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# Barriers to Reducing the Assistive Technology use for Students with Autism as Perceived by Special Education Teachers in Saudi Arabia

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Barriers to Reducing the Assistive Technology use for Students with Autism as Perceived by

Special Education Teachers in Saudi Arabia


by


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## DEDICATION

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# ABSTRACT

Prior research has indicated that assistive technology (AT) devices and services can improve the functional capability of students with autism, which includes multiple areas of student needs, such as communication, accessibility, organization, sound, sight, academic skills, mobility, and memory. Nevertheless, concerns persist as to how AT devices are being implemented in the classroom; this is because teachers are experiencing a variety of barriers to using AT (Hew & Brush, 2007). The purpose of this study is to explore the barriers affecting Saudi teachers' use of AT for teaching children with autism spectrum disorder (ASD). This study's sample consists of 85 teachers who work with students with autism in the city of Riyadh in the central region of Saudi Arabia. The study used an embedded mixed-methods design, which included two types of data collection: quantitative data through the use of a Likert scale and qualitative data consisting of employed open-ended questions. The data were collected using an online survey that gathered information about participants' demographic information, frequency of AT use, barriers to AT use, and how these barriers affect AT use. The findings of the study revealed that teachers face first-order barriers related to lack of resources, support, time, and training. Moreover, teachers' limited skills and knowledge are major second-order barriers. Most of the participants indicated that these barriers reduce or prevent AT usage in the classroom. The teachers also reported that they use high-tech AT more than other types of AT. The study's results may benefit policymakers, education department administrators, school leaders, and teachers who have direct and indirect influence on reducing barriers to the successful use of AT.

# CHAPTER ONE: INTRODUCTION

## Overview

In the last decade, many education systems have sought to provide appropriate education for all students, especially those with disabilities, since effective and efficient instructional methods are needed for their successful education (Smith, Spooner, & Wood, 2013). Policymakers, administrators, educational leaders, and researchers agree that the need to utilize technology in the classroom setting and in teaching activities is growing (Fullan, 2012; Lei & Zhao, 2007; Mishra, 2012; Wachira & Keengwe, 2011). The No Child Left Behind (NCLB) Act of 2001 promoted the use of technology to support instruction (The Special Edge, 2003), mandating that the integration of technology into the curriculum was required to qualify for state and federal funding. Teachers in turn would need to learn how to integrate technology into all aspects of learning in the United States.

Governments throughout the world recognize that the use of technology in the education system to teach all students will increase the success of education (Handler, 1992; Ritchel, 2011). In 2015, the US government designed a new law which was called the Every Student Succeeds Act (ESSA) to replace the NCLB Act, wherein the focus on using technology in schools still remains (Brown, Boser, Sargrad, & Marchitello, 2016).

The Kingdom of Saudi Arabia is currently supporting all schools to improve the country's education system by using technology in the classroom to provide the best education for all students, especially those with a disability (Al-Abdulkareem, 2008; Al-Yousif, 2008). Furthermore, Saudi governments have spent billions of dollars on the Ministry of Education with

the intention of rebuilding learning and teaching based on technology in schools (Ministry of Education, 2008).

Education is a fundamental right of students with disabilities in Saudi Arabia, as stated earlier in the Saudi Basic Law of Governance (Al-Fahad, 2005; Human Rights Commission, 2017; United Nations, 2015). Therefore, schools and teachers need to increase the use of educational strategies based on technologies and assistive technology (AT) to meet the educational needs of students with disabilities in the classroom (Bouck, 2016; Coghlan & Hare, 2005; Ziegler, 2007). The use of technology in this setting has brought about change and makes for an effective learning environment (Bucci, Cherup, Cunningham, & Petrosino, 2003; Dolenc & Abersek, 2015; Lei & Zhao, 2007; Mishra, 2012; Protheroe, 2005; Wachira & Keengwe, 2011). Moreover, students with autism spectrum disorder (ASD) comprise an important group that benefits from the use of technology. In particular, AT has effective tools for participation and learning for students with ASD (Hitchcock, Meyer, Rose & Jackson, 2006; Lancioni & Singh 2014), and it affords them the opportunity to access the general education curriculum (Bouck & Flanagan, 2009; Edyburn, 2000; Jeffs, Behrmann, & Bannan-Ritland, 2006; Okolo & Bouck, 2007; Parette & Stone, 2008).

The passage of the Technology-Related Assistance for Individuals with Disabilities Act (The Tech Act of 1988) provided the first definitions of AT devices and services that helped students with disabilities to access the general classroom setting and education curriculum. Such accessibility can potentially have a positive impact on students' learning (Bouck & Flanagan, 2009; Jeffs, Behrmann, & Bannan-Ritland, 2006; Okolo & Bouck, 2007) and increase the academic, communication, independent functioning, and speech skills of students with disabilities (Bimbrahw, Boger, & Mihailidis, 2012; DePountis et al., 2015; Goldstein & Naglieri, 2013;

Kagohara et al., 2010; Lancioni et al. 2007; McCallum, & Sorrell 2007; Nikopoulos & Keenan, 2007; Rispoli et al. 2010).

The Americans with Disabilities Act of 1990 subsequently addresses the right of students with disabilities to access educational settings and use AT equipment (Mondak, 2000). Furthermore, the Tech Act was improved in 1994 to enhance access to AT devices required by students with a disability in order to support them to succeed in schools and to be more independent (Alper & Raharinirina, 2006). Finally, the Individuals with Disabilities Act of 2004 impacted declared that the Individualized Education Program (IEP) should include AT devices and services to those types of students to ensure their inclusion in the regular education environment (Bartlett, Etscheidt, & Weisenstein, 2007).

The Ministry of Education in Saudi Arabia provides a free public education system for all students. It also has policies and legislation to guarantee their equal access to high-quality education (Alquraini, 2010). Despite this, students with ASD still need a policy that focuses on the use of AT in their schools (Alrubiyea, 2010). A lack of special education services provided to students with ASD has contributed to the Saudi government's reconsideration of the ways in which to improve these services (Alquraini, 2011).

The number of individuals with autism is increasing in Saudi Arabia (Alnemary et al., 2017; El-Ansary, & Al-Ayadhi, 2012; General Authority for statistics, 2017), and teachers still face many challenges in teaching those students (Lindsay, Proulx, Scott, & Thomson, 2014). Educational research has provided many effective methods for teaching students with ASD (McKissick, Spooner, Wood, & Diegelmann, 2013), for whom effective teaching methods are necessary to help them learn new skills (McKissick, Spooner, Wood, & Diegelmann, 2013).

One effective strategy would be to use AT to teach students with ASD, since its valuable role in that context has long been theorized within the published research (McKissick et al., 2013; Panyan, 1984; Pennington, 2010). Research on ASD cases and the use of technology has seen a dramatic rise between 2000 and 2010 (Virnes, Kärnä, & Vellonen, 2015). These researchers indicate that technology may act as an effective intervention for students with ASD (Lancioni & Singh, 2014). Nevertheless, the debate about the effectiveness of using technology to build the skills of students with autism is still ongoing (Burnett, 2010). Many studies have investigated the extent of the implementation of AT for teaching students with disabilities in some countries. However, limited studies in Saudi Arabia have examined the states of using AT to teach these students (AlFaraj and Kuyini, 2014).

The effective use of AT in the classroom can be influenced by many factors, one of which is how teachers apply the technology in their classrooms (Albirini, 2006; Becker, Ravitz, & Wong, 1999; Papanastasiou & Angeli, 2008). Teachers play a significant part in the success or failure of the use of technology in teaching and learning processes (Baylor & Ritchie, 2002; Wang, Ertmer, & Newby, 2004). They also face many barriers that impede the effective application of technology (Cox, Cox, & Preston, 2000. Judge & Simms, 2009; Michaels & McDermott, 2003). Ertmer (2005) has concluded that to effectively implement technology in the classroom, one must understand the obstacles that impact teachers' abilities and prevent them from adopting AT in the classroom. In this regard, it is thus necessary to investigate teachers' utilization of technology and explore all aspects that contribute to its effective application in teaching (Huang & Liaw, 2005). The primary purpose of this research is to explore the barriers affecting Saudi teachers' use of AT for teaching children with ASD.

**Statement of the Problem**

There is a growing structure of knowledge regarding the employment of AT to improve the skills of students with ASD that has contributed to the increasing prevalence of it in schools (DePountis, Pogrund, Griffin-Shirley, & Lan, 2015; Michaels & McDermott, 2003). Federal legislation, policy, and literature have confirmed the benefits of AT for teaching students with ASD (Hollins, 2017). Most studies have found that when special education teachers employ AT effectively, students' engagement and achievement improve (Bell, McCallum, & Sorrell, 2007; Goldsmith & LeBlanc, 2004; Kouzoukas, Siegal, & Thomas, 2000).

Nevertheless, the effective use of AT is still a concern and a critical issue for many special education teachers (Alhossein & Aldawood, 2017; Zilz & Pang 2019). This is because teachers are experiencing a variety of barriers to integrating technology in classrooms (Hew & Brush, 2007; Jeffreys, 2000; Laird & Kuh, 2005; Klopfer, Osterweil, Groff, & Haas, 2009). Most studies have found that teachers will choose to forego the use of technology when they face barriers that affect their ability to use it (Abbott, 2003; Kurt, 2013; Shaffer, 2013).

Barriers to technology integration have been described within some educational literature (Ertmer, 1999; Guha, 2003; Marcinkiewicz, 1994; Sheingold & Hadley, 1990). Ertmer (1999) divided the teacher-related barriers to use technology in the classroom into two major categories: external (first-order barriers) and internal (second-order barriers). First-order barriers are incremental and institutional, such as acquisition of the technical skills needed to successfully work on technology, limited resources, a lack of technical support, and limited time. Second-order barriers are fundamental and personal, such as a lack of adequate skills, teachers' personal attitudes, and their beliefs. With the existence of these barriers, teachers may think that the use of integrated technology is too distant a goal to achieve. However, few studies have investigated how

one can overcome these barriers (Ertmer, Cindy, & York, 2006). Research of this type is important because the challenges facing teachers require attention and solutions.

In many countries, they believe that the effective use of strategies and practices falls to teachers (Davis, 2002) and that the teacher plays a critical role in the teaching process (Groff & Mouza, 2008; Inan & Lowther, 2010; Keengwe et al., 2008; Whitaker et al., 2015). In Saudi Arabia, the Ministry of Education has emphasized the importance of the teacher preparation programs and professional development to improve teachers' knowledge and skills necessary to implement AT for students in classrooms (Aldabas, 2015). While the literature regarding teacher preparation states that teachers have limited opportunities in-depth knowledge of AT (Bausch, Ault, Evmenova, & Behrmann, 2008). For the most part, teachers are not properly trained in using AT, which is essential for teaching students with ASD in the classroom (Alkahtani, 2013; Alsalem, 2010; Lee & Vega, 2005). To achieve the effective use of AT, all barriers that affect teachers' abilities to use AT must be reduced or removed. Therefore, determining these barriers is important.

Many studies have examined the effective use of ATs for teaching students with ASD in the classroom (Daud, Maria, Shahbodin, & Ahmad, 2018; Desideri et al., 2020). However, few studies have explored AT practices and the barriers that are often influential factors in effective AT use in the classroom (Alfaraj & Kuyini, 2014; Subihi, 2014). This lack of research is particularly problematic for the education system in Saudi Arabia because of the large number of students with ASD in the schools.

This study thus seeks to highlight the teachers' perspective regarding barriers to the use of AT. An understanding and a reflection on their perspective will assist policymakers, education department, and school leaders in reducing those barriers (Daniels, Jacobsen, Varnhagen, &

Friesen, 2013; Ertmer et al., 2012; Lim et al., 2013). Furthermore, necessary support can consequently be provided for teachers and schools to utilize AT in classrooms.

**Purpose**

Since special education teachers are the end users of AT, they have a fundamental role in its success or failure in the educational purposes (Mueller, Wood, Willoughby, Ross & Specht, 2008). The present study used data from a mixed-methods approach with those types of teachers who work in Saudi Arabian schools to explore the perceived barriers of the use of AT and to increase the understanding of why such teachers are successfully or unsuccessfully using AT as a classroom tool for teaching students with ASD.

The study was not intended to evaluate a teacher's ability to implement AT; it aimed to identify, explore, and interpret the first- and second-order barriers to the use of AT through the lived experiences of teachers. The results of the study provide valuable information to the Special Education Department, school leaders, and education department administrators who will be contributing to reducing or removing the current barriers facing special education teachers when integrating AT in the classroom. The primary purpose of this study was to explore the barriers affecting Saudi teachers' use of AT for teaching children with ASD.

**Research Questions**

The best approach to identify the perceived barriers is the use of both qualitative and quantitative methodologies, which led to an exploration of the commonalities in special education teachers' failure to integrate AT to help ASD students develop learning skills. The study used of the following central research question to guide the development of the research design:
What barriers do teachers identify as hindering their ability to use AT for teaching children with ASD? This question was answered by exploring the following four questions:

1. How often do Saudi teachers use AT in the classroom with students with ASD?

2. What extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

3. What intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

4. How do the perceived barriers affect teachers' abilities to use AT within the classroom?

**Significance of the Study**

The significance of current research within the special education systems of Saudi Arabia and other countries is manifold. First, understanding the barriers to AT integration could allow teachers to perform their tasks to fulfill the needs of students with ASD, since the literature supports that AT is a successful tool to improve the academic skills, self-efficacy, independence, and quality of life of those students (DePountis et al., 2015; Goldstein & Naglieri, 2013).

