience with AT
1	User	11 years
2	Expert	5 years
3	User	6 years
4	User	5 years
5	User	8 years
6	Expert	12 years
7	User	6 years
8	Expert	15 years
9	Expert	9 years

The demographic information shows that interviews were conducted with both users and experts.

7.2 Data Reliability, Validity and Credibility

Checking reliability and validity is an important step in the qualitative analysis. To elevate the validity of qualitative research, many academics and individuals continue to believe this avenue of research introduces the researcher's conscious or unconscious bias into results (Sofaer, 1999). Gluud (2006, p. 497) accords with this perception stating "selective or delayed publication of the findings of trials with unwanted results seems to be a widespread problem." With this criticism in mind, in order to establish validity it is necessary for

researchers to objectively present results and to desist from moulding results to suit their or other`s agenda or preconception (Sofaer, 1999). Klein and Myers (1999) published what they regard as seven principles which are of particular relevance for information system researchers, in order to enhance validity and reliability through the minimisation of study bias: the hermeneutic circle, contextualisation, interaction between the researchers and the subjects, abstraction and generalization, dialogical reasoning, multiple interpretations, and suspicion.

According to Emory and Cooper (1991), participants should be asked to repeat key points from the interviews at the end of the interviews in order to check reliability. Another technique to improve validity and reliability is for an interviewer to provide interviewees with a transcript of the interviews for verification (Alanezi et al., 2012).

In this study, the above two techniques were merged and used in a different way in order to check reliability because most of the participants are visually impaired students. The interviewer read a summary of the interview for each interviewee at the end of the interviews and asked him if that what is he meant. As recommended by other researchers such as Emory and Cooper (1991), important issues raised in earlier interviews were followed up with subsequent interviewees. The reliability of the results was ascertained by cross-case analyses, which showed that there was a recurrence of many of the ideas across participants. Data validity was checked by comparing the interview findings with the quantitative findings, as recommended by Sekaran (2003).

To ensure data accuracy, each interview was transcribed and then the transcription was compared with the sound recording to confirm that it was free of errors. Also, the

transcription was compared with hand-written notes made by the interviewer during the interview to ensure that the ideas captured in the transcript and notes agreed.

According to the Creswell (2012), researchers can check the credibility of their findings and interpretations through strategies such as triangulation, member checking and auditing. Triangulation is a method of establishing credibility by corroborating evidence from different sources such as different types of participants, different types of data or different methods of data collection (Creswell, 2012). Member checking enhances credibility by providing research participants with information such as interview transcripts or research findings and inviting them to comment on completeness or accuracy (Creswell, 2012).

In this study credibility was confirmed through both triangulation and member checking procedures. Triangulation was incorporated by comparing answers to interview questions from the two different types of participants (users and experts). Member checking was incorporated by having the researcher read a summary of the discussion with each interviewee at the end of the interview, and asking the participant whether the summary was complete and realistic.

7.3 Qualitative Data Analysis

This section will discuss the qualitative study results obtained from the semi-structured interviews and how these results add to the quantitative study results.

This research adhered to (Denscombe, 2007) four guiding principles used to analysis semi-structured interviews:

1. Data analysis and consequential conclusions must be specifically drawn from the collected data.

2. The researcher's interpretation of the data must be based on its meticulous analysis.

3. Researchers should not introduce preconceptions into the data analysis.

4. An iterative process should be applied to data analysis.

During this study, a process was followed to analysis the semi-structured interviews. The interviews were transcribed in Arabic, which is the main language of the interviewees, by the researcher. The resulting transcripts were carefully read for verification and accuracy. The transcripts were analysed to determine how far they confirmed the quantitative study results and to search for interpretations, explanations and deeper understandings of what was already known from the study's earlier quantitative phase. Quotes were selected and translated into English by a professional translator, and have been checked for accuracy by the researcher.

7.3.1 The Effect of PE and EE on Behavioural Intention

Consideration of performance expectancy and effort expectancy have been merged into this section since most interviewees believed both have the same results and explanations. Eight of the nine interviewees thought that expectancy of performance and effort should have a significant influence on the users' behavioural intention, which is contrary to the results obtained from the quantitative study. They provided several explanations for why this relationship was not found to be significant.

The first explanation, suggested by five participants, is that due to the benefits and the importance of the AT in their daily activities and lifestyle, users may have decided to use AT regardless of the expected performance or effort. Users need to use AT in their study to be

able to communicate with others. This means they focus on the need and usefulness of AT in their life and do not care about performance and effort.

In regard to this explanation, Participant 2 said:

> *"As an explanation of the results that you have obtained, that could be because some users use those technologies for daily activity rather than use it in their study, so they don't feel that using these technologies will help them in improving their performance or decrease their effort in the study. Also, another explanation could be that they believe that using these technologies is important regardless of the performance or effort expectancy".*

Similarly, Participant 3 commented:

> *"I believe that these two factors should be significantly related to the behaviour intention to use AT. However, some users could disagree with my opinion because they believe that they intended to use the AT regardless of the performance they will get or the effort they will put in due to the great benefit of it. Therefore, they feel it is important to use it".*

In addition, Participant 5 confirmed:

> *"Some users use the AT just for fun. They don't use it for their study and they use the traditional tools such as books printed in Braille language. So, they don't have an idea about performance or effort expectancy of using these technologies in their study".*

Participant 7 asserts:

> *"I believe, using ATs is important in my daily lifestyle and I am using it every day to do most of my jobs, not just the study. Therefore, in my opinion,*

expecting a good performance or expecting less effort in my study by using it will not influence my acceptance of the AT".

Furthermore, Participant 9 states:

"In my opinion, these factors would not affect user's intention to use AT because users need to use these technologies even if they do not expect a good performance or less effort in their study by using it, as it has become a key tool to help them to communicate with others and for conducting their daily activities."

Three interviewees suggested that another explanation is that some users do not use AT in their study because of lack of training on how to use it, which may mean they see no correlation with performance or effort expectation.

Participant 6 confirmed this explanation saying:

"I believe these factors are important and related to user's intention to use the ATs. However, I can expect some explanations why many users feel those factors are not related to their intention to use the ATs. First, lack of student training for how to use these technologies in the study can lead to not using it for their study, which makes them think that expecting a good performance or less effort does not affect their intention to use the AT".

In addition, Participant 8 stated:

"The lack of training for users in how to use the AT can be to blame".

One interviewee suggested that another reason why AT is not being used in their respective studies is due to the lack of compatibility with the educational system management at the

Saudi universities. The educational environment and the study resources are unfit and not compatible with the AT. Participant 6 confirmed:

> *"Some lecturers are not aware of people's needs so they don't provide material compatible with the AT. This compels those students to use the traditional methods such as asking someone to read the material for them. And therefore, students will not use these technologies in their study".*

Finally, the lack of universities' staff awareness about the visually disabled student needs was suggested by two interviewees as another reason why AT may not be utilized in the students' study.

Participant 8 confirmed:

> *"I think there are some reasons that lead these factors to become not significantly related to the users' intention to use the AT. One reason is the lack of awareness of users of the AT' benefits in their study. In addition, most of the lecturers are not qualified to deal with disabled people and they don't provide them with suitable support and materials. Because of the reasons above, users can't use this AT in their study and they don't think that this AT would be useful in their study".*

7.3.2 The Effect of SI on Behavioural Intention

The results of interviews show that most participants believe that social impact is one of the most important factors if issues related to community awareness are considered, with seven of the nine interviewees expecting that this factor should have a strong impact on users' intent to use assistive technologies. This is the opposite of what the quantitative results showed. Interviews were asked to suggest why the quantitative results showed that the social influence did not significantly affect the intention of users to use assistive technologies.

An explanation offered by four interviewees is lack of confidence of visually impaired users in the ability of their friends, family and society to help them decide on the technologies. Friends and families lack awareness of how visually impaired individuals use AT. Lack of knowledge on the suitability and benefits of AT, as well as limited family consultation centres for the visually impaired student's family, are all related to why there is a lack of confidence for the visually impaired to use the technology.

In this regard, Participant 9 said:

> *"The social influence could be one of the important factors because family and friends can help the disabled user to accept and adopt the AT in his or her study, but in some cases, this cannot happen because the society, including user's family and friends, need to have more education about the disabled needs and how they can cope with their psychologically sensitive situation".*

Similarly, Participant 6 asserts:

> *"The social influence can be an important factor affecting users' intention to use AT. However, in the case of visually impaired users, especially in Saudi Arabia, I think that the social influence would not affect users' intention to use the AT because of many reasons. One of them, the lack of families' and friends' awareness about the disabled users' situation needs, which leads to lack of trust in their ability to help them in decision making and, therefore, they believe that their family and friends do not influence their decisions to use the AT".*

Also, Participant 7 states:

"I believe people around the disabled person are not aware of his or her situation. This makes most people with a vision disability to make their decisions by themselves without reliance on others".

Moreover, Participant 8 said:

"In my opinion, this is an important factor because society, especially family, can play a significant role in the users' acceptance of AT. For example, my disabled brother refused to use this AT, but for a period of time I could persuade him to use it and now he is a professional user. But, I believe many families have no effect on the disabled person's decision in regards of using the AT because of reasons such as the lack of those families' awareness about the disabled person's needs, the lack of their knowledge of the benefits of using this AT, and the lack of the special consultation centres that support families in this regard".

Another reason offered by five interviewees is that the visually impaired are psychologically sensitive and they do not like to feel sympathy from others, even from family or friends. Therefore, to avoid others' negative feelings, they try to make their own decisions without consulting them, and they also try to prove to others that they have high confidence in themselves and they have the ability to make their own decisions.

Participant 6 confirmed this explanation saying:

"Another reason can limit the influence of the social influence on the users' intention to use the AT is that, some friends have incorrect views toward the disabled person's ability in doing daily activities and jobs (such as they think this person can't do anything without obtaining help from someone). This could create a negative attitude toward those friends, and thus he or she will not allow them to participate in decision making".

Participant 6 added:

> *"Most disabled people usually feel high confidence. Therefore, they try to prove to others that they have the ability to make their decisions as normal people. They do this to avoid others' negative feelings as we explained previously".*

7.3.3 The Effect of SE on Behavioural Intention

Seven of the nine interviewees were not surprised that self-efficacy had no effect on the users' intention to use the AT and suggested that most visually impaired students believe that disability gives them the motivation to learn and use technology that will improve their daily life. This makes them feel that they have sufficient ability and self-efficacy to use assistive technologies and, even if they do not have sufficient self-efficacy, they will try to develop their competence to help them use the AT because it is important to them.

Participant 2 confirmed this saying:

> *"Most of the students that I have daily contact with have good belief in their self-efficacy, so they like the challenges and they don't feel like giving up. This can lead to the conclusion that they feel they have the ability to use the AT and they feel self-efficacy will not stop them from using it".*

Also, Participant 6 asserts:

> *"Most disabled users have high confidence because they try to prove to others that they have the ability to do their jobs as normal people. Because of that, they think self-efficacy doesn't affect their intention to use AT".*

Similarly, Participant 5 confirms:

"I think visual disability gives students motivation to overcome challenges and difficulties. This is why most of them feel more self-confident. Because of that, they don't feel that self-efficacy will affect their intention to use AT".

Additionally, Participant 7 states:

"I feel that I have the ability to learn and do any job that I need. Even if I don't have self-efficiency I will try my best to learn sufficient knowledge that helps me to use any AT because it is important to me. So, I don't think this factor will affect my intention to use the AT".

Furthermore, Participant 9 asserts:

"I believe that disabled users are psychologically sensitive, therefore, even if they feel they are not self-sufficient enough to use the AT, they will self-train themselves to use it instead of avoiding it, in an effort to avoid negative comments from others".

Participant 4 claims:

"I think users should use these technologies even if they are not self-confident because they need to get benefit from it".

7.3.4 The Effect of AN on Behavioural Intention

All nine participants agree that the anxiety of using the AT would not be likely to affect the user's intention to use it. One possible explanation, offered by four participants, is that users were not likely to find the technology threatening and so did not experience any anxiety while using it.

Participant 8 confirms this explanation saying:

> *"I think this factor is not affecting users' intention for using AT because most of the users feel there is no serious anxiety that can change their decision in using this AT".*

Similarly, Participant 5 confirmed:

> *"I do not feel anxiety while using AT and I think it's not related to the intention to use AT".*

Participant 7 asserts:

> *"I have used the AT for more than 6 years and I didn't feel any anxiety while using it".*

Participant 6 also states:

> *"The feeling of high confidence of disabled people make them to not feel the anxiety of making mistakes. This means they don't think the factor can affect their intention of using AT".*

Three participants thought that there may be anxiety in the use of the AT the first time, but this anxiety does not seriously affect users' intention to use the AT because they can overcome it.

In this regard, Participant 7 asserts:

> *"I believe that anxiety is not an important factor that could affect the user's intention to use the AT. Also, I think users can overcome it easily".*

Moreover, Participant 1 asserts:

> *"Users can feel anxiety the first time they use the AT, but after that, they don't feel any anxiety and that will not affect their intention to use it".*

In addition, Participant 4 said:

> *"I think anxiety disappears with more experience in using AT, therefore this factor will not affect users' intention to use the AT"*

Four participants believe that anxiety does not affect users' intention to use the AT because they care about the benefits and the importance of using this AT in their daily activities, and will therefore will use it even if they feel anxiety while using it.

Participant 1 confirms:

> *"Users will continue to use the AT even if they feel scared of making mistakes because of the huge benefit of this AT in their life".*

Moreover, Participant 3 asserts:

> *"I believe this factor does not affect my intention to use the AT because I don't care about making some mistakes while using the AT. I will still use it because it is important to me and it helps me within my daily life activities".*

Also, Participant 9 confirms:

> *"Most disabled users do not feel anxiety while using the AT because they know how much this AT is important for their life, so they feel this factor would not affect their intention to use it".*

Similarly, Participant 2 asserts:

> *"I think this factor cannot affect users' intention to use the AT, as using these technologies is more important than the anxiety of using it. Therefore, users may decide to use it even if they will make some mistakes"*

7.3.5 The Effect of AC on Behavioural Intention

The interview data shows that eight of the nine participants believed that accessibility will not affect the user's intention to use the AT. Seven interviewees suggested that this was because most users use the AT on smartphones, which are available to use anywhere, anytime. Therefore, because of the easy access to this AT, they think this factor will not affect their intention to use the AT.

Participant 2 confirms this explanation saying:

> *"Most of the users have easy access to AT on their smartphones. This would make them feel that this factor does not affect their intention to use the AT".*

Also, Participant 9 said:

> *"In regard to the accessibility of the AT in general, users have easy access to this technology as they use the AT on smartphones, which is available anytime everywhere".*

Moreover, Participant 7 states:

> *"I feel there is no difficulty in accessing the AT as I use it on my smartphone and if I face any difficulty I will ask someone to help me. Also, this will not affect my intention of using AT.*

Furthermore, Participant 5 confirmed:

> *"Because I use AT on my smartphone to do all of my work and study jobs, I feel the accessibility is not affecting my intention to use AT".*

Moreover, Participant 8 asserts:

> *"Nowadays, the accessibility becomes easier because of the use of the AT on smartphones, which are available to users anytime. This may lead users to feel this factor does not affect their intentions to use the AT".*

Two interviewees also pointed that some Saudi universities provide visually impaired students assistive technology devices such as "Braille Sense" for free to be used by those students while they study at university. This can also help them to obtain easy access to use this AT any time they need this technology.