Second, this research contributes to the field of autism, particularly in Saudi Arabia. The findings of the research will be shared with The General Administration of Public Education in Riyadh. Data collected from the mixed-method approach will provide insights into the barriers affecting the successful use of AT in the classroom, and Saudi Arabian officials could utilize those insights to reform current practices related to technology support, resource management, and increased professional development opportunities for special education teachers to ensure that they have the ability to integrate AT to teach students with ASD.

Third, this research contributed to the body of literature related to barriers that prevent special education teachers from using AT with students with ASD. Little research exists that explores the barriers affecting special education teachers' adoption of AT to teach students with ASD in the classroom (Bausch et al., 2008; Edyburn, 2009; Edyburn, 2013; Quinn, Behrmann, &

Mastropieri, 2009; Sze 2009). Moreover, more research is needed (Burke, 2014; Gaffner, 2015; Gentry, Wallace, Kvarfordt, and Lynch, 2010; Kopcha, 2012).

Fourth, the findings from this research could benefit education department administrators, who have a direct and an indirect influence on the actions that will reduce barriers to the successful use of AT. Fullan (2007) has indicated that reducing barriers is the cornerstone of achieving successful educational reform. Therefore, exploring and reflecting on teachers' perspectives about the barriers to AT use will help education department to provide the necessary support to special education teachers.

Fifth, reducing the obstacles to AT integration is a critical issue and must be understood to achieve the best results. Teachers provided valuable information to this research through an exploration of what special education teachers experience in their classroom environment. Without asking teachers to explain and identify the first- and second-order barriers that they face when integrating AT into the classroom, it remains of limited use (Gulbahar, 2007; Van Barneveld, 2008; Weisner, 2014).

Finally, the use of AT by special education teachers indicates the need for continued research into the types of barriers (extrinsic or intrinsic) inhibiting teachers' use of the technology in the classroom (Al Faraj & Kuyini, 2014; Subihi, 2014). The findings of this study helps future researchers explore other barriers.

**Conceptual Framework**

Most teachers who fail to use technology in the classroom often claim that obstacles exist that prevent its use in teaching their students (USDOE, 2015; Wright, 2013). The study's Conceptual framework is based on Ertmer's (1999) the main article, and Ertmer et al.'s (2005, 2006, 2008, 2010) subsequent examinations of technology use in the classroom. Ertmer (1999)

describes the first-order barriers to integrating technology as being extrinsic to teachers, such as lack of resources, lack of time, lack of training, and lack of support. In contrast, second-order barriers are intrinsic to teachers, such as teachers' beliefs and attitude, a lack of confidence, and a lack of knowledge. Ertmer's assumption on extrinsic and intrinsic barriers provides a solid foundation for many researchers to explore those barriers (Brush, Glazewski, & Hew, 2008; Chen, 2008; Hew & Brush, 2007; Hinson, et al., 2006; Lowther, et al., 2008; Schoepp, 2004; Wachira & Keengwe, 2011; Wang & Reeves, 2003).

Ertmer followed Brickner's (1995) concept of first-order and second-order barriers that built on the models of change by Fullan and Stiegelbauer (1991). Dianna Brickner has developed a theoretical framework to evaluate the barriers that hinder a teacher when implementing technology for educational purposes in the classroom. Furthermore, Brickner (1995) divided these barriers into extrinsic and intrinsic barriers. She defined both of them as "obstacles which impede the effective implementation of a projected change or innovation" (Brickner, 1995, p. 6). Teachers can easily identify first-order barriers to change because these barriers exist outside of their control, for example the lack of teacher access to AT devices. Conversely, teachers are reluctant to admit to the existence of second-order barriers because these barriers exist within the teacher, for example negative attitudes of teachers toward the use of AT to teach students with ASD.

Brickner's framework is based on the work of three preeminent educational change theorists: Roger's (1983) diffusion of innovation, Fullan's (1991) meaning of educational change, and Cuban's (1993) constancy and change. The concept of change has provided rich commentary on the phenomenon of change in educational systems (Cuban, 1993; Fullan, 1991; Rogers, 1983).

Rogers's concept of diffusing innovations has contributed to identifying teachers' barriers to the integration of educational innovations in classrooms and explaining why some educational

innovations succeed while others fail. The implication of diffusion of innovation is that it requires a time commitment from an individual who participates in embracing innovation, since he or she must fully understand the adopted innovations. Qualified change agents who work with school leaders must thus facilitate innovation for them. In addition, to study the use of technology in schools, the focus should be on the nature of the type of technology, ways in which to use technology in education, the barriers to its effective use, and the characteristics of teachers.

Educational change is related to concepts of the objective reality of the innovation and the subjective realities of the individual. The works of Michael Fullan have focused on the reform and change of the education system. Fullan (1982, 1991) has focused on roles, strategies, and change and suggests that the change process has four broad phases: initiation, implementation, continuation, and outcome. Fullan, (2007) also identifies eight major factors that affect the initiation phase: "1. Existence and quality of innovations, 2. access to innovation, 3. Advocacy from central administration, 4. Teacher advocacy, 5. External change agents, 6. Community pressure/ support/apathy, 7. New policy-funds, and 8. Problem-solving and bureaucratic orientations" (Fullan, 2007, p 70)

Cuban proposes a framework for understanding change. He categorizes educational change as being first- and second-order change, and he labels them as "incremental" and "fundamental."

**Summary of Methodology**

This study used a mixed-methods approach to explore the barriers affecting Saudi teachers' use of AT for teaching children with ASD. A mixed-methods contributed to the better comprehension of the research questions and the problem more than quantitative and qualitative that used by itself (Creswell, 2013). This study used online surveys that included quantitative data through the Likert scale and qualitative data that used open-ended questions. Therefore, the

elements of embedded mixed methods design have the potential to develop a complete exploring the practices of AT and barriers that often the influential factors in effective use it in the classroom (Doyle & Byrne, 2009). The instrument built based on Ertmer (1999) framework, which categorizes the barriers that influencing teachers' ability to effectively use for technology in the classroom.

## Definition of Terms

The purpose of this section is to define several key terms in this research. Definition of terms is important to clarify and understand the significant concepts of this dissertation.

### Assistive Technology

This consist of all tools or technological devices designed to support individuals with disability to enhance access to learning material effortlessly and to gain skills (IDEA, 2004; Schoepp, 2005). The Assistive Technology Act of 1998 and 2004 defines AT as "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" [20 U.S.C. Chapter 33, Section 1401 (26)].

### Integrating Technology

This involves the use of technology resources and technology-based practices in instruction, curriculum, and learning in the classroom (Anderson & Dexter, 2005; NCES, 2005).

### Barriers

These are any factors that lead to the prevention of or reduction in the use of instructional innovation in teaching methods in the classroom (Alaugab, 2007; Beggs, 2000).

**Autism Spectrum Disorder**

Children with autism have varied skills and deficits. The Individuals with Disabilities Education Act 2004 (IDEA; 2004) describes ASD as developmental disabilities that affect communication and socialization and which negatively affect the academic skills of children. The increasing rate of students with ASD to 1 in 54 children (CDC, 2016). Furthermore, 90% of children with ASD have limited expressive language with the development of words or phrases (Pickles et al., 2013). Children with ASD also face a challenge in learning new academic skills because of delayed language acquisition and social skills, which pose a challenge for educators in helping their students to access the general classroom (U.S. Department of Education 2015; Wood, Thompson, & Root, 2015).

**Conclusion**

Assistive technology is a powerful tool for teaching students with ASD when special education teachers use it effectively. While it is recognized that AT can provide a broad range of benefits for students with ASD, teachers are the most significant factor affecting the successful use of the technology among students with disabilities (Edyburn & Gardner, 1999; Hitchcock, Meyer, Rose & Jackson, 2002 Wojcik, Peterson-Karlan, Watts, & Parette, 2004). Many barriers affect special education teachers' successful use of AT in the classroom (Derer et al., 1996; Ashton, 2005; Ault, Bausch, & McLaren, 2013; Borg & Ostergren, 2015; Bouck, 2016), and this success of AT integration depends on how teachers are using the technology. In general, while many studies have examined the effects of use the AT into education and teaching students with ASD, a limited amount of research focuses on teachers' perspectives regarding the challenges of implementation of technology in their context (Luckin et al., 2012).

# CHAPTER TWO: LITERATURE REVIEW

**Introduction**

In this chapter, many studies are reviewed to provide an overall understanding of the barriers that affect teachers' ability to use assistive technology (AT) to support students with autism spectrum disorder (ASD). The beginning of chapter two is an overview of the education system of Saudi Arabia, and following provides more detailed information about teachers of students with autism, while the literature highlighted the needs of students with ASD, then describes AT and provides multiple benefits of using such technology. The next section reviews the legislation and regulations that strove to increase the legal rights of individuals with a disability and integrate AT into their schools.

The final section deals mainly with barriers to the usage of AT. For this section of the literature review, these barriers are divided into two categories, namely, first- and second-order barriers, following Ertmer's (1999) concept of barriers, which was explored in the theoretical framework of this dissertation in chapter one. The following were cited as the top teacher-perceived barriers that hinder the successful utilization of AT in classrooms: lack of access, lack of time, lack of training, lack of support, teachers' beliefs and attitude, lack of confidence, and lack of knowledge. Most of this literature review collected data from U.S studies describing barriers related to the use of AT. More research on this topic is required in Saudi Arabia, with specific attention to special education teachers' perceived barriers.

The importance of using AT to support students with ASD has recently caused a dramatic increase in the number of studies about it (DiGennaro Reed, Hyman & Hirst, 2011; Fletcher-

Watson, 2014; Goldstein & Naglieri, 2013; Keintz et al., 2014; Knight, McKissick, Saunders 2013; Myles, 2009; Parette & Peterson-Karlan, 2007; Ramdoss et al., 2011; Ramdoss et al., 2012; Wainer & Ingersoll, 2011). The search strategy of this literature was based on several databases, which include PsycINFO, ProQuest Dissertations and Theses Global, and Google Scholar. The key terms used in these databases include the following: Assistive Technology, Barriers Assistive Technology, Barriers Technology Autism, Obstacles Assistive Technology, Teachers Assistive Technology, Technology Autism, Barriers Technology, Saudis special education teachers, and Autism Saudi Arabia.

**The Education System in Saudi Arabia**

Crucial reforms in the education sector in the country have occurred since its establishment approximately 90 years ago. Education was initially perceived to be a privilege reserved for rich families only; in fact, it was thought to be for children from elite families (Bowen, 2014). However, gradual changes are currently being witnessed with respect to the construction of education facilities. According to the Ministry of Education (2018), the number of government-sponsored schools and private schools, as well as international schools, is much higher than 28,000 with a capacity for approximately 5 million students. The Ministry of Education provided an equal budget, consistent teachers' salaries, and the same curriculum for all schools. In addition, special needs students are also included in regular classrooms or in special education classrooms to meet their special needs.

At this time, education has become a top need for the Saudi government, which distributes around 33% of the yearly budget to education. Nevertheless, the substantial budget for education does not legitimize the truth that the special education sector in Saudi Arabia still faces numerous hardships in the modern era. The history of Saudi Arabia demonstrates that special education is

still an emerging issue. However, Saudi government offers free education to all students, including those with disabilities. This has helped students with disabilities to pursue independent living with less support from the outside (Al-Mousa et al., 2006).

In Saudi Arabia, individuals with disability were not given services before 1958 (Al-Ajmi, 2006). The guardians of students with special needs were responsible for providing any help to these individuals. In 1958, special education programs for such students began to develop in Saudi Arabia, with a number of students with visual impairment obtaining their education from institutions recognized as scientific institutes (Al-Kheraigi,1989). Then, the Ministry of Education established the Administration of Special Education in 1962. The purpose of this administration was to create and develop the special education programs for students with disabilities (Afeafe, 2000). This initiative was followed by the setup of three special education programs – in Aneaza, Makkah, and Alhofouf – in 1964 to satisfy the different needs of students. These schools were collectively called the Al-Noor Institute and were bolstered by the Ministry of Education (Al-Mousa, 1999).

Thereafter, clear and strict regulations were implemented guaranteeing the rights of individuals with disabilities, better education services, and qualified personnel to offer these services (Al-Quraini, 2010). By 1987, approximately 27 schools and training institutes had consequently been established to provide education to students with disability across the country. The institutions were Al-Noor, Al-Amal, and Intellectual Education Institutes (Al-Kheraigi, 1989). Likewise, service and supports for individuals with disabilities from the government and non-government associations increased by 1990.

Education for children with ASD subsequently began in the 1990s, soon after the culmination of the Gulf War between Kuwait and Iraq (Al-Faiz, 2006; Aldabas, 2015). A Kuwaiti

woman came to Saudi Arabia and established the first classroom for four children with autism at Al-Faisaliah Women's Charitable Society. Following this major initiative, different centers continued to emerge to serve children with ASD. Official services started in schools in 1997 to serve 13 students with ASD. In 2000, the General Secretariat for Special Education created the many programs for students with ASD to be educated in special education schools. Furthermore, various classrooms for students with ASD have continually been established in public schools (Al-Mousa, 2010).

A recent publication indicates that the Ministry of Education offers special education to over 2698 children with autism (Ministry of Education, 2018). The students were served in inclusive and special education classrooms in different public schools or special education schools. Regardless of the massive efforts made by the Ministry of Labor and Social Development and Ministry of Education to improve educational and rehabilitation services, the number of students with autism attending these schools remains low; the students go to neighboring countries, as Jordan, the United Arab Emirates, and Egypt, or to Western countries such as the US and the UK for the same services.

AlQuraini (2011) states that no special services are offered for other areas of disability, such as attention deficit and hyperactive disorder (ADHD) or behavioral and emotional disorders, since these appear to be disorders rather than disabilities. In essence, children with cognitive disabilities attend separate classrooms inside public schools, and they share extracurricular activities with students in general classrooms. The schools offer special education curricula to these children that differ from the common curriculum offered in general classrooms (Al-Mousa et al., 2006).

As noted by Alnemary et al. (2017), other challenges in the services of students with ASD such as diagnostic issues and inclusive education. Social status and location also affect families' abilities to look for diagnosis and education of their children. As indicated in Alnemary et al.'s report, there are limited services offered in small cities. Therefore, if the families do not reside in a big city, special education services and public schools are not meet the needs for their children. As a consequence, regardless of the fact that education in Saudi Arabia is free, it is not accessible to all. Most students with ASD attend private institutions for which their families pay heavily. It has been a common practice for one to travel to the major cities to obtain private services; however, this is dependent on one's financial strength and level of knowledge.

**Teachers of Students with Autism in Saudi Arabia**

The need for well-trained teachers has become increasingly important in light of the growing number of students with ASD in schools (Razali et al., 2013; Sansosti & Powell-Smith, 2008; Zager, 2005). Teachers of students with ASD must possess sufficient knowledge and skills to successfully teach their students with autism (Hart & Malian, 2013). Students with ASD could access to the general educational setting when they receiving an appropriate education (Edyburn, 2000; Schlosser & Blischalk, 2004). They should have an understanding of the variety of needs of students with ASD along with the ability to identify and utilize the best practices to teach their students. The broad knowledge of teachers pertaining to the autism field plays an important role in effectively meeting students' needs. Some studies have revealed that the weakest aspect of teaching students with ASD is teacher preparation (Hart & Malian, 2013; Razali et al., 2013; Scheuermann et al., 2003).

The Ministry of Education, as a government ministry responsible for all Saudi universities and schools, pays much attention to ensuring the quality of teachers who teach students with ASD

(Center for Autism Research, 2014) as well as recruiting and training teachers at all levels. In Saudi Arabia, the Ministry of Education provides financial incentives for principals and teachers who work with students with a disability. For example, teachers who teach individuals with a disability receive a 30% higher monthly salary than other teachers (Al-Mousa, 2010).

Some Saudi universities offer a teacher preparation program in the autism field. The first two years of this program focus generally on the special education area, with an introduction to special education courses, an overview of all disabilities, and strategies and practices to teach students with a disability. Thereafter, students in this program complete coursework in the autism field within two years that will improve their understanding. The program also includes a four-month internship that will provide access to special education classrooms. During this internship, pre-service teachers in an early stage visit the school in order to become acquainted with students with ASD, the classroom environment, and ways in which to use the best practices and strategies to improve students' skills. (Jobling & Moni, 2004; Loiacono & Valenti, 2010). In Saudi Arabia, much of the discussion is still focused on the efficacy or inefficacy of teacher preparation programs because most departments of special education are relatively new (Almasoud, 2010; Haimour & Obaidat, 2013).

Despite the Ministry of Education and universities' current efforts to improve the quality of special education teachers, many weaknesses still exist in teacher preparation for autism (Al-Faiz, 2006; Barnhill, Sumutka, Polloway, & Lee, 2014; Donaldson, 2015; Scheuermann et al., 2003). A number of aspects should thus be reformed within preparation programs for teachers of students with ASD (Hart & Malian, 2013; Loiacono & Feeley, 2009). In-service teachers have negative impressions of preparing special education teachers at universities because of a lack of courses on identifying goals for students with disabilities and insufficient courses about transition

services (Alnahdi, 2014). Furthermore, the teachers reported a lack of courses focused on inclusivity (Aldabas, 2015). On the other hand, only one course exists on AT for pre-service teachers in Saudi Arabia (Alquraini, 2011).

Haimour and Obadiat (2013) used the Autism Knowledge Questionnaire (AKQ) to evaluate the level of Saudi teachers; knowledge about autism. Participants consisted of 391 teachers from Jeddah city, and the findings of the study revealed that teachers have a weak level of knowledge about autism. This has also been explored in another study by Almasoud (2010): most of the Saudi teachers who teach students with ASD had limited knowledge of autism and lacked the skills to teach them. Special education teachers face many difficulties in teaching students with ASD, and continued high-quality professional development for these teachers will reduce most of the obstacles in implementing strategies and practices in classrooms (Donaldson; 2015). Training special education teachers on effective strategies through multiple resources is required because many teachers have limited knowledge on employing these strategies with their students with a disability (Scheuermann et al., 2003). Equally important, preparation for pre-service and in-service teachers is a central factor that impacts on the effective use of AT to teach students with disability in classrooms (Cramer et al., 2015).

**Importance of Teachers of Students with Autism Training on use AT**

The use of AT for students with ASD is an effective learning support because of the many benefits of integrating it in a classroom (Goldsmith & LeBlanc, 2004; Lancioni & Singh 2014). Special education teachers play a critical role in determining the types of AT devices that will be effective for each student with ASD (Bausch & Hasselbring, 2004; Gooler, Kautzer, & Knuth, 2000; Mosenthall et al., 2004). Training teachers on AT devices is one of the most important factors that help the successful implementation of AT in the classroom (Alquraini, 2011). The

main challenge is that most teachers lack knowledge about using AT to meet the needs of their students (Abner & Lahm, 2002; Beigel, 2000; Michaels & McDermott, 2003; Nelson, 2006). Teacher preparation programs should thus allow learners to have repeated exposure to practices and the use of AT devices and services that will contribute to increasing their skills and knowledge (Bausch & Hasselbring, 2004; Judge & Simms, 2009; Michaels & McDermott, 2003; Smith, 2000). Multiple opportunities for practical experience to improve the skills of special education teachers in successfully implementing AT are much-needed (Van Laarhoven & Conderman, 2011). Judge and Simms (2009) evaluated AT training at the pre-service level for special education teachers at institutions of higher education. The finding has indicated that 33% of bachelor degrees and 25% of master degrees provided AT coursework. The authors have also reported that 86% of undergraduate programs provided one AT course during a teacher's preparation period. These results indicate that a large number of special education teachers began to work at schools without AT skills and knowledge.

Effective professional development contributes to a positive impact on a teacher's teaching practices in the classroom, which reflects positively on student learning (Gulamhussein, 2013; Vescio, Ross, & Adams, 2008). Fullan (1991) defines professional development as "the sum total of formal and informal learning experiences throughout one's career from pre-service teacher education to retirement" (p. 326). Professional development depends on teachers remaining up-to-date in the assistive technology services context in order to ensure that teachers of students with ASD succeed in using AT. One of the primary causes of ineffective professional development is that it does not fit the needs of teachers (Mezill, 2010). Providing effective professional development involves the sharing of teachers' experiences pertaining to designing, developing, and reforming professional training to match their needs (Hargreaves & Fullan, 2012).

Schools and education departments should ensure that teachers have continuous access to skills and comprehensive knowledge to meet those teachers' needs for the learning process (Archibald, Coggshall, Croft, & Goe, 2011). Professional development is not limited to workshops or training courses, but rather involves ongoing interaction between the teacher and the surrounding environment. The teacher also requires continuous education to successfully and effectively employ the strategies and teaching practices in the classroom (Fullan, 2007). Alkahtani (2013) reported that over 84% of general and special education teachers were interested in receiving professional training related to AT use in their classroom.

Many studies have asserted that a strong relationship exists between effective use of AT with students with a disability and teachers' knowledge of AT (Michaels & McDermott, 2003). For the useful integration of AT, special education teachers must have sufficient knowledge of AT devices and services (Oyler, 2001). Many scholars have therefore suggested that teacher preparation programs at colleges should provide a deep understanding of AT for students in the early stage of their studies. Teacher preparation programs contribute to improving teachers' knowledge and helping them to correctly make decisions to implement AT services with their students in the future (Bausch & Hasselbring, 2004; Edybum & Gardner, 1999; Langone, Malone, Stecker, & Greene, 1998; Maushak, Kelley, & Blodgett, 2001; Michaels & McDermott, 2003; Office of Technology Assessment, 1995).

However, AT content must be permanently incorporated into core courses, teachers' preparation, and professional development (Aldabas, 2015; Ashton, 2005; Lahm, 2005). Furthermore, some faculty members who are responsible for teacher preparation programs have a lack of knowledge regarding AT devices and services (Judge & Simms, 2009; Okolo & Diedrick, 2014). This limited knowledge is negatively affecting the preparation of teachers relating to the

use of AT in the future. Another study by Michaels and McDermott (2003) concluded that faculty members' lack of knowledge and expertise about AT impedes the successful use of the technology to teach students with disabilities. Most of the pre-service teachers received a brief overview of AT devices and services within fundamental courses (Judge & Simms, 2009). To help improve teacher quality, Morrier et al. (2011) have suggested that a key objective during the teacher preparation period must be to allow pre-service teachers to gain field experience in order to grant them the opportunity to work with students with ASD. In Saudi, more importantly, the Ministry of Education must support professional development programs focused on using AT in work-related scenarios to train in-service teachers (Aldabas, 2015).

**Students with Autism**

Autism is a developmental disorder affecting social skills, repetitive behaviors, and verbal and non-verbal communication (Geschwind, 2009; Le Couteur & Szatmari, 2015; Lichtenstein et al., 2010; National Research Council, 2001). Autism is usually detectable between the ages of 2 and 3 years old (Al-Salehi, Al-Hifthy, & Ghaziuddin, 2009; Chamak et al., 2011; Howlin & Asgharian, 1999; Lord et al., 2006; National Autistic Society, 2012; Siklos & Kerns, 2007). In 2016 statistics of the Centers for Disease Control and Prevention (CDC) have reported that 1 in 54 children in the US has autism (CDC, 2016; Maenner, Shaw, & Baio, 2020). On average, in terms of the prevalence rate, 1 in every 42 boys and 1 in every 189 girls were diagnosed as children with ASD (CDC, 2014).

The number of individuals with ASD grew by 119.4% from 2000 to 2010 (CDC, 2014), and it is the fastest-growing developmental disability in the US (Alegria, Pescosolido, Williams, & Canino, 2011; CDC, 2008; Zager, 2005). Based on data from 2011–2013 until 2014, there has been a considerable increase in the prevalence of ASD. In 2013, the rate of prevalence increased

by 1.25%, and 2014 data indicated that the prevalence of ASD increased by 2.24% (Zablotsky et al., 2015).

In fact, the number of individuals with ASD is increasing dramatically because of increased individuals' diagnosis and awareness of autism (Amaral, Dawson, & Geschwind, 2011; Downs & Downs, 2010; Gernsbacher et al., 2005; Sansosti & Powell-Smith, 2008; Zager, 2005). However, many individuals are still undiagnosed as children with autism (Russell, Ford, Steer, & Golding, 2010), while 55% to 66% of individuals with ASD traits were undiagnosed (Kim et al., 2011; Russell et al., 2010).

The new diagnostic criteria, DSM-5, from the American Psychological Association (APA) have integrated autism, Asperger's disorder, and pervasive developmental delay into one broad category called "autism spectrum disorder" (APA, 2013; Glicksm, 2012; Harrison, 2012). Individuals with ASD have difficulties with social interactions, communication, and repetitive behaviors (Anderson, Northam, Hendy, & Wrennal, 2001; Brasic, 2013; Ji & Findling, 2015; Kabot et al., 2003; Ratey, 2001; Rodriguez, 2011). The fifth edition of the DSM (DSM-5) has reduced the characteristics from three to two, including social communication across multiple contexts and restrictive or repetitive behaviors (APA, 2013; Frieden et al., 2014). The 90% of children with ASD who have expressive language are extremely limited in the development of words or phrases (Pickles et al., 2013). No relevant medical tests currently exist to diagnose autism; it can only be diagnosed based on the behavior and development of the child (Jeans et al., 2013).

An increasing number of students with ASD are present in schools, and teachers face many challenges in teaching them (Lindsay, Proulx, Scott, & Thomson, 2014). Educational research has provided many effective methods for teaching students with ASD (McKissick, Spooner, Wood, & Diegelmann, 2013). Furthermore, a large number of existing studies in the broader literature have

highlighted challenges and obstacles when teaching these students special education teachers have reported that a lack of both knowledge about autism and appropriate teaching methods is the largest problem (Alkahtani, 2013; Bausch, et al., 2008; Barned, Knapp, & Neuharth-Pritchett, 2011; Donaldson, 2015; Haimour & Obaidat, 2013; Hendricks, 2011; Loiacono & Valenti, 2010; McCormick, 2011; Young, Mannix McNamara, & Coughlan, 2017; Simpson, Mundschenk, & Heflin, 2011).

Children with ASD face a challenge in learning new academic skills because of delayed language acquisition and poor social skills, which pose a challenge for educators in helping their students to access the general curriculum (Wood, Thompson, & Root, 2015). Education and early intervention are major factors to improve the skills of students with ASD and meet the needs of these students (Rattaz et al., 2012; Ruble & McGrew, 2007; Thomas, Morrissey, & McLaurin, 2007). Improving adaptive, social, and communication skills for students with ASD is of major importance to enable them to complete educational tasks independently.

In general, 35% of young adults with autism do not have a job (Shattuck, Orsmond, Wagner, & Cooper, 2011), and 50% of individuals with ASD do not enter any type of post-secondary educational programs (Chiang et al., 2012; Taylor & Seltzer, 2011). Concerns in educating and supporting individuals with ASD remain (Callahan et al., 2008). Therefore, the provision of equal and quality education is important to all individuals with ASD and can result in a better life and independency (Daugherty, 2012). Special education teachers should possess the abilities to implement behavioral interventions, practices, and strategies in order to support and teach students with ASD (Koegel, Singh, & Koegel, 2010). Without using best practices to teaching these students, their lives become difficult (Callahan, Henson, & Cowan, 2008).