In regards to this, Participant 1 confirms:

> *"My University provides each student with "Braille Sense" for free, which students can use everywhere, anytime. This makes them to not feel any difficulty in accessibility for using the AT".*

Similarly, Participant 4 asserts:

> *"My university provides me with a "Braille Sense" device. This makes me feel this factor is not important"*

7.3.6 The Effect of ATT on Behavioural Intention

The interview data shows that all but one of the nine interviewees believe that the users' attitude toward using technology would have a significant influence on the users' behavioural intention, which agrees with the results obtained from the quantitative study. They felt that

negative attitudes towards technology may negatively affect the intention of the user to adopt and accept the AT. Conversely positive attitudes towards technology will positively affect the intention of the user.

Participant 2 asserts:

> *"Of course, a negative attitude toward technology will negatively affect the user's intention to use the AT, while a positive attitude toward technology will positively affect the user's intention to use the AT".*

Moreover, Participant 7 states:

> *"I believe the users' intention to use the AT will be affected by either negative or positive attitudes toward the technology".*

In addition to that, Participant 5 said:

> *"I think this factor affects the user's intention to use the AT because I feel that one of the factors that increased my intention to use the AT is that I care about exploring new technology, and I like to use technology in general".*

Also, Participant 8 confirmed:

> *"I expect the negative attitudes experienced by some users in regard to technology generally may lead them to hesitate in intending to use the AT".*

Furthermore, Participant 1 confirms:

> *"I believe the attitude toward technology can affect user's intention to use the AT. For example, I used to like using the technology before I got the disability. I think this gave me a motivation to use the AT after I acquired my disability".*

Participant 6 asserts:

> *"Having a positive attitude toward technology may lead to increase the users' intention to use the AT, and also the negative attitude can lead to decrease in the intention of the users to use the AT. For example, users that think using AT will be more fun may intend to use the AT more than those who think using it will be boring".*

Also, Participant 3 confirmed:

> *"This factor certainly affects the user's intention to use the AT, where users who have negative attitudes toward technology may not use the AT".*

7.3.7 The Effect of FC on Use Behaviour

All of the interviewees believed that facilitating conditions are an important factor and plays an important role in the actual usage behaviour of the AT user, which agrees with the result obtain from the quantitative study. They believe that providing the necessary facilitating conditions, such as necessary resources and knowledge to use the AT, would positively affect the actual usage behaviour of the AT, while the lack of facilitating conditions will negatively impact the user in using the AT.

In this regard, Participant 4 confirmed:

> *"I believe the facilitating conditions are important because it can affect the user's actual use in either a positive or negative way".*

Also, Participant 9 states:

> *"In my opinion, providing important resources and knowledge that help users to use the AT is an important factor and would help increase the actual use of the AT".*

Moreover, Participant 6 asserts:

> *"Of course, this factor will affect the users' use of the AT as they cannot use the AT without provision of the necessary facilitating conditions that help educate them on how to use it. Without these facilitating conditions, the AT use will decrease".*

Participant 1 said:

> *"I believe the user's actual use of AT will be positively affected by the provision of the facilitating conditions. Also, any limitations in these facilitating conditions will result in an impact of the use of the AT users".*

Participant 2 also clarifies:

> *"I think this factor is related to the use of the AT, where the actual use of the AT will increase if the necessary conditions have been provided in order to use this AT".*

Similarly, Participant 7 justifies:

> *"Of course, the necessary conditions are important to help users to regularly use the AT, as it provides them the necessary knowledge to use the AT".*

Participant 3 confirmed:

> *"If the necessary conditions to use the AT have been provided, this will help users to accept this AT and to use it continuously. This means these facilitating conditions can increase the users' use of the AT".*

7.3.8 The Effect of BI on Use Behaviour

Logically, a user's intention to use a technology would affect their usage behaviour of this technology. This is exactly what the quantitative study found, and it was confirmed from the interviews, where all participants emphasized that the behavioural intention to use assistive technology strongly affects the usage behaviour of this AT.

Participant 8 confirmed:

> *"Definitely, a user's intention will affect the user's actual usage of the AT whether it has a positive or negative outcome".*

Similarly, Participant 4 states:

> *"I believe the increase in my intention to use the AT will be reflected positively in my daily usage of the AT".*

Moreover, Participant 9 confirms:

> *"I think the user's actual usage of the AT will be affected by the intention of this user. Where users that have a strong intention to use that AT, they will use the AT more regularly than those who have less intention to use the AT".*

Also, Participant 5 asserts:

> *"I think that the strong intention to use the AT will lead to increasing the user's actual usage of AT".*

Furthermore, Participant 6 states:

> *"I believe the user's behavioural intention to use the AT has a significant relationship with the user's actual usage of AT because it is logical that a user who intends to use the AT will use it regularly".*

7.3.9 Summary of Interviewee Opinions

Table 22 summarises the issues suggested by interview participants that may help explain why factors investigated in the AVISSA model were not found to significantly affect behavioural intention (BI). An asterisk in the table indicates that the issue in that row was proposed as an explanation for the indicated acceptance factor by interviewee in that column. For convenience, the table also indicates whether each interviewee was a user (U) or expert (E), and their number of years of experience with AT.

Table 22: Summary of interviewee opinions

		Interviewee									
		1	2	3	4	5	6	7	8	9	
		U	E	U	U	U	E	U	E	E	group
Explanation	Factor	11	5	6	5	8	12	6	15	9	years
Importance of AT	PE/EE		*	*		*		*		*	
No training in AT use	PE/EE				*		*		*		
AT Incompatibility with uni systems	PE/EE					*					
Uni staff unaware of AT	PE/EE						*		*		
Others unfamiliar with AT	SI						*	*	*	*	
Psychological sensitivity	SI	*	*	*			*			*	
Self-confident and motivated	SE		*	*	*	*	*	*		*	
AT not threatening	AN					*	*	*	*		
AT problems easy to overcome	AN	*			*			*			
Importance of AT	AN	*	*	*						*	
Most AT is smartphone based	AC		*	*	*	*		*	*	*	
AT Provided by uni	AC	*			*						

7.4 Summary

The interviewees suggested a number of factors that may help explain the result of the qualitative study including the importance and the need of assistive technology, the psychologically sensitive situation of visually impaired students, the lack of society's awareness about AT, the lack of training, the lack of compatibility of the Saudi universities educational management system with the AT, and the lack of universities' staff awareness about the AT. These new factors suggest that the context of this study is different than the context of other studies on the acceptance of technology across different fields. This, therefore, confirms the importance and the need for this study to determine the specific factors of AT acceptance for the Saudi context. These findings will be discussed broadly in the next chapter.

Chapter 8 : Discussion

8.1 Introduction

The main objective of this research is to investigate the factors influencing the use of assistive technology (AT) by visually impaired students in Saudi universities in an attempt to identify solutions that could help to increase acceptance and adoption of these technologies. A quantitative study was carried out to ascertain the relationship between the variables of the study, and a qualitative follow-up study sought detailed explanations and a deep understanding of the results obtained in the quantitative study. This chapter contains a discussion of the results of the quantitative and qualitative studies to provide a clear and detailed picture of the findings, which helps to understand them more deeply and accurately. For convenience, the chapter begins with a summary of the findings presented in previous chapters.

8.2 Summary of Findings

The research framework underlying this research is an extended version of the unified theory of acceptance and use of technology (UTAUT). The original UTAUT model suggests that use behaviour (UB) for a technology is influenced by the potential users' behavioural intention (BI) and by facilitating conditions (FC), and that BI is in turn influenced by performance expectancy (PE), effort expectancy (EE), and social influence (SI). For this study, where the focus is on assistive technology use by visually impaired Saudi students, the model was extended to investigate the effect of four additional factors on BI: accessibility

(AC), self-efficacy (SE), anxiety (AN), and attitude to technology (ATT). Chapter 4 discusses the research framework and additional factors in detail.

The qualitative study was conducted by surveying visually impaired students in Saudi universities. The study concluded that some of the hypothesised relationships between variables were confirmed while others were rejected as having no significant effect on the acceptance and use of assistive technologies by the target audience. In particular, the quantitative study confirmed that the behavioural intention (BI) of visually impaired Saudi students in regard to the use of assistive technology is influenced by their attitude to technology (ATT), and that their use behaviour (UB) is influenced by BI and by facilitating conditions (FC). However, the study found that, in contrast to some previous studies in other domains, there was no significant effect on BI of performance expectancy (PE), effort expectancy (EE), social influence (SI), self-efficacy (SE), accessibility (AC), or anxiety (AN).

To follow up the quantitative study and seek explanations for the difference between these results and those of others, the qualitative study was conducted using semi-structured interviews with both visually impaired students in the Saudi universities (users) and individuals who work in the disability units in Saudi universities and who, therefore, have experience in the use of assistive technologies (experts).

From the interview discussions, two explanations emerged as to why BI for the target audience was not significantly influenced by either PE or EE:

- Because AT is so important to the daily lifestyle of visually impaired students, they will use it regardless of the expected performance or effort.
- Even though visually impaired students use AT in their daily lives, poor support for AT inside some universities means that they are simply unable to use it for their study. Suggested aspects of poor support included lack of training, staff unawareness, and incompatibility of university systems with AT.

Similarly, interviewees suggested two explanations for why social factors did not significantly influence BI:

- Since most family members and friends of visually impaired students are not themselves visually impaired, they may be unaware of the benefits of AT or the needs of its users.
- Visually impaired university students are often confident in their ability to make decisions for themselves and are therefore less dependent on the opinions of others.

Interviewees were unsurprised that neither self-efficacy nor anxiety significantly affected BI because most visually impaired students see the benefit of AT for their daily life and are, therefore, highly motivated to learn how to use it and quickly overcome any anxiety. Finally, interviewees pointed out that since most users in the target audience use smartphone-based AT, accessibility is rarely an issue, which means that a significant effect on BI would be difficult to detect.

8.3 AT Acceptance for Visually Impaired Students in Saudi Arabia

The results of the qualitative study show that some of the factors that played a significant role in influencing technology acceptance in other contexts were not significant in the context of this study, where the focus is on acceptance of assistive technology by students with visual disabilities in Saudi universities. This section discusses reasons for these differences as suggested by interview participants. The discussion is organised under several themes that emerged from the interviews.

8.3.1 Dependence on Assistive Technology

Assistive technology provides a way for individuals with visual disabilities to interact with the outside world and to help themselves to live their lives as independently as possible, which in turn helps them to increase their self-confidence and integrate into society. Indeed, given the importance and great utility of these technologies in daily life, many visually impaired people believe that acceptance and adoption of this technology is essential.

Many studies have confirmed the importance of AT for visually impaired individuals. For example, Linda et al. (2018) found that visually impaired individuals consider that the use of assistive technologies on a daily basis is very important in reading, writing, and mobility, and that people with visual impairments are often more dependent on assistive technology than are people with other disabilities.

The relationship between the importance of AT to disabled users and their adoption and use of technology is consistent with a study by Fakrudeen et al. (2017), which considered the use of technology by school students in Saudi Arabia and found that disabled secondary students

use technology more than disabled primary students, largely because secondary students are more familiar with the technology. Although Fakrudeen et al. didn't investigate university students explicitly, the comments from interview participants in the current study suggest that students with disabilities at the undergraduate level are even more self-sufficient in their use of technology than are school students, perhaps because of their experience in using the technology over a longer time.

Interview participants were of the opinion that the importance of AT to visually disabled students may help explain why the quantitative study did not find that several UTAUT factors were significant determinants for behavioural intention (BI) for this cohort of users. In particular, they felt that because visually disable students see AT as essential to their daily life, they are likely to use the technology for their study even if they do not have high expectations of its performance (PE) or if they find that it requires significant effort to use (EE).

Interview participants also suggested that the same effect might explain why there was no significant effect of either self-efficacy (SE) or anxiety (AN) on BI: students will be motivated to master the technology even if it requires considerable commitment on their part, or even if they are initially anxious about use of the technology.

8.3.2 Limited Awareness of Visual Disability

Although most adults are broadly aware of disabilities and many would know of someone who is disabled, unless they themselves are disabled it is unlikely that most people have a detailed awareness of the needs of disabled people or the importance and benefits of assistive technologies. This lack of understanding is perhaps especially true for visually disabled

people, because many people take sight for granted and find it difficult to imagine what it might be like for those who lack it. Indeed, it is unlikely that even close friends and immediate family members of visually disabled individuals will fully understand the needs or fully realise the importance and benefits of AT.

Others have investigated the general community's limited awareness of disability and of the benefits of AT. For example, Down and Stead (2007) found that there is inadequate awareness of how ATs can provide an opportunity for independent living, and Al Rub and Al Ahmed (2014) found that one of the difficulties that hinders students with disabilities is the lack of specialised counselling centres to provide family and friends of disabled students with advice on ATs.

Interview participants felt that society's lack of awareness about the needs of disabled people and lack of knowledge about the importance and benefits of ATs for those with disabilities may make users with visual impairment less inclined to be influenced by people around them, including family and friends, with regard to the use AT. This could help explain why the quantitative study did not find a significant relationship between behavioural intention (BI) and social influence (SI).

From the interviews it was clear that most interviewees thought that, with regard to technology acceptance in general, social influence *would* be expected to influence behavioural intention. However, for AT acceptance by visually impaired students, they were unsurprised to see that it *was not* significant. They pointed out that the social circle for visually impaired students often includes many non-disabled people who are themselves unlikely to have any first-hand experience of AT. When considering use of AT, interviewees

felt that visually disabled students would be likely to rely more on the opinions and advice of experts (and, of course, of any in their social circle who are also visually disabled) and less on the views of their wider circle of family and friends.

8.3.3 Psychologically Sensitive of Disabled Users

Interview participants also identified the psychological sensitivity of disabled users as a factor that may help explain the results of the quantitative study. They felt that disabled people may be strongly influenced by what they perceive as pity or sympathy from others, even if it comes from friends or family and is well intended. For example, if friends or family show compassion towards a disabled user because of their disability the user may be embarrassed. Interviewees felt that this effect may be particularly strong in Saudi Arabia, where there is a culture where it is thought that disabled individuals cannot do anything by themselves or without obtaining help from others.

The importance of psychological support for disabled students was reported by Salend (2005) and Shapiro (1999), as cited by Alquraini and Gut (2012). The studies emphasize the need to support the family of students with visual disabilities, pointing out that the family often plays a major role in maintaining the psychological welfare of the students.

The result can be that disabled users of AT are more inclined to make their own decisions about matters that arise out of their disability, hoping to minimize their reliance on others. For example, a visually disabled user might not wish to involve friends or family in choosing or adopting AT for their study. This in turn could help explain the finding that the behavioural intent (BI) of visually impaired students concerning AT was not significantly affected by self-efficacy (SE). Even if users were not initially confident in their use of AT,

their determination not to rely on others may have motivated them to seek the information they needed and gain the skills they lacked.

8.3.4 Availability of AT in Saudi Arabian Universities

Discussion with interview participants also identified several problems with availability of AT in the Saudi context that are likely to affect the adoption of ATs by university students. Although these issues are about availability rather than acceptance, interview participants pointed out that they may have had a secondary effect on the results reported in the quantitative study.

For example, survey respondents from universities where AT for visual disability was not available (or at least not easily available) may have been unsure how to respond to survey questions about effort expectancy (EE). They may have reasoned: "As the technology is unavailable at my university, then no amount of effort would influence my intention to use it." Interview participants felt that it is possible that this effect may have masked the relationship between EE and BI. A similar effect may have masked the relationship between behavioural intention and both performance expectancy ("No matter how good it would be, I can't use it") and accessibility ("I have access to the AT, but I can't use it to get the materials I need").

Interestingly, interviewees felt that the ready access to AT via smartphones (most AT for visual disability is now based on smartphones) may have further contributed to the masking of the relationship between behavioural intention and accessibility: ("I've never had any difficulty accessing the AT, so it's not going to influence whether or not I use it in my study"). The result of easy access to technology afforded by smartphones, particularly in developing

countries that have limited fixed infrastructure such as power and wired networks, was reported by Kafyulilo (2014), who investigated the use of phones in education in Tanzania. The study found that students feel comfortable using phones in education and believe that phones are the most accessible way to use information technology.

System Incompatibility with Assistive Technologies

Interviewees pointed out that incompatibility of current ATs with the learning management system in some Saudi universities can result in difficulty using the AT in study activities, which limits the benefit of the AT for students with disabilities. For example, a student with a visual disability may not be able to read educational content through the learning management system or website.

A similar conclusion was reached by Alquraini and Gut (2012), who found that the use of learning management systems that support access to curricula, such as the Universal Design for Learning (UDL), will encourage visually impaired students to use ATs in education, as well as help teachers to create curriculum materials suitable for disabled students. A study by Fakrudeen et al. (2017) identified a specific problem for Saudi students: there is a lack of AT that is compatible with the Arabic language, and most of the curricula materials in Saudi schools and universities are in Arabic.

Lack of Training in Use of AT in Education

Interviewees also pointed out that training for visually impaired users on how to use AT in their education is one of the most important ways to increase the use of AT, and that, conversely, the availability of AT without training could be highly inefficient. Even if they

were using AT in their daily life, interviewees felt that visually impaired students in Saudi universities may not be able to use the AT in their study activities. Unless the university provides appropriate training in the use of AT to access study materials and the university's learning management system, students may not be able to access the materials and services they need for their study.

This observation is supported by a study by Kapperman et al. (2002, p. 107), which found that 60 % of visually impaired students who study in the primary and secondary schools in Illinois, USA could not benefit from using AT because of the lack of training. Moreover, many studies, such as those by Demiris et al. (2005) and Rahimpour et al. (2008), have demonstrated the requirement for specific training to promote the adoption of AT. Indeed, Murphy et al. (2008) found that training is one of the most important issues to address in promoting AT, and that without training the use of AT is daunting.

Teacher Unawareness of Visual Disability

The final issue that interviewees identified with regard to limiting factors affecting availability of AT for visually disabled students in Saudi universities is the lack of awareness amongst university lecturers and staff about the needs of disabled students. They felt that this lack of awareness could result in a failure to take into consideration the needs of students, such as by providing study materials in a manner consistent with assistive technology so that students can access and benefit from these materials.

Other researchers have reported on the importance of teacher awareness in promoting the use of AT. For example, a study by Kapperman et al. (2002) found that suitable teacher training

on the needs of visually impaired students helps teachers to be aware how the students will use AT, which is an important factor to increase AT use. Similarly, Bin Tuwaym and Berry (2018) assert that teacher training and familiarity with AT can help visually impaired students to use the AT in their study activities. Finally, Alquraini and Gut (2012) considered curriculum adaptation by teachers to suit the needs of the visually impaired students who use AT, and the important role that appropriate adaptation plays in helping those students to achieve success in their studies.

8.3.5 Relationship Between Explanatory Themes and Acceptance Factors

Table 23 summarizes the previous discussion of the relationships between the themes that emerged from the qualitative study and the AVISSA model factors that the quantitative study investigated as possible determinants of behavioural intention (BI). Specifically, it considers those factors that were expected to influence BI but were found *not* to have a significant effect. For each theme, an asterisk in a particular factor column indicates that interview participants felt that the given theme plays a role in explaining why that factor was found *not* to may not have had a significant effect on behavioural intention (BI) in the context of acceptance of AT by visually disabled Saudi university students.

The table can be read in two ways: to see what factors each theme affects, and to see which themes affected a particular factor. For example, the table shows that interviewees felt that the importance of AT to visually disabled students contributed to the finding that performance expectancy (PE), effort expectancy (EE), anxiety (AN), and self-efficacy (SE) were not significant in determining behavioural intention (BI). And interviewees felt that

both the importance of AT to visually impaired students and the psychological sensitivity of disabled users contributed to the finding that anxiety was not significant in determining BI.

Table 23: The relationship between explanatory themes and model factors.

Theme	PE	EE	SI	AC	AN	SE
Importance of AT	*	*			*	*
Limited community awareness			*			
Psychological sensitivity					*	*
Availability of AT in universities	*	*		*		

Cells marked with a (*) shows the relationship between explanatory themes and model factors that were found not to have a significant influence on behavioural intention

8.4 The Effect of Context on Technology Acceptance Model Factors

Perhaps unsurprisingly, the explanatory themes that emerged from the interviews in the qualitative study are all related to the particular details of the study: the characteristics of the potential users of the technology (visually impaired students), the kind of technology (assistive technology), or the environment of its use (universities in Saudi Arabia). In other words, the information provided by interviewees suggests that the reasons for the difference in findings between this current study and previous studies derives from the context of the study: factors that are significant in some contexts are not significant in others. The conclusion that follows is that technology acceptance models such as UTAUT do not apply equally well in all contexts. This matter is further discussed in Section 9.7.3.

The current study is not the first to have reported this context dependency. Although, several UTAUT-based studies, including those by Al-Gahtani et al. (2007), Venkatesh and Zhang (2010), and Chu (2013), have confirmed that technology acceptance is significantly affected by performance expectancy (PE), effort expectancy (EE), and social influence (SI), others

have found that one or more of the UTAUT factors are not significant in specific contexts. For example, Isabelle and Sandrine (2009) used UTAUT to investigate technology acceptance in the context of acceptance of knowledge management systems in France and found that PE and EE were not significant behavioural intention determinants. Similarly, Martins et al. (2014) found that SI was not a significant BI determinant when considering acceptance of internet banking in Portugal.

The same effect also applies to the additional factors investigated in the AVISSA model: the context in which technology acceptance is investigated appears to have a marked effect on which factors are significant and which are not.

Table 24 summarizes the findings of technology acceptance studies conducted in a range of contexts, indicating which factors were found to have significant effect on behavioural intention (BI) and which were not. The table includes studies that used the original UTAUT model (discussed in section 4.2.1), and studies that investigated the additional AVISSA factors (discussed in section 4.2.2). For completeness, the table also indicates the findings of the current study and the original UTAUT model. In the table, Y indicates that the factor was found to be significant, N that it was found not to be significant, and – that the factor was not investigated in the study. A blank cell indicates that information is not available. The table shows that studies of the same factor in different contexts may reach different conclusions as to the significance of the factor. For example, Abbad et al. (2009) found that self-efficacy (SE) had a significant effect on acceptance of E-learning in Jordan, but Ong el at. (2004) found that it was not significant in the context of E-learning acceptance by engineers in high-tech companies.

Table 24: Significance of factors on BI for technology acceptance studies.

Study	Context	PE	EE	SI	AC	AN	ATT	SE
Current study	AT for students with visual disability in Saudi universities	N	N	N	N	N	Y	N
Original UTAUT by Venkatesh et al. (2003)	Not specific	Y	Y	Y	-	N	N	N
Al-Gahtani et al. (2007)	Cultural effects on organizational IT: Saudi Arabia vs. North America	Y	Y	Y	-	-	-	-
Venkatesh and Zhang (2010)	Technology acceptance: US vs. China	Y	Y	Y	-	-	-	-
Chu (2013)	Internet intermediary platforms in China	Y	Y	Y	-	-	-	-
Isabelle and Sandrine (2009)	Knowledge management systems in France	N	N	-	-	-	-	-
(Martins et al., 2014)	Internet banking in Portugal	Y	Y	N	-	-	-	-
Venkatesh and Davis (1996)	Not specific	-	-	-	-	-	-	Y
Abbad et al. (2009)	E-learning in Jordan	-	-	-	-	-	-	Y
Davis (1989)								Y
Motaghian et al. (2013)	Web-based learning systems by Iranian university staff	-	-	-	-	-	-	N
Ong et al. (2004)	E-learning systems by engineers in high-tech companies	-	-	-	-	-	-	N
Venkatesh and Bala (2008)		-	-	-	-	Y	-	Y
Elasmar and Carter (1996)	E-mail use by university students in the US	-	-	-	-	Y	-	-
Igbaria and Chakrabarti (1990)	Business students in the US	-	-	-	-	Y	-	-
Karahanna and Limayem (2000)	E-mail use at a financial institution in the US	-	-	-	Y	-	-	-
Teo et al. (2003)	Not specific	-	-	-	Y	-	-	-
Rice and Shook (1988)	Electronic messaging in an aerospace firm	-	-	-	Y	-	-	-
Kafyulilo (2014)	Mobile learning in Tanzania	-	-	-	N	-	-	-

Study	Context	PE	EE	SI	AC	AN	ATT	SE
Taylor and Todd (1995)	IT usage in Canada	-	-	-	-	-	Y	-
Tan and Teo (2000)	Internet banking in Singapore	-	-	-	-	-	Y	-
Asianzu and Maiga (2012)	E-tax services in Uganda	-	-	-	-	-	Y	-
Colesca (2009)	E-government in Romania	-	-	-	-	-	Y	-

Finally, several researchers point out that the significance of some technology acceptance factors changes over time, so that factors that played a larger role in the past may now be less important. For example, Venkatesh and Bala (2008) found that technology anxiety (AN) is decreasing in importance as more individuals gain experience with using the technology, and Alamri (2017, p. 55) found that accessibility to assistive technology (AC) has become less of an issue in Saudi Arabia because most AT for visual disability is smartphone based and the rapid spread of smartphones in Saudi Arabia (the number of smartphone users reached around 16 million by 2016) means that most users now have ready access to the technology.

8.5 Summary

The study reported in Chapter 6 investigated acceptance of assistive technology (AT) by visually disabled students in Saudi universities and found that the data does not fit well with the widely used Unified Theory for Acceptance and Use of Technology (UTAUT). Specifically, in contrast with the UTAUT model, this study found that behavioural intent (BI) was not significantly affected by either performance expectancy (PE), effort expectancy (EE), or social influence (SI).

Interviews with both AT experts and AT users identified several themes that collectively help explain these differences:

- AT users—and particularly visually disabled users—are very dependent on the technology for many aspects of their lives.
- The general Saudi community has limited understanding of the needs of AT users or the potential benefits of the technology.
- In Saudi culture, disabled users are often sensitive to the attitudes of others, including those of family and friends.
- AT is not well supported in some Saudi universities, with incompatible systems, limited training, and poor awareness of AT

It is notable that all of these themes are related to specific details of the context of the technology under consideration: the themes relate to AT (and specifically AT for visually disabled users), to Saudi culture, or to the university environment in Saudi Arabia. This observation suggests that technology acceptance models may be context dependent, and that factors that influence technology acceptance in some contexts may not in others. This finding is consistent with other studies that have investigated technology acceptance factors: for each of the factors considered, studies in some contexts have found the factor to significantly affect acceptance but studies in other contexts have found that it does not have a significant effect.

Chapter 9 : Conclusion

9.1 Introduction

This chapter presents an overview of the study including what has been achieved in relation to the study goals. The final findings will be presented in brief. In addition, the contributions of the study will be discussed as well as study recommendations, limitations, and suggestions for future research.

9.2 Summary of Study Outcomes

The main aim of this study was to investigate the factors that shape the acceptance of assistive (AT) by visually impaired students in the Saudi Arabian universities. The study showed that the factors influencing technology acceptance in this context differed from those previously found to influence acceptance in other contexts.

This research is based on the Unified Theory of Acceptance and Use of Technology (UTAUT), using an expanded model that incorporates factors that have previously been found to be important in AT use. According to the original UTAUT model, acceptance is influenced by performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). This research also considered access (AC), self-efficacy (SE), anxiety (AN), and attitude to technology (ATT). Analysis of data from a survey of visually impaired students in Saudi universities showed that only one of the original UTAUT factors (FC) and only one of the additional factors (ATT) had a significant effect on AT acceptance.

A follow-up study was conducted using semi-structured interviews of users (visually impaired students) and experts (workers in disability support units) to seek explanations for the differences between these results and those obtained in other contexts. Interviewees suggested several context-specific reasons why acceptance factors may be different for assistive technology (rather than other technologies), for university students (rather than other demographics), or for Saudis (rather than citizens of other countries).

- The importance of AT in the daily activities of visually disabled users may incline users to overlook problems with performance, ease of use, anxiety, and self-efficacy.
- Limited community awareness of disabilities and assistive technologies in Saudi Arabia may lead users to discount the opinions of friends and family.
- Disabled users in Saudi culture may be sensitivity to perceptions of pity, which may result in a determination to be self-reliant in making decisions about their disability.

Interviewees felt that these factors may help explain why survey respondents were not particularly influenced by PE ("I need to use the technology no matter how well it performs"), EE ("as I have few alternatives, I'm going to use it even if it's difficult"), SI ("members of my social circle don't really understand my needs, so their opinions about AT aren't as important to me"), AC ("the technology is on my phone so access isn't a problem"), AN ("I've had to overcome many anxieties, so one more isn't a problem"), or self-efficacy ("I like to manage by myself and am happy to learn what's need to master the technology").

The interviews also identified a number of concerns about availability of AT in the Saudi university sector, including incompatibility of AT with university IT systems, lack of training in the use of AT, and poor staff awareness of the needs of disabled students. Although not directly related to user acceptance, interviewees felt that addressing these issues would improve the level of use of AT in universities.

9.3 Contributions of the Study

This research has made contributions in 3 areas:

- It has contributed to technology acceptance modelling by extending the UTAUT model so that it specifically addresses assistive technology in education.
- It has contributed to technology acceptance studies by evaluating the extended model in a real-world context.
- It has contributed to the Saudi educational system by investigating factors that shape acceptance of AT by visually disabled Saudi university students.