One effective strategy would be to use AT to teach students with ASD. The technology plays a valuable role in improving the skills of students with ASD that have long been theorized within the published research (Kuo et al., 2013; Panyan, 1984; Pennington, 2010; Scherer, 2004). Assistive technology plays a critical role in helping students with a disability to be more independent in the classroom and in life in general (Bryant & Bryant, 2003).

Individuals with ASD are drawn to technology, especially mobile devices (Hume, Boyd, Hamm, & Kucharczyk, 2014). Many studies have indicated that individuals with ASD usually enjoy engaging in technology-based activities (Goldsmith & LeBlanc, 2004; Goodwin, 2008; Kuo et al., 2013; Porayska-Pomsta et al., 2012; Shane & Albert, 2008). Kuo, Orsmond, Coster, and Cohn (2014) reported that most teens with ASD spent 5 hours daily on a computer playing games or browsing websites and 2 hours daily watching TV. Mazurek et al.'s (2012) study confirm the same results. They assert that teens with ASD spent more time on technology devices than teens in other disability categories.

**The Number of Students with Autism in Saudi Arabia**

While the Ministry of Education has registered some success, the numbers of students with ASD in Saudi schools are still limited despite the efforts of the past 20 years. While several previous studies reported the number of individuals with ASD in Saudi Arabia, those studies have a noticeable discrepancy between their numbers. For example, some studies have stated that the frequency of ASD is 18 per 10,000 children (El-Ansary, & Al-Ayadhi, 2012; Murshid, 2011), whereas another study has reported that 6 in 1,000 are diagnosed as individuals with ASD (Aljarallah, Alwaznah, Alnasari, & Alhazmi, 2007), that substantially higher than former estimates. Furthermore, most researchers have reported that the number of individuals with ASD in Saudi Arabia is approximately 167,000 (Aljarallah et al., 2007). However, according to official

statistics in the country, 53,282 children have been diagnosed with autism, and they comprise 0.26% of the population (General Authority for statistics, 2017).

The number of students with ASD not being significant in public or special education classrooms, many students need special education services. In Saudi schools, only 14% of students with ASD are receiving education from pre-kindergarten to Grade 12 (Alnemary et al., 2017). The distribution of institutes and programs that provide services for students with ASD in Saudi is continues to grow. Moreover, a lack of services forces the parents of children with ASD to travel to, for example, Egypt or Jordan because of the low cost of services in those countries. In addition, some parents seek out high-quality special education services for their children in the UK or the US.

**Assistive Technology (AT)**

The AT devices have ability to improve the functional capability of individuals with disabilities, which includes multiple areas of student needs, such as communication, accessibility, organization, sound, sight, academic skills, mobility, and memory (Parette & Wojcik, 2004; Poel, 2007). Special education teachers' efforts to improve the functional capability of students with ASD becomes effective when they successfully utilize AT devices and services. It is clear that AT has an important mode to help students with a disability to enjoy fuller participation in their schools, homes, and society (Raskind, 2008; U.S. Department of Education, 2000). Furthermore, AT increases their ability to access the general curriculum in a regular class setting (Bartlett, Etscheidt, & Weisenstein, 2007; Edybum, 2011; Michaels, Prezant, Morabito, & Jackson, 2002; Wood, Thompson, & Root, 2015). Special education teachers with an IEP team make the decision regarding whether students with disabilities need AT devices. Each decision is made for every

student individually, and the specific types of AT devices and services are then employed in the IEP (Bouck & Flanagan, 2016).

General technology has become user-friendly, available, and cheaper than before (Jacobsen, 2012). The recent developments in technology demonstrate how thin the dividing line is between AT and instructional technology. Scholars have mentioned the existing difficulties in identifying the differences between AT and instructional technology (Fichten, Asuncion, Scapin, & 2014; Okolo & Diedrich, 2014). On the one hand, when instructional technology is used for a specific student with a disability to meet an IEP goal, it is more likely to be defined as part of AT devices and services (Virga, 2007). On the other hand, AT helps students with a disability to be more independent. However, when using AT with all students, it becomes instructional technology (Edybum, 2011). In other words, AT is utilized for individual students, whereas instructional technology means using technology tools for the purpose of improving curricula and instruction to all students.

It is important to realize that AT as any type of technology has the possibility to improve the performance of individuals with a disability (Lewis, 1998). For example, AT has the potential to support a student with ASD regarding "access to information, their abilities to convert that information to knowledge, and their communication of this knowledge to others" (Caverly & Fitzgibbons, 2007, p. 38). The definition's lack of clarity offers flexibility for teachers to decide which device could be considered as either assistive or non-assistive technology, based on the way in which it is used with students with disabilities, and which technology is needed for each of these students (Georgia Project for Assistive Technology; 2003).

In addition to the ambiguity in the definition of AT, multiple terms are used to define the types of AT, although none of them change the original meaning. There are three categories of AT

devices that enhance the capability of children with disabilities: low-tech, mid-tech, and high-tech devices (Kroth & Edge, 2007; Myles, 2009):

### Low-Tech Devices

These devices do not require batteries or electricity (Beck, 2002; Myles, 2009), do not use electronic components, and are relatively inexpensive (Dell, Newton & Petroff, 2008). Example of these types of devices are adaptive utensils, pencil grips, picture communication systems, E-Tran frames, and page holders (Behrmann, 1998; Canter, Jeffs, & Judge, 2008).

### Mid-Tech Devices

These devices do not have complex or mechanical features, and they are manually operated. Furthermore, to work, they require at least a battery or to be connected to a power source. Mid-tech devices are usually less expensive than high-tech devices (Blackhurst, 2005; Myles, 2009 Stachowiak & Estrada-Hernandez, 2010). They include calculators, video cassette players, personal spelling devices, talking picture albums, audio books, picture communication symbols (PCSs), and digital recorders (Blackhurst, 2005a).

### High-Tech Devices

These devices require a power source on which to run, and they have sophisticated electronic equipment. Examples include desktop computers, laptops, video games, interactive multimedia systems, tablets, and smartphones (Beck, 2002; Blackhurst, 2005; Floyd, Canter, Jeffs & Judge, 2008; Judge, 2000). High-tech devices are more expensive than both low-tech and mid-tech devices (Parette & Peterson-Karlan, 2007), and they could be tailored to meet the needs of students with ASD. High-tech devices being flexible, further mobility and use it for multiple tasks (Dell et al., 2008).

**Benefit of Assistive Technology**

The use of technology to enhance the abilities of students with ASD is not a new concept; it was used approximately 45 years ago (Colby 1973). Nevertheless, Lancioni et al. (2012) have reported that using technology for students with ASD is still an emerging field that could grow considerably. Kroth and Edge (2007) have indicated that all three categories of AT comprise particularly useful devices that could be used to enhance the learning of individuals with ASD. There are various and multiple areas of implementing AT devices and services depending on the needs of each individual student (Mechling, 2007; Simpson et al., 2009). Assistive technology can take many forms in the classroom; in multiple applications of AT, it is useful to consider the technology as an instrument of change for the betterment of many skills, such as academic, social, and communication skills (Bell, McCallum, & Sorrell 2007; DePountis et al., 2015; Goldstein & Naglieri, 2013).

AT devices and services have been seen as important sources of knowledge and education for individuals with a disability. Moreover, AT has strongly changed the level of special education services, thereby ensuring that students with ASD access quality education (McCallum & Sorrell 2007). The technology has facilitated the accumulation of knowledge for students by allowing them easier access to the general classroom and curriculum. Some researchers have reported that when special education teachers are successful in effectively implementing AT in their classrooms, students with a disability have a chance to learn as their peers do in a general classroom (Bell & Blackhurts 1997; Bell, McCallum, & Sorrell 2007; Kouzoukas, Siegal, & Thomas 2000). The use of AT is essential to effectively teach students with ASD (Goldsmith & LeBlanc, 2004; Lancioni & Singh 2014).

Furthermore, AT is important in promoting the learning of students with ASD and meeting their needs. It has been noted that students with ASD are more likely to become engaged and motivated when provided with technology (Goldstein & Naglieri, 2013). Special education teachers sometimes utilize a temporary technology device for students with disabilities to achieve a goal and then stop using it. Conversely, teachers use it indefinitely, in which case it is referred to as an assistive tool (Goldsmith & LeBlanc, 2004). Since the use of AT in early childhood interventions leads to increased developmental skills for children (Parette & Stoner, 2008), integrating it is important in special education, specifically in the autism field.

The use of AT may lead to the accomplishment of many academic goals, such as spelling, reading, writing, and mathematics in a short period of time (Bryant & Seay, 1998; DePountis et al., 2015; Frank, 2008; Graham & Perin, 2007; MacGregor & Pachuski, 1996; Schlosser & Blischak, 2004). In addition, AT allows students with autism the opportunity to complete tasks that would be difficult to perform without assistive devices (Ennis-Cole & Smith, 2011; Netherton & Deal, 2006; Quenneville, 2001; Sze, 2009). The technology plays a valuable role in teaching students with ASD that has long been theorized within published research (Panyan, 1984; Pennington, 2010). Many studies are discussed next with regard to skills that have been positively affected by the use of AT to teaching students with ASD.

Children with ASD face a challenge in learning new academic skills because of delayed language acquisition and social skills, which pose a challenge for educators to help their students to access the general curriculum (U.S. Department of Education 2015; Wood, Thompson, & Root, 2015). Using AT may significantly enhance the academic skills of students with ASD, mostly in writing and reading. Indeed, increasing evidence from many studies has suggested that AT devices can provide limitless opportunities to eliminate problems related to access to the general education

curriculum. For instance, Basil and Reyes (2003) examined the effect of computer programs on the reading and writing skills of students with ASD. The researchers conducted an intervention, which was based on computer programs, with six students with ASD (Delta Messages and a scaffolding approach). The findings indicated that, with the use of computer programs, those six students' written and reading skills improved significantly in a short time.

Through a study with 10 students with disabilities, Beck (2002) has reported that AT is an emerging method for teaching reading and writing skills. The students in that study were 3 years old, and they began to use AT, including Picture Communication Symbols, BIGmack switch, adapted book, and computers. These devices were integrated into daily activities and the results of this case study indicate that the successful implementation of AT leads to improved reading and writing skills among children with disabilities. Furthermore, according to Cullen, Richards, and Frank (2008), the Talking Word Processor was effective in increasing the writing skills of students with a disability.

In another study, McKissick, Spooner, Wood, & Diegelmann (2013) used three unique 24-slideshow PowerPoint presentations with written cues, verbal and animated prompts, and a hyperlink that independently presented instructional trials to investigate the effectiveness of a computer to teach map reading skills to children with ASD. In the teacher questionnaire, the teachers reported that the Computer-Assisted Instruction (CAI) was more effective than teacher instruction in teaching students with ASD in the classroom. The technology was a highly engaging form of instruction. Overall, the teachers answered favorably toward the use of technology to teach students with ASD. In addition, in some studies, the teachers of students with ASD reported their general impression of using technology as positive, but teacher training has helped to increase the acceptance of PowerPoint (Coleman-Martin, Heller, Cihak, & Irvine, 2005).

Understanding vocabulary and grammar is another critical component of learning, and it is a challenge for students with ASD; Therefore, using AT to improve this skill is necessary (Graham & Perin, 2007; Parette & McMahan, 2002). In a study conducted by Bosseler and Massaro (2003), the authors investigated the effects of using a computer-animated tutor, Baldi, which presents text with supportive pictures and spoken words, to teach vocabulary and grammar to students with ASD. The results indicate that all the students with ASD have successfully learned new vocabulary and grammar. Furthermore, these students can generalize what they learned in a natural and untrained environment. The results of this study support the claim that AT grants students with ASD the opportunity to access a general curriculum and classroom. Schlosser and Blischak (2004) investigated the effects of speech and print feedback on spelling performance in four students with ASD. The results indicated that all participants reached the criterion, and using AT increased the spelling performance of all four students.

Research that examined the effectiveness of using AT has provided evidence of benefits beyond simply improving academic skills. Perhaps one of the major benefits of AT use is the improved social skills; many effective strategies exist that focus on social skill enhancement and helping students with ASD to succeed both in school and in life. Individuals with ASD have difficulties with social skills, such as social communication and initiation, emotional perception, conversation, perspective taking, and spontaneous requesting. Video modeling is one of the best methods of improving these skills (Bellini, & Akullian, 2007; Buggey, Hoomes, Sherberger, & Williams, 2011; Delano, 2007; Jacobi, 2013; McCoy & Hermansen, 2007; Nikopoulos & Keenan, 2004; Nikopoulos & Keenan, 2007). Using a computer to teach a student with ASD is beneficial to enhance his or her social skills (Chen, 2012). The uses of computer with students with ASD have advantages more than picture cards (Mechling, 2007).

Sansosti and Powell-Smith (2008) examined the performance of social stories and video models, which were provided via computer, in improving the social skills of three participants with ASD. Overall, the data demonstrated that AT devices were effective in this regard. Reed, Hyman, and Hirst (2011) investigated the most prevalent technology being used to teach social skills to children with ASD; they found that video technology and DVDs were the most prevalent, and audio devices – to deliver scripts – were the second most-used technology.

The Individuals with Disabilities Education Act (IDEA) of 2004 describes ASD as developmental disabilities that characteristically affect the communication skills of individuals with autism. Assistive technology has the potential to increase the communication skills of these individuals (Ennis-Cole & Smith, 2011), and examples of AT devices and services are iCommunicate, Speakit, DynaVox, LearntoTalk, Liberator II, and Proloquo2Go (Kagohara et al., 2010). Using AT devices will strongly support students' communication skills and leads to an active classroom environment, especially for non-verbal students with ASD (Clark, Austin, & Craike, 2014; Hart & Malian, 2013).