The extended UTAUT model (AVISSA) includes all of the components of the original UTAUT model, plus additional factors identified in the literature as playing a role in the acceptance and use of assistive technology. In conjunction with the AVISSA model, a new survey instrument was developed to gather information about user's attitudes to acceptance of assistive technology. The new instrument is based on the existing instrument used with UTAUT, with the wording modified to specifically refer to assistive technology in the educational context, and additional questions added for each of the additional acceptance

factors. The additional factors are discussed in 4.2.2, and the AVISSA model is described in detail in Chapter 4. The new survey instrument is discussed in Section 5.5.1.

The AVISSA model and survey instrument were evaluated in the context of a study to investigate factors affecting assistive technology acceptance and use in Saudi universities. The investigation was motivated by a lower-than-expected AT uptake by Saudi university students and solutions to overcome barriers to use. Data was gathered from an online survey of visually disabled students in Saudi universities, and validity of the survey instrument was verified using a pilot test of the questionnaire as discussed in Section 5.5.3. Chapter 5 describes the methodology for the study.

The survey results were analysed using structural equation modelling with the partial least-squares technique (PLS-SEM). Analysis of the survey results found that only one of the original ATUAT factors and one of the additional AT-specific factors had a significant impact on acceptance in the study context. To follow up the findings, structured interviews were conducted with AT users and AT support workers. The interviews identified study-specific factors that help explain differences between results in the study context and results of other UTAUT-based studies. Chapter 6 describes the survey data and its analysis in detail. Chapter 7 presents the results of the follow-up interviews, and Chapter 8 discusses how issues identified in the interviews relate to the model factors.

9.4 Answers to the Research Questions.

This section provides brief answers to the research questions identified in Chapter 1, together with pointers to where in the thesis further information can be found.

Q1: What are the factors shaping attitudes towards the adoption and acceptance of assistive technologies for vision impaired students in Saudi universities?

Of the factors included in the UTAUT model, this study found only facilitating conditions (FC) to have a significant effect on acceptance. Similarly, of the additional factors added to the extended model, only attitude to technology (ATT) was found to have a significant effect. Other UTAUT model factors such as performance expectancy (PE), effort expectancy (EE), and social influence (SI) did not appear to have a significant effect. Nor did other extended model factors such as access (AC), anxiety (AN), or self-efficacy (SE). In other words, the study found that visually disabled Saudi university students were likely to accept AT if they had a positive attitude to technology and if the conditions were in place for them to use it effectively.

The data and analysis on which these findings are based is presented in Chapter 6 and follow-up interviews with stakeholders to seek deeper insights into the findings are presented in Chapter 7. Chapter 8 discusses study-specific issues identified by the interviewees that may help explain the results.

Q2: How well do current technology acceptance models account for acceptance of AT by vision impaired students in Saudi universities?

The short answer is “not very well”. The difference between results obtained in this study and those obtained in UTAUT-based studies in other contexts suggests that current technology acceptance models are context-dependant. Although they may give good results

in some contexts, they may not work at all well in others. The degree to which the results of this study match the UTAUT model is analysed in 6.5.6. and the matter of context dependency of acceptance frameworks is discussed at length in Section 8.4.

Q3: How can the acceptance of assistive technology for visually impaired students in Saudi universities be improved?

Only two of the acceptance model factors considered in this study were found to influence acceptance, so the model offers limited help in increasing AT acceptance in the study context. The significant effect of facilitating conditions on use suggests that universities should ensure that conditions are in place to support effective student use of AT. But the significant effect of attitude to technology on behavioural intent is not something that universities can do much about, since for many people their interest in technology (or lack of it) is innate. In a negative sense, the study provides some guidance in that it suggests that efforts to make the technology perform better, easier to use, or more accessible are unlikely to improve acceptance, and that when deciding to use the technology users are not concerned about the opinions of their peers or their own ability to master it.

An issue that emerged strongly from the stakeholder interviews is that lower-than-expected use of AT in Saudi universities may be less to do with acceptance and more to do with availability. Interviewees pointed out that availability of AT in some Saudi universities is a problem, with teaching delivery systems that are incompatible with AT and teaching staff that do not understand the needs of disable students or make curriculum materials available in suitable form. Even if disabled students are ready and willing to adopt assistive technology

in their studies, they will be unable to use the technology if it isn't available. These issues are discussed at length in Chapter 8.

9.5 Study Recommendations

This section describes recommendations that arise out of the contributions that this study has made to the research community. The recommendations are directed at three groups: the Saudi government, Saudi university administrators, and friends and family of disabled Saudi students.

9.5.1 Recommendations for the Saudi Government:

- To achieve the digital transformation of Saudi society that is at the core of Saudi Vision 2030, the Saudi government must focus on developing the infrastructure to support the digital conduct of e-government and e-learning (Saudi Vision 2030, 2018). For these services to be made available to disabled Saudis, government and education systems and sites must be compatible with assistive technology.
- The results of the quantitative study showed that social influence have little effect on acceptance of AT by visually impaired students, the qualitative study suggested that this could be because community members such as families and friends have insufficient knowledge of the importance of assistive technologies for people with disabilities. Because of the influence of family and society on an individual's decisions in the Saudi culture, the Saudi government should provide services such as counselling for disabled students and their families, and information centres and publicity campaigns to raise awareness about visual disability and the role that the

community plays in supporting visually impaired individuals and helping them to integrate into society more broadly.

- The Saudi government should support research on assistive technologies for people with disabilities. Research is needed to find ways to improve acceptance of AT in the Saudi context, as well as for adapting existing technology to the Saudi environment and developing new technologies for Saudi-specific needs.

9.5.2 Recommendations for Saudi Universities:

- Saudi universities should provide better support for disabled students, including an education environment that is compatible with their needs and appropriate infrastructure. All Saudi universities should provide specialised disability support units to foster continued study.
- Saudi universities should provide training for disabled students on how to use assistive technologies in the educational environment, thus enhancing opportunities for using these techniques.
- All Saudi universities should provide learning management systems compatible with assistive technologies to allow visually impaired students to access educational content without difficulties, thus promoting and motivating students to use assistive technologies in the learning environment.
- Saudi universities should educate faculty and staff about the needs of visually impaired students and encourage them to provide materials that are compatible with assistive technologies so that students with disabilities can benefit from these materials.

- Saudi universities should provide professional development of teachers as researchers and encourage research into issues relevant to the Saudi context, such as the use of emerging assistive technologies.

9.5.3 Recommendations for Family and Friends:

- The community, including family and friends, should be better informed about the needs of visually impaired students and the capabilities of technologies to assist them. In particular, family and carers should understand the benefits and operation of assistive technologies so that they can better support the student in making decisions about using and adopting this technology.
- The results of the study showed that visually impaired people are psychologically sensitive and they tend to make their own decisions to avoid expressions of compassion from others around them. However, the importance of social factors in Saudi culture suggests that family and friends can have a positive influence on the decision-making process of disabled students if they interact positively. Therefore, it is important for family and friends to know how they can positively interact with disabled students commensurate with their psychological state.

9.6 Scope of the Study

Although this study is specifically focused on studying the factors affecting the acceptance and adoption of assistive technologies by students with visual disabilities in Saudi universities, it is likely that outcomes from the study will have applicability beyond that scope. For example, findings about factors that affect assistive technology use for Saudi university students may well apply to students at other levels in the Saudi education system,

and findings that apply in Saudi Arabia are likely to apply in other countries with similar culture and circumstances, such as other Arabic countries, other Islamic countries, or even other developing countries. Finally, it is likely that recommendations for Saudi government and administrators in relation to access to assistive technology in universities will also facilitate access to other technologies and in other contexts.

9.7 Study Limitations and Future Work

This section identifies the key limitations of this study and suggests future research to address those limitations.

9.7.1 Limited Sample Size

The survey that underlies this study was sent to all Saudi universities that had an identifiable disability support unit and forwarded to all visually disabled students registered with those units. In total, around 300 survey invitations were sent out to students in 6 universities, and 87 responses received. But the true size of the population of visually disabled university students is unknown because many Saudi universities do not have a disability support unit or do not record information about student disabilities. Further, universities with disability support units are generally large, well-resourced institutions and are located in large cities. Whether or not students at these institutions are representative of the broader population is also unknown.

To validate and consolidate this study, further work should be conducted to more fully sample the target population. The current study was able to establish significant relationships with technology acceptance for only 2 model factors. Although the SEM analysis described in

Chapter 6 hinted that other factors may be important, no other relationship was statistically significant. With larger sample sizes, it may be possible to identify other significant contributors to acceptance.

This study approached all potential participants in the target group and used a range of strategies to maximise the participate rate, as discussed in sections 5.5.2 and 5.6.2. To significantly expand the sample size, it would be necessary to contact a broader range of disabled students, including those who have not formally registered with disability support units, and those who attend universities that do not have such units. Consideration could also be given to extending the reach to other stakeholders in the field, such as classroom teachers or friends and family of disabled students.

9.7.2 The Rapid Pace of Change

Like most computer-based technologies, computer-based assistive technologies continue to undergo rapid development. New devices and new platforms -- or new ways of using devices and platforms -- are continually becoming available. For example, rapid advancement in text-to-speech and speech-to-text technology on the mobile platform has revolutionised the ability of visually disabled students to read study materials and produce written work.

Significant change is also underway in the Saudi context, directed by the Saudi Vision 2030 program and fuelled by the growth of technology and social pressure. Like many other developing countries, Saudi society is rapidly adopting new ways of working, studying, and relaxing and technology is playing a central role.

In response to these rapid changes, it will be necessary to regularly update technology-based studies. The results of a study such as this may soon be overtaken by changes in either the technology itself or in the way in which it is applied.

9.7.3 A Better Model for Acceptance

An important outcome of this research is to demonstrate that the UTAUT model does not fit the study context well, although which aspect of the context caused the misfit remains to be identified. Was it that the technology under consideration was assistive technology for visual disabilities? Was it that the demographic was university students? Was it some aspect of Saudi culture or society? Or was it some combination of all of these aspects? Further studies will be required to explore these questions, with a view to identifying the factors that *do* influence technology acceptance in the Saudi university context, rather than those that *don't*.

From a broader perspective, it is certainly true that in some contexts technology acceptance modelling has proved helpful in identifying barriers to technology acceptance and suggesting how those barriers can be overcome. However, general-purpose models such as UTAUT have been most successful when modelling technology acceptance for the adoption of "general" IT by "mainstream" users in a "westernised" environment. As this and other studies have shown, many important technology acceptance problems occur in contexts that do not fit this pattern and thus are not well served by the UTAUT model. Further work is needed to refine and enhance technology acceptance frameworks by capturing relevant aspects of the technology, the user, or the environment. Such advances will be of considerable benefit to technology designers and system administrators. And, of course, the ultimate beneficiaries will be the technology users.

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Appendix A. Questionnaire in English

(Assistive Technology is: Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities)

Part one. **Citizen demography**: Please choose the most appropriate answer for the following items.

Q1) Gender

○ Male ○ Female

Q2) What is your age?

○ 18-21 ○ 22–25 ○ 26–30 ○ 31–34 ○ Above 34

Q3) What is your current education level?

○ Diploma degree ○ Bachelor degree ○ Master degree ○ Doctorate or higher

Q4) How would you rate your computer skills?

○ Beginner ○ Intermediate ○ Advance

Q5) How often do you use Assistive Technology?

○ Once a month
○ A few times a month
○ A few times a week
○ Once a day
○ Several times a day

Q6) How long have you been visually impaired?

○ Since birth ○ More than 10 years ○ 10-5 years ○ Less than 5 years

Q7) What is your level of vision impairment?

○ Moderate visual impairment ○ severe visual impairment ○ Blindness

Q8) Select the type of Assistive Technology that you normally use. *(You can choose more than one).*

- ○ Screen Readers
- ○ Optical Character Recognition
- ○ Text Windows
- ○ Smart phone applications
- ○ Braille Technologies
- ○ Electronic Dictionaries
- ○ Text Telephones
- ○ Others ……

Part two. **Performance Expectancy:** Please choose how much you agree with each of the statements within your general experience with Assistive Technology.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Using Assistive Technology is useful for my study.					
Using Assistive Technology enables me to accomplish tasks more quickly.					
Using Assistive Technology increases my productivity.					
If I use Assistive Technology, I will increase my chances of getting a good grade.					
Using Assistive Technology wastes my time.					
Using Assistive Technology decreases the time needed for my important study responsibilities.					

Part three**. Effort Expectancy:** Please choose the degree to which you believe that using Assistive Technology would be free of effort.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My interaction with Assistive Technology would be clear and understandable.					
It would be easy for me to become skilful at using Assistive Technology.					
I would find Assistive Technology easy to use.					
Learning to operate Assistive Technology is easy for me.					

I find it easy to use Assistive Technology to get the knowledge that I want.					
I find flexibility when dealing with assistive technology.					

Part four. **Social Influence*:*** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
People who influence my behaviour think that I should use Assistive Technology.					
People who are important to me think that I should use Assistive Technology.					
The staff of the university have been helpful in the use of Assistive Technology.					
In general, the university has supported the use of Assistive Technology.					
I would use Assistive Technology if my friends used them.					
The university lecturers are very supportive of the use of Assistive Technology for my study.					

Part five. **Facilitating Conditions:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have the necessary resources to use Assistive Technology.					
I have the necessary knowledge to use Assistive Technology.					
Assistive Technology is compatible with other systems I use.					
A specific person (or group) is available for assistance with Assistive Technology difficulties.					
I have enough experience to use Assistive Technology.					
I think that Assistive Technology fits well with my learning style.					

Part six. **Attitude toward using technology:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Using Assistive Technology is a good idea.					
Assistive Technology makes study more interesting.					
Studying with Assistive Technology is fun.					
I like studying with Assistive Technology.					
Using Assistive Technology is boring.					
Using Assistive Technology is pleasant.					

Part seven. **Behavioural intention to use the AT:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I intend to use Assistive Technology frequently.					
I predict that I will use Assistive Technology in the future.					
I predict I will continue to use Assistive Technology on a regular basis.					
I plan to use Assistive Technology in my study.					
I will do my study activities using Assistive Technology.					

Part eight. **Self-efficacy:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I could complete a task using Assistive Technology if there was no one around to tell me what to do as I go.					
I could complete a task using Assistive Technology if I could call someone for help if I got stuck.					
I could complete a task using Assistive Technology if I had a lot of time to complete it.					
I could complete a task using Assistive Technology if I had just the built-in help facility for assistance.					
I will be able to successfully overcome many study challenges by using Assistive technology.					
I am confident that I can perform effectively on many different tasks by using Assistive Technology.					
Compared to other vision impaired students who don't use Assistive Technology, I can do most tasks very well.					

Part nine. **Anxiety:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I feel apprehensive about using Assistive Technology.					
It scares me to think that I could lose a lot of information using Assistive Technology by hitting the wrong key.					
I hesitate to use Assistive Technology for fear of making mistakes I cannot correct.					
Assistive Technology is somewhat intimidating to me.					
I would be reluctant to use Assistive Technology because I'm not too familiar with it.					

Part ten. **Accessibility:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have easy access to Assistive Technology devices in the university.					
Easy access to Assistive Technology devices in many locations in the university will help me.					
The installation of Assistive Technology devices in my classroom is important for my success.					
Easy access to Assistive Technology devices at home and university is helpful.					
Mobile and portable Assistive Technology devices that I can bring anywhere will be useful.					

Part eleven. **Use behaviour:** Please choose the degree to which you agree with the following statements.

Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I want to use Assistive Technology to perform my study activities.					
I frequently use Assistive Technology.					
I use Assistive Technology on a regular basis.					
Most of my study tasks were done using Assistive Technology.					

Thank you very much for your time and valuable contribution to this research.

- If you have any further comment or suggestion, please include it in the following space:

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- If you are interested in receiving the results of this study or participating further, please add your email.

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Appendix B. Questionnaire in Arabic

<u>الجزء الأول : المعلومات العامة</u>

الرجاء اختيار ماتراه مناسبا لك من العناصر التالية

س1) الجنس

❍ انثى ❍ ذكر

س2) حدد عمرك من التالي :

❍ 18-21 ❍ 22-25 ❍ 26-30 ❍ 31-34 ❍ أكبر من 34

س3 ما هو المؤهل التعليمي الذي تقوم بدراسته حالياً ؟

❍ دبلوم ❍ بكالوريوس ❍ ماجستير ❍ دكتوراه

س4) كيف تقيم نفسك في مهارات استخدام الحاسب الآلي ؟

❍ مبتدئ ❍ متوسط ❍ متقدم

س5) منذ متى وأنت تعاني من إعاقة بصرية ؟

❍ منذ الولادة ❍ منذ أكثر من 10 سنوات ❍ من 5 الى 10 سنوات ❍ أقل من 5 سنوات

س6) ماهو مستوى الإعاقة البصرية لديك ؟

❍ ضعف بصر معتدل ❍ ضعف بصر شديد ❍ عمى كلي

س8) كم عدد مرات استخدامك للتقنيات المساعدة لذوي الاحتياجات الخاصة ؟

❍ مرة واحدة في الشهر
❍ عدة مرات في الأسبوع
❍ عدة مرات في الشهر
❍ مرة واحدة في اليوم
❍ عدة مرات في اليوم

س 9) اختر نوع التقنية المساعدة التي تستخدمها عادةً (يمكنك اختيار اكثر من واحدة) ؟

- ❍ قارئات الشاشة
- ❍ تقنيات التعرف الضوئي على الحروف
- ❍ تقنيات تحويل النص إلى صوت
- ❍ أخرى.....
- ❍ تقنيات بريل
- ❍ القواميس إلكترونية
- ❍ تطبيقات الهواتف الذكية

الجزء الثاني : الأداء المتوقع

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
استخدام التقنيات المساعدة مفيد لي في دراستي					
استخدام التقنيات المساعدة يسمح لي أن انجز مهامي الدراسية بشكل أسرع					
استخدام التقنيات المساعدة يزيد من انتاجي					
إذا استخدمت التقنيات المساعدة سوف أزيد من فرصي في الحصول على معدل دراسي أعلى					
استخدام التقنيات المساعدة يضيع وقتي					
استخدام التقنيات المساعدة يساعد في تقليص الوقت المستهلك في الواجبات الدراسية الهامة					

الجزء الثالث : الجهد المتوقع

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
تفاعلي مع التقنيات المساعدة واضح ومفهوم					
أجد من السهل بالنسبة لي أن أصبح متقن لاستخدام التقنيات المساعدة					
أجد أن التقنيات المساعدة سهلة الاستخدام					
تعلم كيفية استخدام التقنيات المساعدة سهل بالنسبة لي					
أجد من السهل استخدام التقنيات المساعدة للحصول على المعرفة التي أريد					
أجد مرونة عند تعاملي مع التقنيات المساعدة					

الجزء الرابع : التأثير الإجتماعي.

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
يعتقد الناس الذين لهم تأثير على سلوكي بأنه يجب علي استخدام التقنيات المساعدة					
يعتقد الناس المهمين بالنسبة لي أنه يجب علي استخدام التقنيات المساعدة					
يساعدني موظفي الجامعة في استخدام التقنيات المساعدة					
بشكل عام تدعم الجامعة استخدام التقنيات المساعدة					
سوف استخدم التقنيات المساعدة إذا استخدمها أصدقائي					
يؤيد أعضاء هيئة التدريس بالجامعة استخدام التقنيات المساعدة في الدراسة					

الجزء الخامس : الحالات الميسرة.

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
لدي الموارد اللازمة لاستخدام التقنيات المساعدة					
لدي المعلومات والمعرفة اللازمة التي تجعلني أستخدم التقنيات المساعدة					
التقنيات المساعدة متوافقة مع الأنظمة الأخرى التي استخدامها.					
يوجد شخص (أو مجموعة أشخاص) بالجامعة للمساعدة في صعوبات استخدام التقنيات المساعدة					
لدي الخبرة الكافية لاستخدام التقنيات المساعدة					
أعتقد بأن استخدام التقنيات المساعدة يتناسب تماما مع طريقة التعلم الخاصة بي					

الجزء السادس : المواقف تجاه استخدام التكنولوجيا.

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
استخدام التقنيات المساعدة فكرة جيدة					
استخدم التقنيات المساعدة يجعل التعلم أكثر إثارة					
التعليم باستخدام التقنيات المساعدة ممتع					
يعجبني التعليم باستخدام التقنيات المساعدة					
استخدام التقنيات المساعدة ممل					
استخدام التقنيات المساعدة مسلي					

الجزء السابع : النية السلوكية.

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
إنني أنوي استخدام التقنيات المساعدة في كثير من الأحيان					
أتوقع أنني يجب أن استخدم التقنيات المساعدة في المستقبل					
أتوقع أنني سوف أستمر في استخدام التقنيات المساعدة بشكل منتظم					
أنا أخطط لاستخدام التقنيات المساعدة في دراستي					
أود أن أؤدي أنشطتي الدراسية باستخدام التقنيات المساعدة					

الجزء الثامن : الكفاءة الذاتية.

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
يمكنني اكمال مهمة ما مستخداماً التقنيات المساعدة اذا لم يكن بالجوار أي شخص يخبرني بماعلي فعله					
يمكنني اكمال مهمة ما مستخداماً التقنيات المساعدة اذا كان بإمكاني الاتصال بشخص للمساعدة إذا واجهت مصاعب					
يمكنني اكمال مهمة ما مستخداماً التقنيات المساعدة اذا كان لدي الكثير من الوقت لاكمالها					
يمكنني اكمال مهمة ما مستخداماً التقنيات المساعدة اذا كان لدي فقط وسائل مدمجة للمساعدة					
سوف أكون قادر على النجاح في التغلب على الكثير من التحديات الدراسية باستخدام التقنيات المساعدة					

أنا واثق من أنني قادر على أؤدي بشكل فعال في العديد من المهام المختلفة باستخدام التقنيات المساعدة					
مقارنة مع الطلاب ضعاف البصر الآخرين الذين لا يستخدموا التقنيات المساعدة، يمكنني أن أفعل معظم المهام بشكل جيد.					

الجزء التاسع : القلق .

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
أشعر بتخوف حول استخدام التقنيات المساعدة.					
إنه يخيفني التفكير في أنني يمكن أن أفقد الكثير من المعلومات أثناء استخدام التقنيات المساعدة بالضغط على الزر الخاطئ					
أتردد في استخدام التقنيات المساعدة خوفا من الوقوع في خطأ لا يمكن تصحيحه.					
التقنيات المساعدة تكون مخيفة بعض الشيء بالنسبة لي.					
سوف أكون ممانع لاستخدام التقنيات المساعدة لانني لست على دراية جيدة بها					

الجزء العاشر : إمكانية الوصول .

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
لدي سهولة في الوصول إلى أجهزة التقنيات المساعدة في الجامعة.					
سهولة الوصول إلى أجهزة التقنيات المساعدة في العديد من المواقع في الجامعة ستكون مفيدة بالنسبة لي.					
توفير أجهزة التقنيات المساعدة في غرفة الصف مهم لنجاحي					
سهولة الوصول إلى أجهزة التقنيات المساعدة في المنزل والجامعة مفيد.					
أجهزة التقنيات المساعدة المحمولة والمتنقلة التي تحمل في كل مكان ستكون مفيدة					

الجزء العاشر : سلوك الاستخدام .

الرجاء اختيار ما يعبر عن مدى موافقتك على كل عبارة من العبارات التالية :

العنصر	لا أوافق بشدة	لا أوافق	محايد	أوافق	أوافق بشدة
أريد أن استخدم التقنيات المساعدة لأداء أنشطتي الدراسية					
أنا أستخدم التقنيات المساعدة بشكل متكرر					
أنا أستخدم التقنيات المساعدة على نحو منتظم					
معظم مهامي الدراسية أنجزت باستخدام التقنيات المساعدة					

شكرا جزيلا على إعطاءنا من وقتك الثمين ومشاركتك في هذه الدراسة

- اذا كان لديك أية تعليق أو اقتراح الرجاء إضافته و كتابته في الأسطر التالية :

.....

.....

.....
.....
.....
.....
.....

- إذا كنت مهتماً بنتائج البحث أو بالمشاركة مستقبلا في هذا الرجاء إضافة إيميلك

.....
.....
.....

Appendix C. Quantitative Study Ethics Approval

FINAL APPROVAL NOTICE

Project No.:	**7261**
Project Title:	Extension of The Unified Theory of Acceptance and Use of Technology model (UTAUT) to determine factors affecting acceptance and use of Assistive Technology for vision impaired students in the Saudi universities
Principal Researcher:	Mr Saeed Alshahrani
Email:	alsh0316@flinders.edu.au
Approval Date:	1 June 2016
Ethics Approval Expiry Date:	**31 July 2018**

The above proposed project has been **approved** on the basis of the information contained in the application, its attachments and the information subsequently provided.

C1. Quantitative English Information Sheet

Dr Paul Calder
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CRICOS Provider No. 00114A

INFORMATION SHEET

Title: 'Use the UTAUT model to determine factors affecting acceptance and use of Assistive Technology for vision impaired in the Saudi universities.'

Investigators:

Mr Saeed Alshahrani

School of Computer Science, Engineering and Mathematics

Flinders University

alsh0316@flinders.edu.au

Dr Paul Calder

School of Computer Science, Engineering and Mathematics

Flinders University

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paul.calder@flinders.edu.au

Description of the study:

This study is part of the project entitled 'Use the UTAUT model to determine factors affecting acceptance and use of Assistive Technology (AT) for vision impaired in the Saudi universities.' This project will investigate the current state of acceptance of use Assistive Technology in Saudi universities and attempt to suggest appropriate protocols, infrastructure and applications to enhance the adoption of AT in Saudi universities. This project is supported by Flinders University School of Computer Science, Engineering and Mathematics.

Purpose of the study:

This study aims to:

1. To determine the factors shaping attitudes towards the adoption and acceptance of assistive technologies for vision impaired students in the Saudi universities.
2. To develop and introduce a set of instruments to test the constructs and context of Performance expectancy, Effort Expectancy, Attitude toward using technology, Social influence, Facilitating conditions, Behavioral intention, Self-efficacy, Anxiety, Accessibility and Use behaviour for the purposes of measure Assistive Technology acceptance of vision impaired students in the Saudi universities.
3. To find out the influence of UTAUT moderators on individual's perceptions to use Assistive Technology in the Saudi Universities.

What will I be asked to do?

You will simply be asked to answer a questionnaire that is exploring your adoption and acceptance of use Assistive Technology. The questionnaire is also seeking to identify strategies and applications that may be of benefit in this technology.

The questionnaire is not expected to take more than 15 minutes.

This is voluntary.

What benefit will I gain from being involved in this study?

The sharing of your experiences will improve the planning and delivery of future programs. There will be no direct benefit to you as an individual for taking part in this evaluation.

Will I be identifiable by being involved in this study?

We do not need your name and your responses will be anonymous. All data collected for the project will be de-identified, and any comments you make will not be linked directly to you. While every attempt will be made to ensure anonymity given the nature of submission for this questionnaire we cannot guarantee complete anonymity as you will be required to physically deliver your completed, sealed within an envelope survey to a submission box located in the department.

Are there any risks or discomforts if I am involved?

The investigator anticipates no risks from your involvement in this study. We only seek your comments on your experiences in using AT. If you have any concerns regarding anticipated or actual risks or discomforts, please raise them with the investigator.

How do I agree to participate?

You can agree to participate by taking an information pack and completing the survey. Participation is voluntary. You may choose not to answer any questions, and you are free to withdraw from the questionnaire at any time without effect or consequences.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project number 7261). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

C2. Quantitative Arabic Information Sheet

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ورقة المعلومات (الصفحة الاولى من الاستبيان الالكتروني)

العنوان :

الاستخدام الموسع للنظرية الموحدة لقبول واستخدام نموذج التكنولوجيا (UTAUT) لتحديد العوامل التي تؤثر في قبول واستخدام التكنولوجيا المساعدة للطلاب المعاقين بصريا في الجامعات السعودية .

الباحثون :

السيد : سعيد الشهراني - طالب دكتوراه

كلية علوم الحاسب الآلي والهندسة والرياضيات بجامعة فلندرز.

alsh0316@flinders.edu.au

الدكتور : بول كولدر – المشرف

كلية علوم الحاسب الآلي والهندسة والرياضيات بجامعة فلندرز.

هاتف : 82012827

paul.calder@flinders.edu.au

وصف الدراسة:

هذه الدراسة هي جزء من المشروع والذي عنوانه " الاستخدام الموسع للنظرية الموحدة لقبول واستخدام نموذج التكنولوجيا (UTAUT) لتحديد العوامل التي تؤثر في قبول واستخدام التكنولوجيا المساعدة للطلاب المعاقين بصريا في الجامعات السعودية ." هذا المشروع هو تقييم لدرجة اعتماد و قبول التكنولوجيا المساعدة لضعاف البصر في الجامعات السعودية. سيقوم هذا المشروع بتحديد المشاكل أو الصعوبات التي تحول دون الاستخدام الواسع لهذه التكنولوجيا في الجامعات،

وأيضا تحديد العوامل التي تؤثر في قبولها، ومن ثم اقتراح و تقييم الحلول لبعض المشاكل التي يمكن أن تساعد على زيادة قبول واعتماد استخدامها في الجامعات . ويدعم هذا المشروع من قبل كلية علوم الحاسب الآلي والهندسة والرياضيات بجامعة فلندرز.

الغرض من هذه الدراسة:

وتهدف هذه الدراسة إلى:

1. تحديد العوامل التي تشكل المواقف تجاه اعتماد وقبول التكنولوجيات المساعدة للطلاب المعاقين بصريا في الجامعات السعودية.

2. تطوير وطرح مجموعة من الأدوات لاختبار تركيبات وسياق العوامل التي تؤثر في قبول التكنولوجيا. ويحدد النموذج القائم التالي: الأداء المتوقع، الجهد المتوقع، التأثير الاجتماعي، الحالات الميسرة ، سلوك الاستخدام ، والنية السلوكية. أيضا سيأخذ هذا البحث بعين الاعتبار المواقف تجاه استخدام التكنولوجيا، الكفاءة الذاتية، والقلق، وإمكانية الوصول لأغراض قياس قبول الطلاب المعاقين بصريا في الجامعات السعودية للتكنولوجيا المساعدة.