In a large number of studies, researchers have revealed choices for tablet devices such as the iPad® during interventions, since they are portable for diverse activities (Flores et al., 2012). Speech-generating devices (SGDs), which produce electronic voice output that allows users to click on text or pictures to synthesize speech about an item or activity (Lancioni et al. 2007; Shane et al., 2012), are also important AT devices that have often been used to improve the communication skills of students with ASD. These individuals sometimes have difficulties with speech skills, and SGDs have the potential to improve their functional speech output and communication (Goldstein 2002; Lancioni et al. 2007; Mirenda, 2003; Rispoli et al. 2010). Speech-generating devices previously required the purchase of an electronic device dedicated to gaining

the benefits of SGDs. However, at this time, SGDs are allowed to be installed as applications on an iPad or a smartphone, thereby making them cheaper and available for each student with a disability.

Xin and Leonard (2015) investigated the effects of using the SonoFlex application by iPad to improve the communication skills of three students with ASD. The results revealed that all participants' communication skills improved, including responding, requesting, and communicating socially with teachers and peers. Travis and Geiger (2010) examined the effects of using the Picture Exchange Communication System (PECS). They found that PECS increased the communication skills and requesting skills of individuals with ASD. Waddington et al. (2014) examined the effectiveness of using speech-generating technology through an iPad to teach communication skills to three students with ASD, and they found that utilizing a speech-generating application increased engagement in requesting and social communication sequence.

AT devices have been used for students with ASD to acquire various skills; one of these skills is independent functioning (Bimbrahw, Boger, & Mihailidis, 2012; Mechling, Gast, & Krupa, 2007; Mechling, Gast, & Seid, 2009; Palmen, Didden, & Verhoeven, 2012), and AT is proving to be a major support in this area (Hume, Boyd, Hamm, & Kucharczyk, 2014). It can help students to bypass challenges and to become increasingly independent without having to rely on others (Taylor et al., 2004; Myles, Ferguson, & Hagiwara, 2007). In several studies, researchers have found that AT has potentially positive outcomes for students with ASD in terms of successful integration into activities, task completion, task management, and increasing independence (Ayres, Mechling, & Sansosti, 2013; Mazurek & Wenstrup, 2013; Vries & Geurts, 2012).

In a study by Gentry, Wallace, Kvarfordt, and Lynch (2010), 22 students with ASD in one group were trained in task management using personal digital assistants (PDAs) at school during

8 weeks of meetings. The group using PDAs improved significantly in occupational performance and independence activities. Therefore, AT has clear advantages in improving the independent skills of students with ASD and in allowing them to perform tasks they could not have completed without AT devices. Furthermore, for students with disabilities, AT has been shown to be effective in improving their integration and their engagement in activities with their classmates (Copley & Ziviani, 2004). Mechling (2007) reviewed 40 studies from 1990 to 2005 focusing on the benefits of using AT to develop the self-management ability in students with disabilities. All these studies have indicated that AT is a powerful tool to improve self-management and complete daily tasks.

**Legislation and Regulations**

Legislation and regulations strove to increase the legal rights of individuals with a disability and to integrate technology into their schools. These contributions supported research, services, and training related to using technology to increase those students' abilities to access the general education classroom (Blackhurst, 2005; Edyburn, 2000). The legislation of each country is important to legitimize insights and initiatives. Much legislation regarding AT services was written over 30 years ago in the US. As such, it was used as a reference for developing countries in education. Saudi Arabia is one of these countries that has established legislation and policies based on what was developed in the US (Al-Faiz, 2006). Saudi education policy makers, planners, implementers, and researchers reviewed the legislation of the US to create legislation and regulations that strove to increase the legal rights of individuals with a disability in Saudi Arabia. For instance, regulations were written for special education programs and institutes (RSEPIs) when the All Handicapped Children Act (EHA) of 1975 and the Individuals with Disabilities Education Improvement Act of 1997 were reviewed (Alquraini, 2011). To contemplate this topic

scientifically, a review is provided of a group of legislation and laws in the US and Saudi Arabia that is considered pertinent to the rights of students with disabilities and AT.

**The Legislation of the US**

**The Technology-Related Assistance for Individuals with Disabilities Act of 1988 (The Tech Act Public Law 100-407).** The Tech Act was the first federal legislation that introduced and defined AT devices and services (Marino, Marino, & Shaw, 2006). According to this legislation, an AT service involves "directly assisting an individual with a disability in the selection, acquisition, or use of an assistive technology device"(29 U.S.C. § 2202(3)(2)). Bryant et al. (1998) described this act as the most influential in enhancing and ensuring that all students with a disability have the right to access to AT devices and services. Furthermore, the act promoted the quality of AT and funding to help students with a disability and their families (Behrmann & Jerome, 2002).

**The Americans with Disabilities Act of 1990 (ADA) (42 U.S.C. § 12101)**. The ADA was designed to provide standards that prevent discernment against people with disability (Marino, Marino, & Shaw, 2006). This law addresses the right of students with a disability to access educational settings and use AT equipment (Mondak, 2000). The Americans with Disabilities Act of 1990 had a positive effect on the use of AT for students with a disability (Marino, Marino, & Shaw, 2006).

**The 1998 Amendment to Section 508 of the Rehabilitation Act**. The fundamental approach with this act is that the federal government must provide effective information technology and AT equipment for each individual with a disability. The AT Act (1998) stressed continued funding to the federal government that provided by the 1988 Tech Act which confirmed

that improve the coordinate between interagency, expand technical support, and enhancing awareness of AT (Blackhurst, 2005).

**The Assistive Technology Act of 1998**. This act was designed to promote the right of all individuals with a disability to improved access to AT devices and services (Bailey, Meidenbauer, Fein, & Mollica, 2005). Furthermore, it provided funding to the states and increased information about the benefits of using AT.

**The Technology-Related Assistance for Individuals with Disabilities Act Amendments of 1994 (Tech Act of 1994)**. This act aimed at improving access to AT devices required by students with a disability in order to support them to succeed in schools and to be more independent (Alper & Raharinirina, 2006). This law was created for the development, monitoring, and implementation of strategies to provide AT to individual with disability (Noble, 2002) and to explore the barriers that impacted access to and implementation of AT services.

**The Individuals with Disabilities Education Improvement Act of 2004**. The Education for All Handicapped Children Act (EHA) was passed by Congress in 1975. This act was then merged with the law of the IDEA of 1997 and reauthorized in the IDEA of 2004. A large group of equipment and many devices were identified as AT, including low-tech, mid-tech, and high-tech devices. School districts have the responsibility to provide AT devices to all students with a disability who need AT services, and the IDEA of 2004 indicated that the IEP should include AT devices and services to these students to help them with inclusion in the regular education environment (Bartlett, Etscheidt, & Weisenstein, 2007).

**The Legislation of Saudi Arabia.**

**Legislation of Disability (LD)**. The first legislation in Saudi Arabia was the Legislation of Disability (LD), which was passed in 1987. It provided a definition of disabilities and granted

rights to individuals with disabilities. The fundamental provisions of LD include diagnosis of individuals with a disability, special education services, and intervention.

**Disability Code**. The second legislation for individuals with a disability in Saudi Arabia was the Disability Code, which was passed in 2000. This act provided the right for all individuals with a disability to receive multiple free services, which included education, health, social, rehabilitation, training, and employment services, through public agencies (Gharaibeh, 2009).

**Regulations of Special Education Programs and Institutes**. A group of professionals and policy makers from the Ministry of Education and King Saud University, and who graduated from the US, reviewed the legislation of the US to create RSEPI of 2001. These RSEPIs sought to develop the special education services provided to individuals with a disability in Saudi Arabian institutions (Alquraini,2010). As mentioned above, RSEPIs were built and developed according to the IDEA. However, the IDEA of 1997 indicates the importance of using technology and AT to teach students with a disability in their classrooms. In contrast, the RSEPI lacks clarity on the implementation of technology in special education classrooms or in general. This affects the effective use of many types of technology to develop the skills of students with a disability (Hunt, 2010).

Furthermore, RSEPI politics do not provide a guide on the implementation of an early intervention program for schools, for example for a child with autism under 6 years of age who does not receive early intervention in schools (Alnahdi, 2007). This law required special education schools to provide free education, the IEP, and early intervention for students with a disability (Ministry of Education of Saudi Arabia, 2002). The RSEPIs focus on providing education to individuals with disability in the inclusive classrooms similarly to the IDEA of 1997. However, there is a lack of policies about inclusion.

**Barriers to the Usage of Assistive Technology**

Research from previous years has suggested that the use of AT is becoming increasingly important in teaching students with ASD in schools; however, it also notes that the gap is becoming larger in applying AT services and devices in the classroom (Bausch, Ault, Evmenova, & Bauman, 2008; Edyburn, 2004; Okolo & Diedrich, 2014; Sze, 2009) and that special education teachers who work with the individual with disabilities are not using AT (Van Laarhoven & Conderman, 2011; Wojcik, Peterson-Karlan, Watts, & Parette, 2004). Furthermore, concerns exists regarding the way in which AT devices are being implemented in the classroom (Edyburn, 2004).

Studies that have explored AT usage by students with ASD have found common obstacles within the educational setting that limit effective AT application (Bouck, 2016; Edyburn, 2005a; Lahm, 2005; Morrison, 2007). It is likely that barriers arise from an interaction of factors linked with teachers, the school system, and procedures that guide AT practice for students with a disability (McGregor & Pachuski, 1996). Within this chapter, there are various tracks discussing AT barriers. The problematic issues listed in the literature are divided into two separate categories (external and internal). For this section of the literature review, these barriers are broadly grouped into two categories, following Ertmer's concept in 1999. This classification of barriers is divided into first-order barriers (external) and second-order barriers (internal).

### First-Order Barriers

Special education teachers face many barriers to the successful use of AT in their classrooms (Ault, Bausch, & McLaren, 2013; Berry & Gravelle, 2013; Gallo & Beckman, 2016). The major first-order barriers include lack of access, lack of time, lack of training, and lack of technical support (Hechter & Vermette, 2013).

**Lack of access.** Lack of access to AT equipment is a problematic factor frequently reported by special education teachers (Ashton, 2005; Flanagan et al., 2013; Flanagan, Bouck, & Richardson, 2013; Priest & May, 2001; Rogers, 2000; Wehmeyer, 1999). This lack of access would be defined as a barrier that prevents teachers from effectively implementing AT in the classroom. This would encompass problems such as lack of resources, lack of funds, and high costs to procure AT tools and devices (Wehmeyer, 1999).

Previous research has stated that barriers exist in teachers and students' access to AT devices and services (Berry & Gravelle, 2013; Borg & Ostergren, 2015). The unavailability of AT in the classroom is a common barrier that results in impeded efforts of special education teachers to use it in an educational setting. If special education teachers cannot access devices and tools, they will not be able to purchase it to integrate AT into their classrooms (Ashton, 2005). This would be highly discouraging for any teacher who strives to effectively use AT to develop the skills of his or her students.

Teachers in Saudi Arabia are impacted by a lack of access to AT tools resulting from a lack of resources in their schools (Al-Moghyrah, 2017). Moreover, universally, AT resources are not available in most schools (Derer, Polsgrove, & Rieth, 1996; Sundeen & Sundeen 2013). When education departments do not provide sufficient AT devices to schools and special education teachers to facilitate teaching students with ASD, the AT is meaningless.

According to Lee and Vega (2005), 19% of special education teachers reported that the lack of AT resources was a barrier to using AT with their students. Furthermore, a lack of funds was one of the largest obstacles that special education teachers face. Limited software devices and tools in the Arabic language are indirectly related to the lack of resources. Saudi special education

teachers reported that there are not adequate Arabic devices tailored for Saudi schools' needs (Al-Moghyrah, 2017).

Access is not merely about the availability of AT devices and services in the classroom. It also refers to the provision of a sufficient quantity of devices that are appropriate to students' needs in the school (Fabry & Higgs, 1997). Similarly, another concern is that the availability of AT devices in schools does not necessarily mean that special education teachers have easy access to these resources, because some AT resources are shared among all teachers in schools, thereby restricting access to those resources (Hew & Brush, 2007). The availability of computers in the classroom will increase the use of technology by teachers to achieve students' goals (Inan & Lowther's, 2010). Furthermore, it is important to support teachers with new resources that help them to use AT in the classroom (Bauer & Kenton, 2005). Special education teachers avoid using AT when they face a challenge with old devices that fail to meet their expectations (Kopcha, 2010). Barfurth and Michaud (2008) have found that 70% of special education teachers reported that outdated computers and resources prevented them from successfully implementing AT with their students.

Some issues also impact the effective access to AT in the classroom and schools. Many studies have reported that the high cost of AT devices is a barrier (Flanagan, Bouck, & Richardson, 2013; Stead, 2009), since the price makes the integration of AT prohibitive. Flanagan, Bouck, and Richardson (2013) conducted a quantitative study with middle school teachers who taught students with disability in one Midwestern state. Teachers reported that the high cost of AT is the number one barrier to using it in their classrooms. The high cost to purchase AT equipment contributed to the lack of resources in the schools (Parette & Murdick, 1998). The main reason for the high cost is that the needs of students with disabilities for AT vary from one individual to another (Borg &

Ostergren, 2015; Hasselbring & Glaser, 2000). In addition, the maintenance and repair of AT equipment drives the cost up (Hutinger, Johanson, & Stoneburner, 1996).