3. معرفة تأثير العوامل الوسيطة للنظرية الموحدة لقبول واستخدام نموذج التكنولوجيا" UTAUT على تصورات الفرد في استخدام التكنولوجيا المساعدة في الجامعات السعودية.

ماذا سوف يطلب مني؟

ببساطة سوف يطلب منك أن تجيب على استبيان يهدف لكشف اعتمادك و قبولك للتكنولوجيا المساعدة . وليس من المتوقع أن يأخذ الاستبيان أكثر من 20 دقيقة ، وتعتبر المشاركة تطوعية .

ما هي الفائدة التي سوف احصل عليها من المشاركة في هذه الدراسة؟

تبادل الخبرات الخاصة بك سيعمل على تحسين قبول التكنولوجيا المساعدة . لن يكون هناك فائدة مباشرة لك كفرد لمشاركتك في هذا التقييم .

هل سيتم تحديد هويتي من خلال المشاركة في هذه الدراسة؟

نحن لسنا بحاجة لتحديد اسمك وسوف تكون إجاباتك مجهولة . سيتم إلغاء تحديد جميع البيانات التي تم جمعها لهذا المشروع، وأي تعليقات تقوم بها لن تكون مرتبطة مباشرة بك. بما أن هذه الدراسة سوف تكون على الانترنت حيث أنه لن يكون هناك أي اتصال جسدي لذلك ، يمكننا أن نضمن لك السرية التامة وعدم الكشف عن هويتك.

هل سيكون هناك أي مخاطر أو مضايقات في حال المشاركة؟

من المتوقع ألا يكون هناك أي مخاطر من مشاركتكم في هذه الدراسة . ونحن فقط نسعى للحصول على تعليقاتكم من خبراتكم في استخدام التكنولوجيا المساعدة . إذا كان لديك أي مخاوف بشأن المخاطر أو المضايقات المتوقعة أو الفعلية ، يرجى رفعها للباحثين.

كيف أوافق على المشاركة ؟

يمكنك الموافقة على المشاركة من خلال استكمال الاستطلاع على الانترنت . المشاركة تطوعية . من الممكن لك عدم الإجابة على أية أسئلة ، و أنت حر في الانسحاب من الاستبيان في أي وقت دون تأثير أو عواقب .

شكرا لأخذ الوقت الكافي لقراءة هذه المعلومات و نأمل بأن تقبل دعوتنا في المشاركة .

تمت الموافقة على إجراء مشروع البحث من قبل لجنة أخلاقيات الأبحاث السلوكية والإجتماعية(رقم المشروع *7261*). وللحصول على المزيد من المعلومات فيما يتعلق الموافقة الأخلاقية على هذا المشروع يمكنكم الإتصال بالموظف التنفيذي للجنة عبر الهاتف على رقم 82013116 أوعبر الفاكس على رقم 82012035 أو عبر البريد الأكتروني على*human.researchethics@flinders.edu.au*

Appendix D. Interview Questions in English

Interview Questions

This interview seeks your views of the results of a survey about attitudes of visually impaired students towards acceptance and use of assistive technology (AT). Before participating in the interview, please carefully read the document entitled Quantitative Report, which provides a background to the project, the research methodology, and the results of the survey.

Your details

- What university do you study in / work to?
- What is your position?
- How would you likely describe your experience with AT?
- What types of AT you use / deal with?

Your views

Category 1: Performance expectancy

- How does 'expecting good performance' affect the 'intention to use AT? Why?

Category 2: Effort expectancy

- How does 'expecting less effort when using AT ' affect the 'intention to use it? Please elaborate?

Category 3: Social influence

- How does social influence affect the 'intention to use AT? Why?

Category 4: Accessibility

- How does the degree to which a person has the ability to access and use AT can affect the 'intention to use AT? Please elaborate?

Category 5: Self-efficacy

- How does increasing a user's ability to perform a specific task by using AT can affect the 'intention to use it? Please elaborate?

Category 6: Anxiety

- How does anxiety about using AT can affect a user's intention to use it? Why?

Category 7: Attitude toward using technology

- How does the user's attitude towards technology can affect the behavioural intention to use AT? Please elaborate?

Category 8: Behavioural intention to use AT

- How does the intention to use AT can affect actual user behaviour? Why?

Category 9: Facilitating conditions

- How does facilitating conditions such as obtaining resources and knowledge necessary to use AT can affect actual user behaviour? Please elaborate?

Category 10: additional information

- Please choose the most important factors of the following factors to indicate your view of its effect on the user's acceptance of AT.

  …… Performance expectancy

  …… Effort expectancy

  …… Attitude toward using technology

  …… Social influence

  …… Facilitating conditions

  …… Self-efficacy

  …… Anxiety

  …… Accessibility

- Why do think these factors are very important?
- What other factors do you believe can affect a user's acceptance of assistive technology?
- Do you have any further comment or suggestion?

Thank you very much for your time and valuable contribution to this research.

Appendix E. Interview Questions in Arabic

أسئلة المقابلة

تسعى هذه المقابلة إلى التعرف على وجهة نظرك حول نتائج المسح البحثي المتعلق بمواقف الطلاب ذوي الإعاقة البصرية تجاه قبول واستخدام التقنية المساعدة. قبل الاشتراك في هذه المقابلة، الرجاء قراءة الوثيقة المعنونة "تقرير الاستبيان" والذي يوفر معلومات عن خلفية المشروع ومنهجية البحث ونتائج المسح البحثي.

معلوماتك

- في أي جامعة تدرس/ تعمل ؟
- ماهو منصبك ان وجد؟
- كيف يمكنك وصف خبرتك مع التقنيات المساعدة لذوي الاعاقة البصرية؟
- ماهي أنواع التقنيات المساعدة التي تستعملها / تتعامل معها؟

وجهات نظرك

الفئة 1: الأداء المتوقع

- كيف يمكن أن يؤثر "توقع الأداء الجيد" في "نية استخدام التقنيات المساعدة"؟ لماذا ؟

الفئة 2: الجهد المتوقع

- كيف يمكن أن يؤثر "توقع بذل جهد أقل عند استخدام التقنية المساعدة" في "نية استخدامها"؟ لماذا ؟

الفئة 3: التاثير الإجتماعي

- كيف يمكن أن يؤثر "التأثير الإجتماعي" في "نية استخدام التقنيات المساعده" ؟ لماذا ؟

الفئة 4: إمكانية الوصول

- كيف يمكن أن يؤثر " الدرجة التي يتمتع بها الشخص بالقدرة على الوصول إلى التقنيات المساعده " في "نية استخدامها" ؟ يرجى التوضيح ؟

الفئة 5: الكفاءة الذاتية

- كيف يمكن أن تؤثر "زيادة قدرة الشخص على أداء مهمة معينة باستخدام التقنيات المساعده" في "نية استخدامه لها"؟ يرجى توضيح؟

الفئة 6: القلق

- كيف يمكن "القلق المصاحب لاستخدام التقنيات المساعده" أن يؤثر على "نية المستخدم في استخدامها"؟ لماذا؟

الفئة 7: الموقف تجاه استخدام التقنية

- كيف يمكن أن يؤثر "موقف المستخدم تجاه التقنية بشكل عام" على "النية السلوكية لاستخدام التقنيات المساعده"؟ يرجى توضيح؟

الفئة 8: الظروف المساعدة

- كيف يمكن أن تؤثر "الظروف المساعدة مثل الحصول على الموارد والمعرفة اللازمة لاستخدام التقنيات المساعدة" على "الاستخدام الفعلي لهذه التقنيات"؟ يرجى توضيح؟

الفئة 9: النية السلوكية لاستخدام التقنيات المساعده

- كيف يمكن أن تؤثر "نية استخدام التقنيات المساعده" على "سلوك المستخدم الفعلي"؟ لماذا؟

الفئة 10: معلومة اضافية

- يرجى اختيار الاكثر أهمية من العوامل التالية لتوضيح وجهة نظرك حول تأثيرها على قبول المستخدم للتقنيات المساعده.
- (توقع الأداء)
- (توقع الجهد)
- (الموقف من استخدام التقنية)
- (التأثير الإجتماعي)
- (الظروف المساعدة)
- (الكفاءة الذاتية)
- (القلق)
- (إمكانية الوصول للتقنية)
- لماذا تعتقد أن هذا العوامل مهمه؟
- لو أتيحت لك الفرصه لتطوير التقنيات المساعده , ماذا يتقترح ؟

- هل تعتقد أنه توجد عوامل أخرى قد تؤثر على قبول التقنية المساعدة؟
- هل لديك أي تعليقات أو ملاحظات؟

شكرا لك على الوقت الذي منحته للإجابة وعلى المساهمة القيمة في هذا البحث.

Appendix F. Qualitative Study Ethics Approval

FINAL APPROVAL NOTICE

Project No.:	**7261**
Project Title:	Extension of The Unified Theory of Acceptance and Use of Technology model (UTAUT) to determine factors affecting acceptance and use of Assistive Technology for vision impaired students in the Saudi universities
Principal Researcher:	Mr Saeed Alshahrani
Email:	alsh0316@flinders.edu.au
Approval Date:	1 June 2016
Ethics Approval Expiry Date:	**31 July 2018**

The above proposed project has been **approved** on the basis of the information contained in the application, its attachments and the information subsequently provided.

F1. Qualitative English Information Sheet

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CRICOS Provider No. 00114A

INFORMATION SHEET

Title: 'Extension of The Unified Theory of Acceptance and Use of Technology model (UTAUT) to determine factors affecting acceptance and use of Assistive Technology for vision impaired students in the Saudi universities.'

Investigators:

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Description of the study:

This study is part of a project to evaluate adoption and acceptance of Assistive Technology (AT) for visually impaired students in the Saudi universities. The project aims to identify problems or difficulties that prevent widespread use of AT in universities in Saudi Arabia and determine the factors that influence its acceptance, and then propose and evaluate solutions that could help to increase acceptance and adoption of AT in universities. We have already surveyed visually impaired students in Saudi Arabian universities to collect information about their use of AT and their attitudes to using AT in education. In this stage of the research, we are looking to follow up the survey by interviewing both AT users and experts in the field and asking them about the survey results.

What will I be asked to do?

Before the interview, you will be given a copy of the Quantitative Report, which provides a more detailed background to the project, the research methodology, and the results of the survey phase. Please read the report carefully because the interview will relate to the survey results.

During the interview, you will be asked for your opinion about issues explored in the survey and about possible explanations for the survey results. A copy of the interview questions is attached. Interviews will generally be conducted via Skype and an audio recording will be done for this interview for the purpose of documentation and will be arranged at a mutually agreeable time. The interview is not expected to take more than 45 minutes, and you can withdraw or decline to answer a question at any time. Of course, information you provide will be confidential

and you will not be identified in any way in any publications that arise from this research.

Thank you for taking the time to read this information sheet and we hope that you will accept our invitation to be involved.

This research project has been approved by the Flinders University Social and Behavioural Research Ethics Committee (Project Number7950). For more information regarding ethical approval of the project the Executive Officer of the Committee can be contacted by telephone on 8201 3116, by fax on 8201 2035 or by email human.researchethics@flinders.edu.au

F2. Qualitative Arabic Information Sheet

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CRICOS Provider No. 00114A

ورقة المعلومات

العنوان: توسيع النظرية الموحدة للقبول واستخدام نموذج التقنية(UTAUT) لتحديد العوامل المؤثرة في قبول واستخدام التقنية المساعدة للطلاب ذوي الإعاقة البصرية في الجامعات السعودية

الباحثون:

السيد سعيد الشهراني

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الدكتور باول كالدير

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وصف الدراسة:

هذه الدراسة جزء من مشروع لتقييم الاعتماد على التقنيات المساعدة(AT) وقبولها للطلاب ذوي الإعاقة البصرية في الجامعات السعودية.إن هدف الدراسة الرئيسي هو تحديد المشاكل والصعوبات التي تعيق الاستخدام الواسع للتقنيات المساعدة(AT) في الجامعات السعودية، وتحديد العوامل التي تؤثر في قبولها ومن ثم اقتراح الحلول وتقييمها ، والتي تساعد بدورها في زيادة القبول لهذه التقنيات وتبنيها والاعتماد عليها من قبل طلاب الجامعات السعودية.

ولقد قمنا سابقا بإجراء مسح بحثي للطلاب ذوي الإعاقة البصرية في الجامعات السعودية وذلك لجمع معلومات حول استخدامهم للتقينات المساعدة وموقفهم من استخدام هذه التقنيات في التعليم. وفي هذه المرحلة من البحث نسعى إلى متابعة المسح البحثي الذي قمنا بإجرائه عبر إجراء مقابلات مع مستخدمي التقنية المساعدة ومع الخبراء في هذا المجال وتوجيه أسئلة إليهم حول نتائج المسح.

ما المطلوب مني القيام به؟

قبل إجراء المقابلة، سوف تستلم نسخة من تقرير الاستبيان والذي يعرض معلومات تفصيلية عن خلفية المشروع ومنهجية البحث ونتائج مرحلة المسح البحثي. الرجاء قراءة التقرير بعناية لأن المقابلة سوف تكون متعلقة بنتائج المسح البحثي.

وأثناء المقابلة سوف يتم توجيه أسئلة إليك حول رايك بالقضايا التي يطرحها المسح البحثي وحول التفسيرات الممكنة لنتائج المسح البحثي. وتتوفر نسخة مرفقة من اسئلة المقابلة. وسوف يتم إجراء المقابلات بشكل عام بواسطة وسائل التواصل الألكتروني (مثل السكايب) أو عبر الهاتف وسيتم تسجيل المقابلة صوتياً لغرض التوثيق وسوف يتم ترتيب الموعد في وقت يتفق عليه كلا الطرفين.

من المتوقع ألا تستغرق المقابلة أكثر من 45 دقيقة، ويمكنك الانسحاب من المقابلة أو رفض الأجابة عن أي سؤال في أي وقت تشاء. وبالطبع فإن المعلومات التي تقدمها سوف تكون معلومات سرية ولن يتم كشف أي معلومات عن هويتك الشخصية في اية منشورات تصدر عن هذا البحث.

شكرا لكم على إتاحة الوقت لقراءة ورقة المعلومات ونأمل أن تقبلوا دعوتنا للاشتراك في هذا البحث.

تمت الموافقة على إجراء مشروع البحث من قبل لجنة أخلاقيات الأبحاث السلوكية والإجتماعية(رقم المشروع 7950). وللحصول على المزيد من المعلومات فيما يتعلق الموافقة الأخلاقية على هذا المشروع يمكنكم الإتصال بالموظف التنفيذي للجنة عبر الهاتف على رقم 82013116 أوعبر الفاكس على رقم 82012035 أو عبر البريد الأكتروني على*human.researchethics@flinders.edu.au*

F3. English Quantitative Report

Quantitative Report

Purpose of the Study:

This study aims to determine the factors shaping attitudes towards the adoption and acceptance of assistive technologies (AT) for visually impaired students in Saudi Arabian universities. The primary goal is to identify problems or difficulties that prevent widespread use of AT, and then propose and evaluate solutions that could help to increase acceptance and adoption of AT by Saudi university students.

Research Methodology

The underpinning framework for the investigation is the Unified Theory of Acceptance and Use of Technology (UTAUT), a model that has been widely used to understand technology acceptance. The original UTAUT model includes 4 factors that have previously been shown to influence technology acceptance in general: performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). For this study, the model was expanded to include 4 additional factors that were identified through a review of the literature as likely influences for adoption of assistive technology in particular: attitude toward using technology (AT), self-efficacy (SE), anxiety (AN) and accessibility (AC). Table 1 summarises UTAUT variable factors and their definitions.

Variable	Definition
Performance expectancy (PE)	The degree to which an individual believes that using the assistive technology will help attain gains in study performance.
Effort expectancy (EE)	The degree of ease associated with the use of the assistive technology.
Social influence (SI)	The degree to which an individual perceives that most people who are important to him or her think he or she should use the assistive technology.
Attitude toward using technology (AT)	The individual's positive or negative feeling about performing the use of assistive technology.
Self-efficacy (SE)	The degree to which an individual believes that he or she has the ability to perform specific a task using assistive technology.
Anxiety (AN)	The degree of an individual's apprehension, or even fear, when he or she is faced with the possibility of using assistive technology.
Accessibility (AC)	The degree to which a person has the ability to access and use the assistive technology.
Behavioural intention to use AT (BI)	The degree to which a person has formulated conscious plans to perform or not perform some specified future behaviour.
Facilitating conditions (FC)	Factors in the environment that facilitate the use of the assistive technology.
Use behaviour (UB)	The degree to which a user actually uses assistive technology.

Table 1: UTAUT variable factor definitions

A questionnaire was developed by adapting an instrument that has previously been used in UTAUT studies. The wording of questions was modified to explicitly focus on assistive technology in a university setting, and new questions were added to address newly added factors. All questions asked respondents to indicate their degree of support for statements that explored attitude towards technology factors, using a 5-point Likert scale. In addition, the survey gathered demographic data on age, gender, educational level, experience with computer skills and with AT, and the period and level of visual impairment.

Data about the use of AT and about student attitudes to use it in their education was collected through on-line survey of visually impaired students in Saudi universities. To ensure that the data provided a good representation of the whole country, all Saudi universities that have an established disability support unit were identified, and permission obtained from the head of unit to distribute participation invitations to all registered visually impaired students. In total, 200 invitations were distributed and 87 completed questionnaires were received. 3 questionnaires were incomplete and were discarded, leaving 84 usable responses.

The results of the analysis of the survey data are discussed in following sections. The focus of the current phase of the research is to interview users and experts in the field in order to validate the survey results and seek strategies for improving acceptance and use of assistive technologies in Saudi universities.

Demographic Analysis

Table 2 summarises demographic information about the survey responses.

Variable		**Frequency**	**% (n=84)**
Gender	Male	45	53.6
	Female	39	46.4
Age	18-21	17	20.2
	22-25	34	40.5
	26-29	15	17.9
	30-33	14	16.7
	More than 33	4	4.8
Visual impairment duration	Since birth	62	73.8
	More than 10 years	15	17.9
	9-5 years	4	4.8
	Less than 5 years	3	3.6
Level of vision impairment	Moderate visual impairment	14	16.7
	Severe visual impairment	37	44
	Blindness	33	39.3
Frequency of use of AT	A few times a month	5	6

Variable		Frequency	% (n=84)
	A few times a week	8	9.5
	Once a day	2	2.4
	Several times a day	69	82.1
Computer skills	Beginner	23	27.4
	Intermediate	40	47.6
	Advanced	21	25

Table 2: Demographic summary

Based on the 84 valid survey responses, most respondents were male (53.6%) and the largest group was aged 22-25 (40.5%). Moreover, most respondents have had some form of visual impairment since birth (73.8%) and most have either severe visual impairment or blindness (total of 83.3%). Finally, most respondents utilize AT several times daily (82.1%), and the most frequent computer skills rating was intermediate (47.6%).

Quantitative Analysis

The survey data was analysed by applying the Partial Least Squares method (using the Smart PLS package) to assess the strength of relationships in the UTAUT Structural Model, which is shown in Figure 1. PLS was chosen because it is considered well suited for explaining complex relationships with limited data sets.

In all, 9 hypothesized relationships were tested: the influence on behavioural intention (BI) of performance expectancy (PE), effort expectancy (EE), social influence (SI), attitude towards using technology (AT), self-efficacy (SE), anxiety (AN), and accessibility (AC), and the influence of BI and facilitating conditions (FC) on use behaviour (UB).

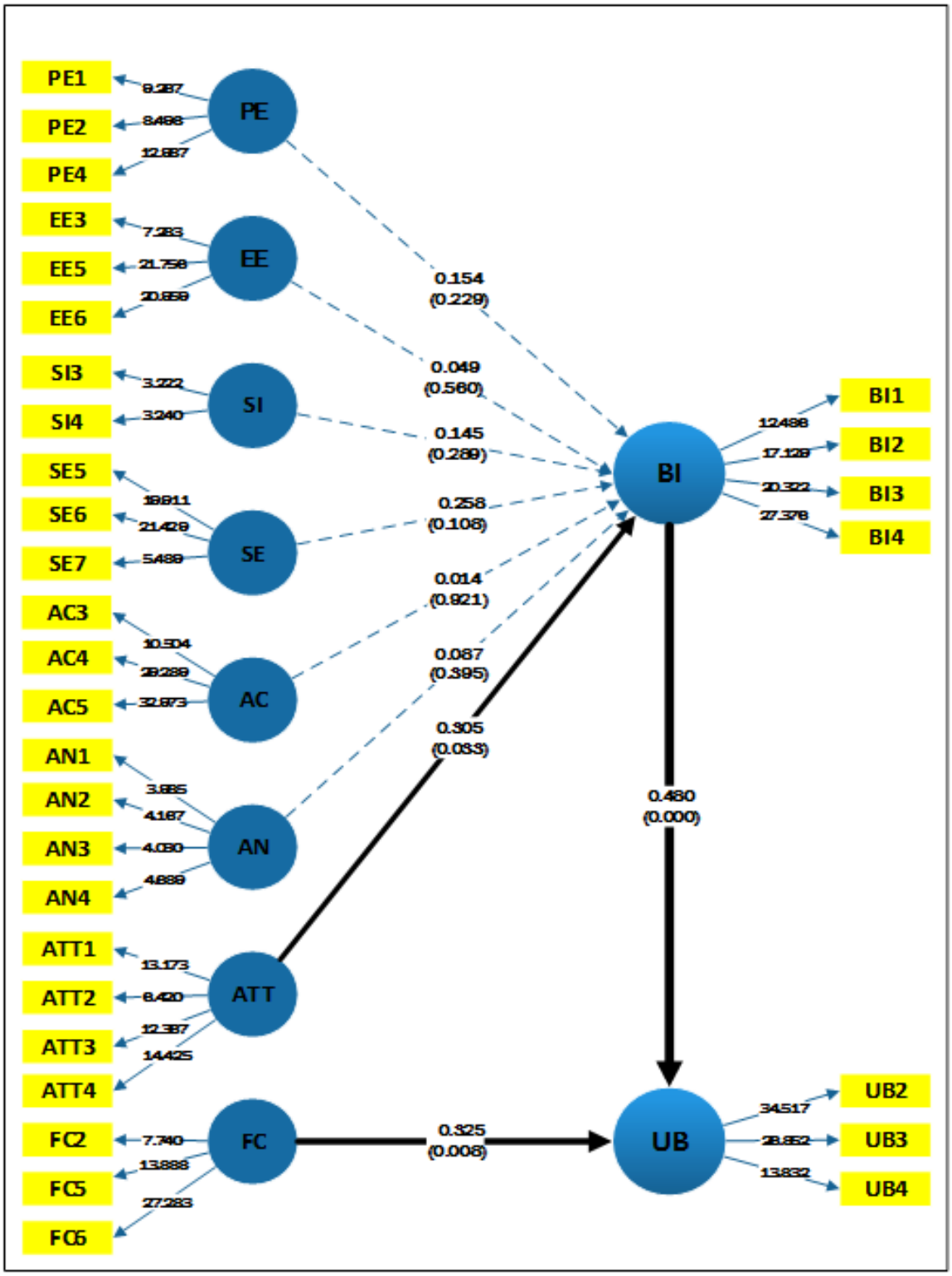


Figure 1: UTAUT Structural Model

The assessment procedure included an examination of model fit indices and standardised Structural Equation Model (SEM) path coefficients to provide a basis upon which to accept or reject the hypothesised relationships. For a relationship to be supported, the important test statistic is the p-value test where the relationship can be significant at three levels: if p-value <0.001 the relationship is considered very strong; if p-value <0.01 the relationship is strong; if p-value <0.05 the relationship is less strong but still significant. Larger p-values indicate that the relationship is not statistically significant, which means that the hypothesis is not supported. Table 3 summarises the strength of support for each hypothesised relationship.

Hypothesis	SEM Path	P Values	Hypothesis testing result
H1	PE -> BI	0.229	Not supported
H2	EE -> BI	0.560	Not supported
H3	SI -> BI	0.289	Not supported
H4	ATT -> BI	0.033	supported
H5	SE -> BI	0.108	Not supported
H6	AN -> BI	0.395	Not supported
H7	AC -> BI	0.921	Not supported
H8	BI -> UB	0.000	Very strongly supported
H9	FC -> UB	0.008	Strongly supported

Table 3: Support for hypothesised relationships

As the table shows, the survey data suggests that the respondents' behavioural intention to use assistive technology (BI) very strongly affects their use behaviour (UB), with a p-value <0.001. Facilitating conditions (FC) also had a strong effect on UB, with a p-value <0.01. Of the factors hypothesised to affect behavioural intention, only attitude toward using technology (AT) had a significant effect, with a p-value <0.01. The survey data did not show that any other factors significantly affect behavioural intention to use assistive technology, although researchers have previously reported significant effects in other contexts.

F4. Arabic Quantitative Report

(التقرير الكمّي)

هدف الدراسة:

تهدف الدراسة إلى تحديد العوامل التي تشكل المواقف من الاعتماد على التقنيات المساعدة (AT) وقبولها من قبل الطلاب ذوي الإعاقة البصرية في الجامعات السعودية. إن هدف الدراسة الرئيسي هو تحديد المشاكل والصعوبات التي تعيق الاستخدام الواسع للتقنيات المساعدة ، ومن ثم اقتراح الحلول وتقييمها ، والتي تساعد بدورها في زيادة القبول لهذه التقنيات وتبنيها والاعتماد عليها من قبل طلاب الجامعات السعودية.

منهجية البحث

إن إطار العمل الأساسي لعملية البحث والاستقصاء في هذه الدراسة هو النظرية الموحدة للقبول واستخدام نموذج التقنية (UTAUT)، وهو نموذج يستخدم على نطاق واسع لفهم عملية قبول التقنية. ويتضمن نموذج UTAUT أربعة عوامل استخدمت في الماضي لتثبت تأثير نظرية القبول بشكل عام ، وهذه العوامل هي: توقع الأداء وتوقع الجهد والتاثير الاجتماعي والظروف المساعدة. ولغرض هذه الدراسة فقد تم توسيع هذا النموذج لكي يتضمن اربعة عوامل إضافية والتي تم تحديدها عبر مراجعة البحوث والدراسات المرتبطة بهذا الحقل وقد تم تحديدها على أنها عوامل محتملة التأثير على قبول اعتماد التقنية المساعدة وهذه العوامل هي بالتحديد ما يلي: الموقف من استخدام التقنية والكفاءة الذاتية والقلق وإمكانية الوصول لهذه التقينة.

الجدول التالي يلخص عوامل UTAUT المتغيرة وتعريفاتها.

العامل المتغير	التعريف
Performance expectancy (PE) **توقع الأداء**	درجة إعتقاد الشخص أن استخدام التقنية المساعدة يساعد في الحصول على فوائد في أدائه الدراسي.

العامل المتغير	التعريف
Effort expectancy (EE) **توقع الجهد**	درجة إعتقاد الشخص تسهيل الحهد المتوقع باستخدام التقنية المساعدة
Social influence (SI) **التأثير الإجتماعي**	درجة إعتقاد الشخص أن الأشخاص الأكثر أهمية بالنسبة له كالعائلة والاصدقاء يعتقدون أنه يجب أن يستخدم التقنية المساعدة.
Attitude toward using technology (ATT) **الموقف من استخدام التقنية**	شعور الشخص السلبي أو الأيجابي حول أداء التقنية المساعدة.
Self-efficacy (SE) **االكفاءة الذاتية**	درجة إعتقاد الشخص بأنه يمتلك القدرة على أداء مهمة . محددة باستخدام التقينة المساعدة.
Anxiety (AN) **القلق**	درجة خشية أو خوف الشخص عندما يواجه إمكانية استخدام . التقنية المساعدة.
Accessibility (AC) **إمكانية الوصول**	درجة تمكن الشخص من الحصول على التقنية المساعدة والوصول إلىها.
Behavioural intention to use AT (BI) **الرغبة السلوكية لاستخدام التقنية المساعدة**	درجة تشكيل الشخص لخطط واعية حول القيام بأداء أو عدم . أداء سلوك محدد في المستقبل.
Facilitating conditions (FC) **الوسائل المساعدة**	العوامل المتوفرة في البيئة لتسهيل عملية استعمال التقنية المساعدة.
Use behaviour (UB) **سلوك الاستخدام**	درجة استخدام المستخدم الفعلية للتقينة المساعدة.

تم تطوير الاستبيان عبر تعديل الأسئلة التي تم استخدامها في دراسات سابقه لكي تتناسب مع سياق هذه الدراسة. حيث تم تعديل الكلمات المستخدمة في الاستبيان لكي تركز بشكل واضح على التقنيات المساعدة في البيئة الجامعية وتمت إضافة أسئلة جديدة لكي تركز على العوامل المضافة حديثاً. والأسئلة المستخدمة تطلب من المشتركين في البحث تحديد درجة دعمهم للعبارات التي تكشف عن مواقفهم تجاه العوامل المحددة وذلك باستخدام مقياس ليكرت ذو النقاط الخمسة. وبالإضافة الى ذلك، يقوم المسح الاستبياني بجمع معلومات ديموغرافية عن العمر والجنس والمستوى التعلمي والخبرة في مجال استخدام الكمبيوتر واستخدام التقنيات المساعدة ومدة ومستوى الإعاقة البصرية.

وتم جمع البيانات المتعلقة باستخدام التقنيات المساعدة وموقف الطلاب من استخدامها في تعليمهم عبر مسح على الأنترنت شارك فيه الطلاب ذوي الإعاقة البصرية في الجامعات السعودية. ولضمان أن تقدم

البيانات تمثيلاً جيدا للبلد بأكمله، تم تغطية كافة الجامعات السعودية التي تتوافر فيها وحدة دعم لذوي الاحتياجات الخاصة في الدراسه ، وتم الحصول كذلك على إذن من رئيس الوحدة لتوزيع دعوات المشاركة في البحث على كافة الطلاب ذوي الإعاقة المسجلين في الجامعات. وإجمالاً كان عدد الدعوات الموزعة 200 دعوة وتم استلام 87 استبيان تمت الإجابة عليها و3 استبيانات لم تكمل وتم إلغائها وبذلك يكون عدد الإجابات التي يمكن استخدامها 84 استبياناً.