Hechter and Vermette (2013) examined the barriers to using technology for teachers. The results, which were analyzed according to the technology, pedagogy, and content knowledge (TPACK) framework, indicated that the major barrier experienced by all teachers is the lack of technology resources. Furthermore, Derer, Polsgrove, & Rieth (1996) implemented the Analysis of Technology Assistance for Children (ATAC) project in three states, namely, Kentucky, Indiana, and Tennessee. This project sought to examine the status of AT in schools, as well as the benefits, barriers, and effects of AT. Most of the special education teachers remarked that AT was unavailable to them. Moreover, a lack of funds hinders the availability of AT resources in the schools. It is critical that education departments continue to strive to provide funds to schools that need AT devices.

Although no recent information is available on the cost of AT (D. L. Edyburn 2011 cited by Jacobsen, 2012), some researchers point out that the cost is currently higher than it has been in the past 10 years (K. Higgins, 2011 cited by Jacobsen, 2012). In Saudi Arabia, there is a lack of government funds for providing AT devices and services to teachers and their students with a disability in the schools. For the successful integration of AT in the schools, the special education teachers have suggested that the Ministry of Education must increase support to provide AT resources in the schools (Al-Moghyrah, 2017).

**Lack of time.** Scholars have suggested that despite providing adequate AT resources in schools, little will be gained if other barriers that affect teachers' abilities to use AT in the classroom are not removed (Constantinescu, 2015). Simply funding the required AT devices without providing sufficient time for special education teachers to practice and use AT in their

classroom reduces the effectiveness of this technology in teaching students with ASD (Cuban, Kirkpatrick, & Peck, 2001; Ertmer et al., 2012; Hew & Brush, 2007; Kurbanoğlu et al., 2014; Machado & Chung, 2015; Russell et al., 2007; Tondeur et al., 2015).

The lack of time can be viewed in multiple ways. Special education teachers should be spending a long time learning the new AT tools and understand the associated applications; this requires an investment of their time (Ashton 2005; Kurbanoğlu et al., 2014). The amount of time required for teachers to learn how to use AT in the classroom is usually underestimated (Carey & Sale, 1994; Derer et al., 1996; McGregor & Pachuski, 1996). In fact, teachers need to practice and train on technology to learn how to implement it in their classroom; however, these practices take a long time to master (Brand, 1997). Teachers have limited time to learn, train, and implement new technology in their classrooms, since their time is not limited to teaching their students in the classroom; they also spend much time on tasks outside the classroom, such as attending parent-teacher conferences, reviewing students' homework, attending IEP meeting, supervising during lunch, joining committee and parent meetings, and being at school events (Fabry & Higgs, 1997).

As Lei and Morrow (2009) noted earlier, teachers will not spend their own time to learn how to use educational technologies to teach their students. Lack of time is thus a major barrier when teachers use AT in the classroom. Implementing AT requires more time to learn on it and teach students with a disability how to use it. limited training courses for teachers on the use of AT devices also increases the severity of the time barrier.

Special education teachers with an IEP team make the decision regarding whether students with a disability require AT devices. Each decision is made for every student individually, and the specific types of AT devices and services are then utilized in the student's IEP (Bouck & Flanagan, 2016). In Saudi Arabia, special education teachers have fewer teaching classes than general

teachers, and available time may contribute to implementing AT in their classrooms. Furthermore, some teachers have a lack of time to use AT with children during class time. Al-Moghareh (2017) examined the use of AT for students with a disability in Saudi schools. Special education teachers reported that the time required to use AT to teach students with a disability frequently takes longer than initially anticipated. These teachers have a lack of time or skills required to process all of the components involved in making decisions and using AT because it is related to each student individually.

In addition, some teachers avoid using AT to teach students with a disability in their classrooms because they feel it does not fit with their limited classroom schedules (Hutinger et al., 1994). A series of recent studies have indicated that lack of time remains the largest concern for teachers and prevents them from successfully implementing AT for their students with a disability. Blue (2017) used the qualitative interview-based approach with special education teachers to identify the barriers of AT by examining those teachers' experiences and perceptions. The findings indicated that lack of time relating the use and practices of AT was one of the critical barriers to the effective use of AT in the classroom.

**Lack of training.** Regardless of the amount of AT equipment in schools, it will be worthless if special educators do not receive appropriate training to implement it in their classrooms (Alper & Raharinirina, 2006). Many studies dealing with AT implementation to teach individuals with disabilities emphasize the important role of teachers in the successful use of AT in schools. The lack of preparation for these teachers constitutes the key barrier to the successful use of AT (Alsalem, 2010; Flanaga, Bouck & Richardson, 2013; Michaels & McDermott, 2003). Special education teachers' training in AT devices and services should range from pre-service training to in-service training (Flanagan et al., 2013; Lee & Templeton, 2008) because the need

for the use of AT to teach student with ASD effectively in the classroom has increased (Goldsmith & LeBlanc, 2004; Lancioni & Singh 2014). Special education teachers must acquire high levels of skill, knowledge, and confidence to use multiple types of AT tools (Gustafson, 2006). There is an indisputable relation between suitable training on AT and the successful use thereof to teaching students with ASD. To ensure that these students will gain the benefits from AT, special education teachers must be eligible to use AT with their students (Edyburn, 2004).

Much of the literature has indicated that special education teachers are unable to use AT with students with disabilities because they lack sufficient preparation on AT (Alkahtani, 2013; Alsalem, 2010; Lee & Vega, 2005). Only a few teachers receive an opportunity to practice and train with AT. Most studies have found that teachers will choose to forego the use of technology when they face barriers that affect their ability to use it (Abbott, 2003. Kurt, 2013; Shaffer, 2013). Ebner (2004) has indicated that the amount of AT training is one of the obstacles facing special education teachers. While the rate of AT abandonment has reached 75% to 80%. The lack of training is a complex issue that is not limited to the required skills that teachers need to implement AT for students with ASD. In other words, the IEP team should collaborate to decide whether students with ASD need AT services and to understand how to apply the AT devices for students in classrooms (Marino, Sameshima, & Beecher, 2009).

Derer, Polsgrove, and Reith (1996) pointed out that special education teachers receive some training in using AT during their academic preparation. However, providing a basic overview of AT in a preparation program for these teachers is insufficient (Laarhoven & Conderman, 2011). Pre-service teachers must receive opportunities to practice on AT equipment and tools during practical experiences (Judge & Simms, 2009). Inadequate teacher preparation is one of the problems affecting the use of AT in schools. Furthermore, some faculty members who are

responsible for teacher preparation programs have a lack of knowledge of AT devices and services (Judge & Simms, 2009), and their limited knowledge has a negative impact on preparing special education teachers to use AT in the future. This has been explored in a prior study by Michaels and McDermott (2003), who found that, of the surveyed special education teachers who were part of the study, over 57% reported that their level of AT knowledge was intermediate, 24% novice, and 5% no experience. In addition, Michaels and McDermott put forward suggestions about the problem of teacher preparation. In order to ensure that pre-service teachers knowledge and skills on the use of AT before graduates, teacher preparation programs should enhance the knowledge of faculty members related to AT, and increase AT curriculum in the courses. Also, provide resources for pre-service teachers.

In Saudi Arabia, special education teachers have a lack of skills because, unlike the legislation of the US, the RSEPIs do not provide clear requirements for teacher preparation programs (Zabala, 2010). Many studies have indicated that high-quality professional development is a critical factor that will increase special education teachers' skills to use AT in their classrooms. These teachers are always in need of sufficient professional development on AT to support their students. This lack of AT use in Saudi schools is because of a lack of training for special education teachers on AT. Furthermore, the lack of paraprofessionals in Saudi schools to support teachers in special education classrooms or inclusive classrooms is another barrier (Al-Qhatine, 2009). The RSEPIs do not require schools to have paraprofessionals to assist teachers in the classroom.

**Lack of support.** Special education teachers sometimes have AT devices available in their schools and receive high-quality professional development on them but fail to use the devices with their students because of the lack of technical support (Scheeler, Congdon, & Stansbery, (2010). The use of AT multiple times results in damaged or malfunctioning equipment, and special

education teachers need technical support to fix these problems. Nevertheless, they try to repair the malfunctioning equipment by themselves if they do not receive support from technicians (Coney, 2010). Nees and Berry (2013) indicated that AT has many benefits in teaching students with disabilities; however, technical problems with AT devices remain a major barrier that affects their successful implementation. The lack of support for technical problems by schools, the education department, and the Ministry of Education contributes to the persistence of technical issues as a barrier (Brush, 2003; Bullock, 2004).

Alhazmi, Najat-Aldeen, Almowaraay, and Jonaid (2010) have reported that there are many malfunctioning pieces of equipment that require repair in Saudi schools. Varma et al. (2008) have pointed out that malfunctioning equipment impacts teachers' abilities to successfully implement AT for their students. Employing technicians in each school will help to solve these problems immediately, thereby enabling special education teachers to focus on the education process, which helps teachers to increase the use of AT in the classroom (Demps, Lincoln, & Cifuentes's, 2011).

Even the day-to-day maintenance of equipment will require much time from teachers, which will impact on class time. Technical support will save teachers time, since they will not waste time investigating and exploring technical problems (Holland, 2001). In Technology and Education Reform, which is a U.S. DOE report, Singh and Means (1994) emphasize that "If technical problems arise frequently and teachers have to wait hours, days, or weeks to get them resolved, they will abandon their efforts to incorporate technology" (para. 10). When AT devices need maintenance or repair, it will take a long time to send them to the supplier or manufacturer. During this time, students with disabilities remain without AT equipment for a month or more (Carey & Sale, 1994; Hutinger, Johanson, & Stoneburner, 1996). Brinkerhoff (2006) has reported that when teachers face technology problems, their technology confidence will be affected. In

contrast, Shapley, Shehan, Maloney, and Caranikas-Walker (2010) indicated that when teachers received immediate technology support, their technology confidence, attitude, and self-efficacy will increase (Holden & Rada, 2011).

In addition, according to Thorburn (2004), one of the problems of technology support is related to the negative relationship between special education teachers and technicians. The lack of technical support from a technology specialist reduces the opportunities for special education teachers to use AT in the classroom, and this has caused many of them to abandon the use of AT altogether (Berrett, Murphy, & Sullivan, 2012). Technical support is imperative for the effective use of AT to teach student with disability in the classroom. Furthermore, maintenance in regard to all types of AT equipment must be available for special education teachers to become more confident and successful in the classroom. However, technical support for the use of AT in Saudi schools is underdeveloped, and most schools are not provided with adequate maintenance to address the technical problems, thus leading to a failed implementation.

**Second-Order Barriers**

Second-order barriers (intrinsic) are the internal feelings of special education teachers that prevent them from using AT effectively (Ertmer, 1999). The first-order barriers are easier to reduce or remove than second-order barriers because of the latter being related to the fundamental personality of special education teachers. Many studies on barriers to using technology in schools have found that those second-order barriers are still some of the most significant issues for policy makers and special education teachers (Alkhawaldeh & Menchaca, 2014; Bausch, Ault, & Hasselbring, 2015; Becker, 2000; Ertmer et al., 2012; Peterson-Karlan, 2015; Stitzlein & Quinn, 2012). Furthermore, when special education teachers are faced with extrinsic barriers, they often

develop negative attitudes and beliefs about using technology to teach their students (Cuban, 2001; Cuban, Kirkpatrick, & Peck, 2001; Doornekamp & Carleer, 1993; Ertmer et al., 1999).

Second-order barriers also include special education teachers' beliefs about autism (Parette & Scherer, 2004), their beliefs about using AT devices in the classroom (Bouck, 2016), experience, skills, and confidence (Cuban et al., 2001; Ertmer et al., 2012; Hew & Brush, 2007; Machado & Chung, 2015; Russell et al., 2007; Tondeur et al., 2015). While first-order barriers, especially the lack of training, is the major barrier to successfully using AT in the classroom, second-order barriers are the most significant barrier in implementing AT (Lahm, 2005; Okolo & Bouck, 2007).

**Lack of teachers' beliefs and attitude.** Special education teachers' conceptions of the use of AT influence the effective implementation thereof in their classrooms. Scholars use various terms to describe these conceptions within their studies and articles, including a lack of belief (Dugan, Campbell, & Wilcox, 2006; Peterson-Karlan, 2015; Stitzlein & Quinn, 2012), a lack of attitude (Brown, 2005; George, Schaff & Jeffs, 2005; Parette & Scherer, 2004), and teachers' perceptions (Stoner et al., 2008). Researchers confirm the imperative to examine teachers' beliefs about using technology in order to access successful use of it (Ertmer et al., 1999; Stitzlein & Quinn, 2012), because special education teachers' beliefs about practices and strategies determine their decisions to use it or not in educational contexts (Cuban, 2001 as cited in Palak & Walls, 2009; Sandholtz, Ringstaff, & Dwyer, 1997). Furthermore, Bingimlas (2009) has provided a meta-analysis of the barriers to technology integration. The author has highlighted that the negative attitudes and beliefs of teachers regarding technology use are a central barrier.

Policy makers should thus consider reforming teachers' attitudes and beliefs before asking them to apply some strategies in their classrooms (ChanLin, 2007). Special education teachers will understand the benefit of technology in teaching their students when they successfully use the

technology in educational goals (Luan, Fung, Nawawi, & Hong, 2005), while teachers who have negative beliefs about technology will resist its implementation (Almekhlafi & Almeqdadi, 2010; Daniels, Jacobsen, Varnhagen, & Friesen, 2013; Levin & Wadmany, 2008; Tondeur et al., 2008).