تمت مناقشة نتائج تحليل المسح البحثي و البيانات التي تجدونها في القسم التالي. وتركز المرحلة الحالية من البحث على إجراء مقابلات مع المستخدمين والخبراء في هذا المجال للتأكد من صلاحية نتائج المسح البحثي و والسعي لإيجاد إستراتيجيات لتحسين قبول واستخدام التقنية المساعدة في الجامعات السعوية.

التحليل الديموغرافي

يلخص الجدول التالي المعلومات الديموغرافية التي تخص المشاركين في الدراسة.

العامل المتغير		التكرار	النسبة المئوية
الجنسGender	الذكو رMale	45	53.6
	الإناث Female	39	46.4
العمر Age	18-21	17	20.2
	22-25	34	40.5
	26-29	15	17.9
	30-33	14	16.7
	أكبر من عمر33 More than	4	4.8
Visual impairment duration مدة الإعاقة البصرية	منذ الولادة Since birth	62	73.8
	اكثر من 10 سنوات	15	17.9
	بين 5-9 سنوات	4	4.8
	أقل من 5 سنوات	3	3.6
Level of vision impairment مستوى الإعاقة البصرية	إعاقة بصرية متوسطة	14	16.7
	إعاقة بصرية شديدة	37	44
	فقدان البصر	33	39.3
Frequency of use of AT معدل تكرار استخدام التقنية المساعدة	عدة مرات في الشهر	5	6
	عدة مرات في الأسبوع	8	9.5

النسبة المئوية	التكرار		العامل المتغير
2.4	2	مرة واحدة في الأسبوع	
82.1	69	عدة مرات في اليوم	
27.4	23	مبتدأ	Computer skills مهارات الكمبيوتر
47.6	40	متوسط	
25	21	متقدم	

وبناء على الـ 84 استبياناً الصالحة للاستخدام ، كان معظم المشتركين من الذكور بنسبة (53.6%) والمجموعة الأكبر كان معدل عمرها ما بين 22-25 بنسبة (40.5%). وبالإضافة إلى ذلك، يعاني معظم المشتركون من نوع من أنواع الإعاقة البصرية منذ الولادة بنسبة (73.8%) ومعظمهم يعاني من إعاقة بصرية شديدة أو من فقدان البصر بنسبة (83.3 %). واخيرا، معظم المشتركون يستخدمون التقنية المساعدة عدة مرات يوميا بنسبة (82.1%) ومستوى مهارات الكمبيوتر الأكثر تكرارا كان المستوى المتوسط بنسبة (47.6%).

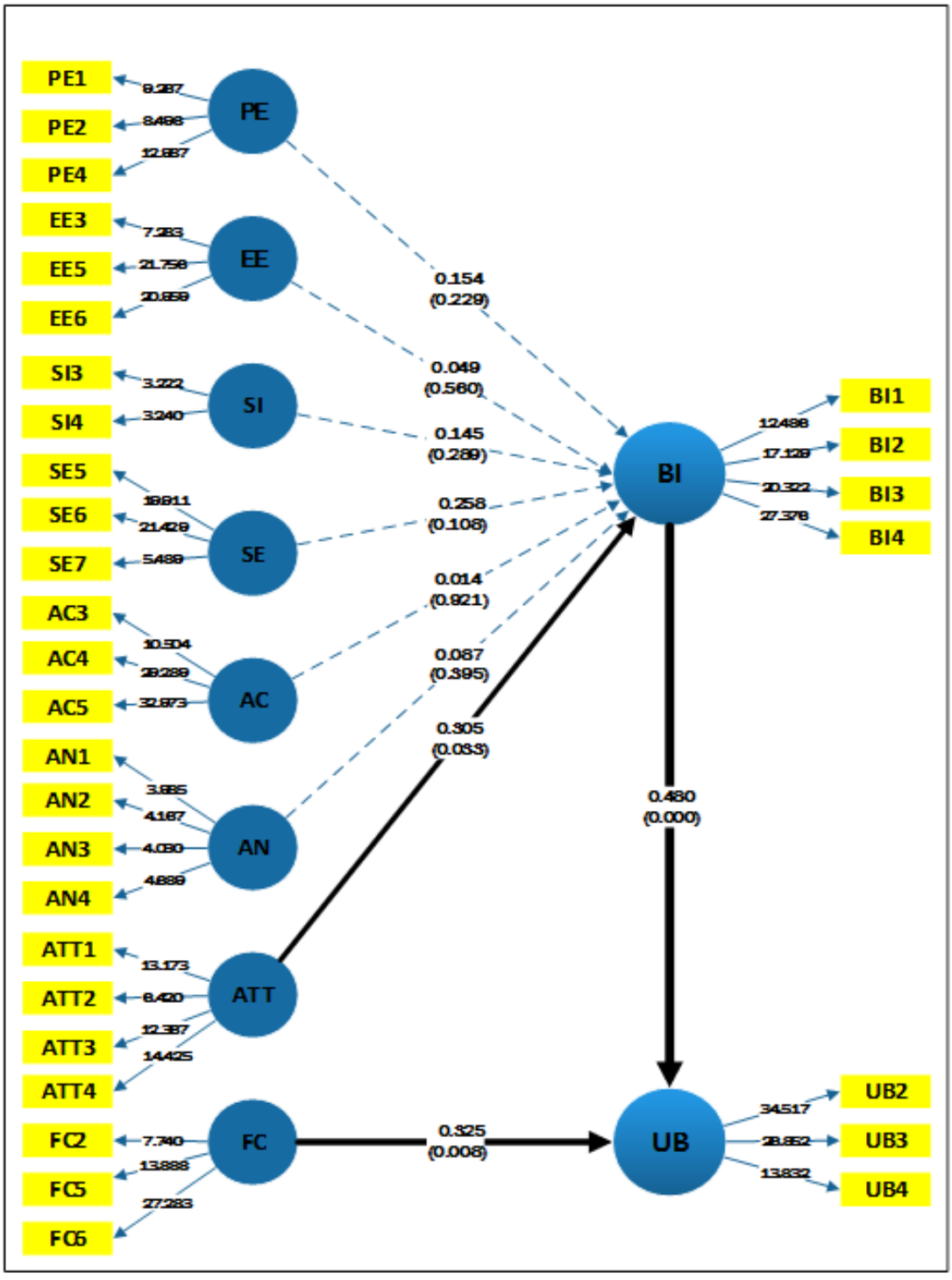
التحليل الكمّي

ولقد تم تحليل البيانات عبر تطبيق طريقة المربعات الجزئية الأقل (SmartPLS) وذلك لتقييم قوة العلاقة في النموذج الهيكلي المستخدم والذي يظهر في الشكل التالي. ولقد تم إختيار SmartPLS باعتباره مناسبا لشرح العلاقات المعقدة مع مجموعات البيانات المحدودة.

إجمالا، تم فحص 9 علاقات مفترضة وهي: التاثير على الرغبة السلوكية الخاصة بتوقع الأداء وتوقع الجهد والتأثير الإجتماعي والكفاءة الذاتية والقلق وإمكانية الوصول وتأثير الرغبة السلوكية لتوقع الأداء والظروف المساعدة على اسعمال السلوك.

وتضمنت العملية الأساسية فحصاً لمؤشرات النموذج المناسبة والمسار القياسي لنموذج المعادلة الهيكلية وذلك لتوفير أساس يتم بناء عليه رفض او قبول العلاقات الأفتراضية.

ولكي يتم دعم العلاقة فإن تم فحص قيمة p-value حيث يمكن أن تكون العلاقة مهمة على ثلاثة مستويات: إذا كان قيمة p أصغر من 0.001 فإن العلاقة تعتبر قوية جدا، وإذا كانت قيمة p أصغر من 0.01 فإن العلاقة قوية، وإذا كانت قيمة p أصغر من 0.05 فإن العلاقة اقل قوة ولكنها ما تزال مهمة. وتشير القيم الأكبر لـ P إلى أن العلاقة ليست مهمة إحصائياً وهذا يعني ان الفرضية غير مدعومة.


PE1
PE2
PE4
PE
8.287
8.498
12.887
EE3
EE5
EE6
EE
7.283
21.758
20.859
SI3
SI4
SI
3.222
3.240
SE5
SE6
SE7
SE
19.811
21.429
5.489
AC3
AC4
AC5
AC
10.504
29.289
32.873
AN1
AN2
AN3
AN4
AN
3.885
4.167
4.030
4.889
ATT1
ATT2
ATT3
ATT4
ATT
13.173
6.420
12.387
14.425
FC2
FC5
FC6
FC
7.740
13.888
27.283
0.154
(0.229)
0.049
(0.560)
0.145
(0.289)
0.258
(0.108)
0.014
(0.921)
0.087
(0.395)
0.305
(0.083)
BI
BI1
BI2
BI3
BI4
12.488
17.128
20.322
27.378
0.480
(0.000)
0.325
(0.008)
UB
UB2
UB3
UB4
34.517
28.852
13.832

الجدول التالي يلخص قوة العلاقات داخل نموذج الدراسة.

الفرضية	المسار	قيمة *p*	نتيجة اختبار الفرضية
H1	PE -> BI	0.229	غير مدعومة
H2	EE -> BI	0.560	غير مدعومة
H3	SI -> BI	0.289	غير مدعومة
H4	ATT -> BI	0.033	مدعومة
H5	SE -> BI	0.108	غير مدعومة
H6	AN -> BI	0.395	غير مدعومة
H7	AC -> BI	0.921	غير مدعومة
H8	BI -> UB	0.000	مدعومة بشكل قوي جدا
H9	FC -> UB	0.008	مدعومة بقوة

وكما يظهر الجدول، فإن بيانات المسح الكمي تشير إلى أن رغبة (نية) المشتركين السلوكية لاستخدام التنقنية المساعدة تؤثر بشكل قوي على سلوكهم بقيمة p أصغر من 0.001. وكان للظروف المساعدة تاثير قوي على السلوك بقيمة p أصغر من0.01.

ومن بين العوامل التي من المفترض أن تؤثر على الرغبة السلوكية كان الموقف من استخدام التقنية المساعدة فقط ذو تأثير قوي بقيمة p أصغر من 0.05. ولم يظهر المسح البحثي أن أية عوامل أخرى تؤثر بشكل مهم على الرغبة السلوكية وذلك على الرغم من أن الباحثين أشاروا إلى وجود تاثيرات لهذه العوامل ضمن سياقات أخرى.

Appendix G. Descriptive Statistics of the Observed Variables

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
PE1	84	3.00	5.00	4.79	0.47	-2.11	3.89
PE2	84	2.00	5.00	4.68	0.56	-1.99	5.22
PE3	84	3.00	5.00	4.64	0.55	-1.25	0.64
PE4	84	1.00	5.00	4.39	0.78	-1.61	3.82
PE5	84	1.00	5.00	4.37	0.94	-1.78	3.18
PE6	84	1.00	5.00	4.24	0.83	-1.25	2.16
EE1	84	1.00	5.00	4.27	0.90	-1.91	4.76
EE2	84	1.00	5.00	4.23	0.80	-1.31	2.84
EE3	84	2.00	5.00	4.23	0.70	-0.56	0.03
EE4	84	1.00	5.00	4.23	0.84	-1.57	3.86
EE5	84	2.00	5.00	4.20	0.79	-0.83	0.41
EE6	84	2.00	5.00	4.20	0.72	-0.91	1.35
SI1	84	1.00	5.00	3.44	1.19	-0.30	-0.64
SI2	84	1.00	5.00	3.80	1.15	-0.86	0.10
SI3	84	1.00	5.00	2.87	1.29	-0.10	-1.09
SI4	84	1.00	5.00	3.12	1.35	-0.25	-1.20
SI5	84	1.00	5.00	2.61	1.41	0.23	-1.25
SI6	84	1.00	5.00	3.31	1.17	-0.54	-0.32
FC1	84	1.00	5.00	3.13	1.15	-0.16	-0.86
FC2	84	1.00	5.00	4.05	0.71	-1.10	3.60
FC3	84	1.00	5.00	3.46	0.97	-0.50	-0.01
FC4	84	1.00	5.00	2.98	1.46	-0.03	-1.33
FC5	84	1.00	5.00	3.89	0.86	-0.82	0.88
FC6	84	1.00	5.00	4.30	0.76	-1.24	2.93
ATT1	84	4.00	5.00	4.79	0.41	-1.42	0.01
ATT2	84	2.00	5.00	4.39	0.74	-1.15	1.04
ATT3	84	2.00	5.00	4.43	0.70	-1.04	0.67
ATT4	84	1.00	5.00	4.40	0.81	-1.58	3.12
ATT5	84	1.00	5.00	4.42	0.91	-1.92	3.97
ATT6	84	2.00	5.00	4.20	0.72	-0.72	0.56

Item	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
BI1	84	2.00	5.00	4.39	0.66	-0.89	0.87
BI2	84	2.00	5.00	4.56	0.65	-1.46	2.16
BI3	84	2.00	5.00	4.42	0.79	-1.49	2.05
BI4	84	1.00	5.00	4.46	0.81	-1.88	4.18
BI5	84	2.00	5.00	4.55	0.68	-1.68	3.17
SE1	84	2.00	5.00	4.08	0.85	-0.76	0.10
SE2	84	1.00	5.00	4.08	0.82	-1.08	1.91
SE3	84	1.00	5.00	4.07	0.90	-1.25	2.11
SE4	84	1.00	5.00	3.55	0.96	-0.39	-0.12
SE5	84	2.00	5.00	4.56	0.59	-1.33	2.72
SE6	84	3.00	5.00	4.63	0.51	-0.83	-0.68
SE7	84	1.00	5.00	4.27	0.95	-1.71	3.35
AN1	84	1.00	5.00	1.77	1.05	1.38	1.21
AN2	84	1.00	5.00	2.63	1.25	0.17	-1.26
AN3	84	1.00	5.00	1.95	1.04	1.08	0.60
AN4	84	1.00	5.00	1.94	1.19	1.23	0.49
AN5	84	1.00	5.00	1.52	0.86	1.92	3.80
AC1	84	1.00	5.00	2.85	1.31	-0.13	-1.12
AC2	84	1.00	5.00	4.48	0.81	-1.91	4.28
AC3	84	2.00	5.00	4.46	0.78	-1.50	1.83
AC4	84	3.00	5.00	4.71	0.48	-1.30	0.48
AC5	84	4.00	5.00	4.82	0.39	-1.71	0.94
UB1	84	2.00	5.00	4.56	0.72	-1.92	3.98
UB2	84	2.00	5.00	4.45	0.72	-1.53	2.87
UB3	84	2.00	5.00	4.24	0.87	-1.04	0.45
UB4	84	1.00	5.00	4.26	0.92	-1.31	1.47