Many studies have maintained that an important relationship exists between positive teacher attitudes towards technology and the successful use of technology in the classroom, and vice versa (Christensen, 2002; Christensen, 2002; Luan, Fung, Nawawi, & Hong, 2005; Ndibalema, 2014; Paraskeva, Bouta, & Papagianni, 2008; Twidlea et al., 2006; Zhao & Frank, 2003). While changing teachers' beliefs is not an easy task, professional development plays an important role in this change through an increase in the level of knowledge and by meeting the needs of special education teachers (Gaffner, 2015; Lei & Zhao, 2007; Windschitl & Sahl, 2002). According to Hew and Brush (2007), when teachers receive high-quality professional development on technology, their positive belief about using the technology in their classrooms will increase. Moreover, Chen (2008) suggested that for professional development to be successful, it should go beyond teaching basic skills and embed teachers' beliefs and experiences in order for them to integrate technology into their learning. According to Inan and Lowther (2009), a teacher who has skills and knowledge in using technology has a positive belief about its use in the classroom.

In a study conducted by Alkahtani (2013) titled, "Teachers' Knowledge and Use of Assistive Technology for Students with Special Educational Needs" (P 65), she collected data from 127 Saudi Arabian teachers. The results have revealed the existence of negative attitudes toward the use of AT for student with disability because of the lack of professional development. Furthermore, teachers' attitudes remain a constant concern for the successful implementation of AT. Copley and Ziviani (2004) reviewed many previous studies related to barriers in effectively using AT to teach students with a disability. The authors identified current obstacles to the effectively

implementation of AT, including a lack of professional development, a lack of support, a lack of funding, teachers' negative attitudes and belief, high-cost equipment, a lack of time, and a lack of assessment and planning processes.

The next obstacle preventing the use of AT to teach students with ASD consists of teachers' beliefs about disability. Parette and Scherer (2004) stated that one of the obstacles that affects the use of AT comprises teachers' attitudes toward disability. For the effective integration of AT, special education teachers' negative attitudes regarding disability must change. Teachers usually disregard the use of important strategies and practices if they did not accept the disability. In contrast, their positive attitudes toward their students with disabilities correspond to the support they provide in the classroom (Willis & Brophy, 1974). Maushak, Kelley, and Blodgett (2001) evaluated the attitudes of pre-service teachers regarding the AT devices to teach student with disability, and they documented teachers' acceptance of students with disabilities. The findings of their research have revealed differing attitudes of teachers towards the use of AT. Furthermore, almost 75% of the pre-service teachers felt students with disabilities should be in special education schools. The researchers have suggested that teacher preparation programs must add AT courses to the programs.

Addison, Lerman, Kuhn, and Vorndra (2004) surveyed teachers who taught students with ASD and other developmental disabilities. The researchers have noted that teachers exhibited high usage of methods and effective practices when teaching their students because they understood the diagnostic criteria for ASD; they also taught many students with ASD, which contributed to increasing their knowledge about autism. The teachers reported that during teacher preparation programs, pre-service teachers must enter a classroom that has students with ASD because this will positively influence their attitudes toward autism and students with ASD.

In addition, numerous authors in the literature discussed teachers' pedagogical beliefs as one of the main factors affecting the use of technology (Ertmer et al., 2012; Ertmer & Ottenbreit-Leftwich, 2010). Teachers' attitudes and beliefs about learning and teaching influence the use of AT in the classroom. Chen (2008) investigated the relations between teachers' use of technology and their pedagogical beliefs. The results have revealed inconsistencies between teachers practices and beliefs practices in the classroom because of their lack of theoretical understanding and their conflicting beliefs. The author has also suggested that professional development programs must improve teachers' beliefs about learning and teaching.

**Lack of confidence.** To avoid the failure of AT usage when teaching students with a disability, special education teachers' level of confidence on AT or computers should be high (Alkhawaldeh & Menchaca, 2014; Ball & Levy, 2008; Cui & Vowell, 2013; Ertmer, Ottenbreit-Leftwich, & York, 2007; Eteokleous, 2008; Groff & Mouza, 2008). Teachers who have limited confidence in using AT will implement it less than those who have more confidence (Bausch, Ault, & Hasselbring, 2015; Inan & Lowther, 2010; Niederhauser & Perkmen, 2008). Many studies have indicated that rapid technological development makes teachers feel as though they are beginner users (Ertmer et al., 2007; Eteokleous, 2008; Inan & Lowther, 2010; Mueller et al., 2008; Watson, 2005).

The level of confidence has a strong correlation with the age of special education teachers (Alkhawaldeh & Menchaca, 2014). According to Zhou et al., (2012), 59.3% of special education teachers reported that they do not have confidence in teaching and using AT for their students. Moreover, the results of this study have demonstrated that older special education teachers are less confident in using AT than those who are younger.

When special education teachers are faced with first-order barriers, such as a lack of professional development or a lack of technical support, their confidence to use technology to teach their students diminishes (Cuban, 2001; Cuban et al., 2001; Doornekamp & Carleer, 1993; Ertmer et al., 1999). Mueller et al. (2008) suggested that building teachers' confidence through professional development provides an opportunity for teachers to practice and train on technology or devices in their classrooms. Furthermore, teachers' confidence is also enhanced when they have the appropriate chance to collaborate with other teachers who have had success with technology. Hartsell, Herron, Hourbin, and Rathod (2010) have found that teachers' confidence could be increased when the professional development training emphasizes practice on using technology devices. In addition, providing continuous technical support to teachers will enhance their confidence to use technology in their classrooms. Shapley, Shehan, Maloney, and Caranikas-Walker (2010) reported that when teachers receive immediate technical support, their confidence to use the technologies to teach their students in the classroom will increase.

An additional barrier to the effective use of technology is teachers' self-efficacy, which pertains to their belief in their abilities to master methods and technologies to complete tasks successfully (Bandura, 1997). Lin and Lu (2010) have reported that high self-efficacy of teachers contributes to increased time and effort by teachers to use technology in their classrooms. Conversely, a teacher who has a low level of self-efficacy will avoid using technology in the classroom (Niederhauser & Perkman, 2008). Inan and Lowther (2010) agree that professional development regarding technology usage will enhance teachers' levels of self-efficacy. Technology self-efficacy usually affects teachers' acceptance of technology (Gong, Xu, & Yu, 2004).

**Lack of knowledge.** Numerous studies have indicated that students with a disability who should benefit from AT tools and services may be denied their use because of a lack of knowledge on the part of teachers (Bausch, et al., 2008; Edyburn, 2004; Lahm & Sizemore, 2002; Okolo & Diedrick, 2014; Sze, 2009). Ashton (2005) has found that one of the most significant barriers that special education teachers face when integrating AT is lack of knowledge to use it in their classrooms. These teachers have reported that the lack of training is the primary reason for their limited knowledge. A survey by Alkahtani (2013) was designed to examine special education teachers' level of AT knowledge for teach student with a disability in Saudi schools. The results indicated that 72.4% of special education teachers have little or no knowledge about AT, while 3.9% have some knowledge, and only 1.6% have in-depth knowledge of the subject.

The lack of knowledge is not limited to AT services, but includes other types of technology devices, such as computers (Bausch, Ault, & Hasselbring, 2015). Stoner et al. (2008) investigated preschool teachers' experiences using AT with a preschool class. The authors found that most teachers and paraprofessionals had limited knowledge about AT devices and services, with especially limited computer skills and software. The preparation program for pre-service teachers and professional development programs for in-service teachers and must thus increase teachers' skills in using AT. However, it must be noted that the disparity in teachers' abilities and skills will cause difficulties in creating the same training for all teachers because each teacher has a distinct level of skills that must be developed (Wong & Cohen, 2012).

**Summery and Conclusion**

In sum, researchers explained key aspects of using assistive technology with students with ASD, then connected it with this current study. Previous studies agree that AT has become integral to the teaching and learning process for students with ASD. Students with ASDs access to assistive

technology within a classroom without barriers is one of the rights to mandated in multiple legislation and regulations. The field of special education lacks technological support, resource management, and professional development opportunities to assist teachers with the integration of AT. Furthermore, information about autism in the Middle East is still poorly documented, and there is also limited knowledge about ASD in Saudi Arabia because few studies have been published in Middle Eastern countries (Al-Faiz, 2006; Barnhill, Sumutka, Polloway, & Lee, 2014; Donaldson, 2015; Scheuermann et al., 2003). Instead, researchers and professionals in these countries have consulted studies published in the US and the UK (Al-Salehi, Al-Hifthy, & Ghaziuddin, 2009).

The body of literature reviewed revealed many barriers affecting the successful use of AT to teach students with ASD. However, thoroughly identifying all the barriers that prevent special education teachers from using AT in their classrooms may not be possible, because of limited studies on this issue. For this study, the literature review categorized barriers based on first-order and second-order barriers (Ertmer,1999). This type of study seeks to provide a clearer understanding of how to create better conditions to implement AT for teaching students with ASD and supporting change framework for in education setting, one that Saudi education society to seem be calling for. Finally, Chapter 3 will establish the methodological to explore the barriers affecting Saudi teachers' use of AT for teaching children with ASD.

# CHAPTER THREE: RESEARCH DESIGN AND METHODS

**Introduction**

In chapter 3, I discussed the methodology that I used to conduct this research, including the research questions, research design, participants, the setting for the research. The instrumentation used to collect data and validity and reliability. Also, the way in which the collected data that be analyzed, and ethical considerations. The data collected from teachers who teach students with autism spectrum disorder (ASD) contributed to efforts to provide the appropriate education for these students. Furthermore, this study aimed to increase the use of assistive technology (AT) by exploring the barriers that impact teachers' abilities to use it. This research also contributed to reducing the gap in research regarding those current barriers particularly in relation to teaching student with ASD. The primary purpose of this research was to contribute further to the literature by exploring the barriers affecting Saudi teachers' use of AT for teaching children with ASD.

**Research Questions**

The best approach to identify the perceived barriers is the use of both qualitative and quantitative methodologies, which may lead to an exploration of the commonalities in teachers' failure to integrate AT to help students with ASD develop learning skills. The study used of the following central research question to guide the development of the research design:

1.What barriers do teachers identify as hindering their ability to use AT for teaching children with ASD? This question was answered by exploring the following sub-questions:

1.a How often do Saudi teachers use AT in the classroom with students with ASD?

2.b What extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

3.c What intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

4.d How do the perceived barriers affect teachers' abilities to use AT within the classroom?

**Research Design**

This study used a mixed-methods approach to explore the barriers that affect teachers' abilities to use AT for teaching children with ASD in Saudi Arabia. By utilizing both a quantitative and a qualitative approach, the research questions for this study was addressed (Creswell, 2014). A mixed-methods approach contributed to better comprehension of the research questions and the problem compared to a quantitative or qualitative method used by itself (Creswell, 2013). As Creswell (2014) discussed, "mixed methods research is a good design to use if you seek to build on the strengths of both quantitative and qualitative data" (p. 535). The mixed-methods approach helped a researcher gain the strengths of each approach and avoid the weaknesses to develop a better understanding of a research problem (Terrell, 2012; Creswell & Plano-Clark, 2007).

Cameron (2009) identified four types of mixed-methods approaches: exploratory, explanatory, embedded, and triangulation. This study used the embedded mixed-methods design, which included two types of data collection: quantitative data through the use of a Likert scale, and qualitative data that employed open-ended questions (Appendix D). In conjunction with the quantitative data, the researcher asked teachers to write their responses to open-ended questions in a single instrument at the same time. This approach had the potential for richer data gathering, validity, and deeper understanding (Creswell, 2003), because embedded quantitative and qualitative data provided new insights into the problem. The open-ended questions provided a

better understanding of the obstacles that teachers face when using AT to teach students with ASD, and validated responses were collected from the quantitative data (Marshall & Rossman, 2011). Therefore, the elements of an embedded mixed-methods design have the potential to develop a complete understanding of the practices of AT and the barriers that influence in its effective use in the classroom (Doyle & Byrne, 2009).

**Participants**

To explore the barriers that prevent participants from using AT for teaching children with ASD in Saudi Arabia, this study targeted Saudi teachers of students with autism. Selecting the appropriate participants was important to guarantee that the target population was represented to ensure reliable results (Patton, 2002). For this reason, and after obtained approval from the University of South Florida Institutional Review Board (IRB) (Appendix A), all 193 teachers of students with autism who work in 51 schools under the supervision of the General Administration of Public Education in Riyadh, Saudi Arabia were targeted using a purposive sampling strategy. The researcher set the ideal sample size of the study approximately 80 to 100 special education teachers. 85 teachers participated in this study, with a 44% response rate. The criterion to participate in this study was that participants must currently be working with students with autism. Teachers who were not working with students with ASD were excluded.

The e-mailed addresses of teachers of students with autism were identified via the General Administration of Public Education. All teachers of students with autism in Riyadh city, Saudi Arabia, received an invitation via email from the department of research and studies in the General Administration of Public Education to participate in this study. The email included a consent form to participate in research which explained the title of study, the purpose of the study, procedures, and the rights of participants (Appendix B). In addition, the email attachment contained a consent

form that stated that the head of the education department in Riyadh city approved this study (Appendix C) and that taking part in the study was optional. Contained in the email was a link to a web-based questionnaire (Qualtrics). All of the teachers had the right to refuse participation in the study. This survey website ensured all participants remain anonymous to motivate more honest and open responses. These emails were sent to participants in July, 2020 and ended on the 1st of October, 2020. When teachers who teach students with ASD decided to participate in this study, they clicked a link allowing them to access the Qualtrics survey.

**Response Rate**

The general population for this research consisted of all teachers working with students with ASD at 51 schools in Riyadh city. In total, 193 surveys were distributed to a purposive sampling of teachers located in this region, and 98 teachers participated in the survey, with a 51% response rate. However, 13 uncompleted surveys were excluded from the statistical analysis. Therefore, 85 surveys were usable for analysis to explore the research questions, with a 44% response rate.

Of the 193 surveys distributed to teachers of students with ASD, 9 were completed in July 2020, with a low return rate, even though it was sent emails again to participants in the second week of July as a reminder. The response rate was also low because the summer vacation continued midway into July. Next, 24 surveys were completed in August 2020, with the response rate continuing to be low. When teachers returned from their summer vacation, all schools were closed because of the Covid-19 pandemic, and distance learning and online learning were consuming much of the teachers' time. I contacted most of the leaders of schools to increase the response rate. This resulted in 65 surveys being completed in September 2020 and the first week of October.

**Setting**

This study was conducted at the University of South Florida; the setting was in Riyadh city in the central region of Saudi Arabia. It is one of the largest areas in the country and has 30 offices of education under the supervision of the General Administration of Public Education of Riyadh. These offices of education located in different districts are responsible 2215 schools (General statistics of the General Administration of Public Education, 2018). For this study, there were two reasons for choosing teachers of students with autism in Riyadh city, Saudi Arabia as the target population. First, the education department and schools in this region were easy to access because of the researcher's connections as a previous special education teacher in Riyadh city. These connections made the process of survey distribution and participant recruitment fast. Second, Riyadh city is one of the largest Saudi education areas with the largest population of teachers, estimated at approximately 51050 teachers, including 193 teachers of students with autism who work in 51 schools (General statistics of the General Administration of Public Education, 2018). Therefore, the number of institutions with teachers of students with autism was higher compared to other cities in Saudi Arabia. Elementary, middle, and high schools were chosen for this study.

This instrument of study was distributed using an online questionnaire tool called Qualtrics. A web-based questionnaire has the potential to reduce financial expenses and time (Schonlau, Fricker, & Elliott 2002). Furthermore, participants were more comfortable responding to questionnaire items from anywhere and at any time, thereby increasing response rates (Sax, Gillmartin, & Bryant 2003; Kiernan et al. 2005).

**Instrument Development**

This study explored the barriers affecting Saudi teachers' use of AT for teaching children with ASD. The researcher developed the survey items after reviewing the relevant literature related

to barriers to technology use in the classroom. In this study, the researcher looked for multiple data sources as a means of measurement. The instrument used a quantitative method to gather data, but used additionally qualitative data in order to improve a deeper understanding of barriers. The instrument has 48 items/questions to gather data, which consisted of four main parts that includes participants' demographic information, frequency of AT use, barriers of AT use, and how these barriers effecting in AT use (Appendix D). Instrument consisted development of three major phases: (a) constructing items of the instrument; (b) reviewing instrument by six experts; (c) a back-translation. Each of these phases will be described later in this chapter.

**Instrumentation**

The instrument of this study designed to collect both qualitative and quantitative types of data, and it included a Likert scale and open-ended questions. as mentioned above, the researcher developed the items of instrument after reviewing the relevant literature related to barriers to using AT in the classroom. The instrument for this research included 48 items/questions divided into four sections that gathered information about participants' demographic information, frequency of AT use, barriers of AT use, and how these barriers effecting in AT use.

### Quantitative Data

The first part focused on participants' demographic information (four response items), specifically sex, age, number of teaching experience years, and offices of education, that described the sample of the study. The second part consisted of three response items that collected the frequency use of AT. Participants were asked to answer a three-item questionnaire about the frequency of use low AT, medium AT, and high AT on a five-point Likert scale (Do not Use = 1, 1 Time or Less a Week = 2, 1 to 2 Times a Week = 3, 3 to 4 Times a Week = 4, and 5 Times and More a week = 5). The third part had a 32 five-point Likert-scale. These 32 survey items designed

to collect data about the barriers to teachers' success in using AT into the classroom. As shown in the literature review, the list of barriers in this survey has been organized as first-order barriers and second-order barriers that influence teachers' use of AT in their classrooms.

Specifically, questions 9 to 26 measured the first-order barriers, which are lack of resources (six-items), lack of time (three-items), lack of training (five-items), and lack of support (four-items), and questions 30 to 43 measured the second-order barriers, which are teachers' beliefs and attitudes (five-items), lack of confidence (five-items), and lack of knowledge (four-items). Moreover, the responses were quantified on a five-point Likert scale (strongly disagree, disagree, undecided, agree, strongly agree). According to Crano and Brewer (2002), a Likert scale has higher reliability than other scales. The Likert scale supported the exploration of teachers' experiences and their attitudes regarding the factors that influence the use of AT for teaching children with ASD (Leedy & Ormrod, 2001).

**Qualitative Data**

Following the survey items, participants were given an opportunity to respond to nine open-ended questions. These questions were designed to collect data about the barriers in effectively using AT to teach students with ASD, and how these barriers impact teachers' abilities to use AT in the classroom. The open-ended questions were used to explore barriers by painting a verbal picture of them. These questions probed participants' thoughts and opinions for the barriers of AT use. Therefore, the analyses of qualitative data supported the outcomes of statistical analyses. Nine open-ended questions included in this study were as follows:

1. What assistive technologies are you currently using? Among them, which assistive technology you think is the most useful for students with ASD? how many times do you use the assistive technology per week?

2. What can make it difficult to access and use assistive technology devices in your school?

3. What was the most useful training experience to use assistive technology that you have had?

4. How does your school support you in using assistive technology with your students?

5. What specific skills do you need to better use assistive technology for your students with ASD?

6. How would you describe the importance of assistive technology in meeting the needs of students with ASD?

7. What other barriers impede your use of assistive technology for students with ASD?

8. Please describe your experiences of those barriers and how those barriers affected your ability to use assistive technology for students with ASD?

9. Please describe how you overcame those barriers to better teach your students with the assistive technology?

**Reliability**

The term reliability refers to the consistent results of an instrument every time it is used (Patton, 2014; McIntire & Miller, 2007). This study used a mixed-methods approach to explore the barriers that affect teachers' abilities to use AT for teaching children with ASD in Saudi Arabia. Utilizing both a quantitative and qualitative approach that offered a wealth of data, which reduced researcher bias and increased the credibility of the results (Creswell, 2014). In order to increase the reliability of the instrument, the researcher calculated the internal consistency coefficient (Cronbach's alpha) to ensure that the items of the instrument relate to each other as a group (Gay, et al., 2006). Nunnally (1978) set the acceptable internal consistency of Cronbach's alpha at 0.70

or higher. The findings revealed an excellent level of internal consistency for all items of the instrument (n = 32), with Cronbach's alpha being .93.

**Validity**

Validity relates to the accuracy of the instrument that were used in this study and what it is supposed to measure (Frey, 2006). Ensuring that the data collection was appropriate and ethical and that it exactly measures the intended content area was essential for the research (Cresswell, 2003). A test of the validity of measurement instruments evaluated all aspects of the assessment tool's quality to ensure that the instrument is accurate in measuring barriers to the use of AT for teaching students with ASD (Trochim, Donnelly, & Arora, 2015). The instrument was presented to three experts from the University of South Florida and three special education teachers. The construct of the instrument was reviewed by experts in order to improve content validity. The experts provided feedback on the clarity of the instrument's items, wording, and content. According to their feedback, the researcher removed, added, and modified some survey items. Twelve items were added to the instrument based on the suggestions and critique from the experts. Moreover, the process of validation was accomplished on three different occasions to ensure the face validity of the instrument. Finally, when all feedback and edits were reconsidered to the original document. Four items were deleted from the survey instrument due to their inconsistency in measuring the use of AT barriers.

The translation of measuring instruments from one language to another plays an important role in validity and confirms that "the results obtained in cross-cultural research are not due to errors in translation" (Maneesriwongul & Dixon, 2004, p. 175). Brislin (1970) indicated multiple methods for the validation of a translated instrument, including (i) a pilot study, (ii) a back-translation method, (iii) a committee approach, and (iv) bilingual techniques. The instrument of

this study was developed in the English language; however, all participants in this research were native Arabic speakers. Therefore, the researcher translated the survey items into the Arabic language using the back-translation method, which improved instrument validation (Behling & Law 2000). The Arabic version was reviewed by an expert in both languages to examine the clarity and confirm the content and construct; thereafter, he was asked to back translate to it English language. The original and the new English versions were given to three Ph.D. students in special education majors to examine whether there are any significant differences between the two versions. Based on their comments, the researcher modified some survey items.

**Data Collection**

The process of data collection was conducted in three steps: first, I requested permission from the General Administration of Public Education; second, sent instrument to participants; and third, received the data. The first stage of the data collection process began with a letter to the General Administration of Public Education to request permission to conduct the study among teachers who teach students with ASD. Furthermore, a list of the email addresses of target participants was obtained. The second step was to send emails to all 193 teachers, explained the purpose and nature of study, the survey items, the average time for completion, the security procedures to protect confidentiality, and IRB approval. These emails were sent to participants in July 2020 and again as a reminder after 1 week to meet the expected response rate. When teachers who teach students with ASD decided to participate in this study, they clicked a link that allowed them to access the Qualtrics survey. This researcher used an embedded mixed-methods approach to answer the research questions (Creswell & Plano Clark, 2007). The collected quantitative and qualitative data were then integrated into the interpretation of the results. Table 1 explains the relation between the research questions and the research methods.

**Table 1**

*Descriptive the relation between the research questions and the research methods*

| N | Research Question | Research Methods |
|---|---|---|
| 1 | How often do Saudi teachers use AT in the classroom with students with ASD? | Quantitative data: 5, 6, 7<br><br>Qualitative data: 8 |
| 2 | What extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD? | Quantitative data: 9, 10, 11, 12, 13, 14 ,15, 16,17, 18, 20, 21, 22, 23, 23, 24, 25, 26<br><br>Qualitative data: 27, 28, 29 |
| 3 | What intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD? | Quantitative data: 30. 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43<br><br>Qualitative data: 44, 45, 46 |
| 4 | How do the perceived barriers affect teachers' abilities to use AT within the classroom? | Qualitative data: 47, 48 |

By combining both the qualitative data and quantitative data, the researcher gained a comprehensive understanding of the barriers that hinder teachers' ability to use AT. Quantitative data collected information related to the list of barriers defined based on the pertinent literature reviewed. The items of barriers were organized according to Ertmer's concept. The survey

presented the barriers and was asked respondents to indicate the extent to which each barrier influences their use of AT for teaching students with ASD. The first-order barriers were lack of resources, lack of time, lack of training, and lack of support, and the second-order barriers were teachers' beliefs and attitudes, lack of confidence, and lack of knowledge. The survey instrument also used to determine the frequency of reported weekly use of AT. Participants indicated this use for each type of AT (low AT, medium AT, or high AT).

The qualitative open-ended questions followed the quantitative items to gain deeper insight into the barriers and their influence on teachers' abilities to use AT within the classroom. The reason for including these questions was the need to allow participants to add barriers that the researcher may have neglected in the earlier quantitative items. In addition, it afforded respondents an opportunity to explain their views about the barriers to AT. The open-ended questions supported the researcher to expand on the data collection (Bryman, 2006; Jensen, 2002; Kuada, 2012). Furthermore, the open-ended questions helped to deepen the understanding of the barriers teachers face when using AT for teaching students with ASD.

**Data Analysis**

The significance of the research was to identify many of the barriers that hinder teachers' use of AT for teaching students with ASD. The major concept of embedded mixed methods was that qualitative data can be collected and analyzed to confirm or support the quantitative data (Hesse-Biber, 2010). The process of data analysis was conducted in two steps: analyzed quantitative data first (Phase I – a Likert scale) and qualitative data second (Phase II – open-ended questions). The quantitative data analyzed via the Statistical Package for the Social Sciences (SPSS) tests, and the qualitative data analyzed through a method involving the coding of important themes, and the MAXQDA qualitative data analysis computer software package managed the data.

The data collection included four items about participants' demographic information (sex, age, years of experience, and office of education) that were used to describe the sample of the study.

To answer the first research question, how often do Saudi teachers use AT in the classroom with students with ASD, the survey had three items related to the frequency of reported weekly use of AT. The participants responded to five choices: Do not Use = 1, 1 Time or Less a Week = 2, 1 to 2 Times a Week = 3, 3 to 4 Times a Week = 4, and 5 Times and More a week = 5). The frequency, percentage, mean, and standard deviation for each item of AT use were utilized to analyze each item to obtain a clear idea of the state of use of AT in the classroom. To continue exploring this question, the instrument had one open-ended question that addressed the type of assistive technology that teachers currently use and how many times they are using it per week.

To answer the second research question, what extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD, the responses were quantified on a five-point Likert scale. Likewise, the third research question, what intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD, the researcher used a five-point Likert scale (strongly disagree = 1, disagree = 2, undecided = 3, agree = 4, and strongly agree = 5). The data collected from the survey items were input into SPSS to identify the mean and the standard deviation of each barrier. The items were on a scale from 1 to 5, with 1 representing "strongly disagree" and 5 representing "strongly agree".

To continue exploring the barriers, the instrument had six open-ended questions that addressed the barriers that hinder the use of AT. Open-ended questions provided a deeper understanding of the barriers from the teachers' perspectives (Teddlie & Tashkkori, 2009). The researcher set up the coding process for barriers and challenges in using AT in the classroom after receiving responses from teachers who teaching students with autism. Then, the researcher

analyzed and compared the barriers and challenges among teachers. Furthermore, the open-ended questions presented an opportunity for participants to share their own specific barriers beyond the information that the survey data provided. For each of these questions, the researcher analyzed all participants' responses and the statements were then coded via MAXQDA software. These codes were sorted and categorized to create themes, each of which was grouped into categories. (Creswell, 2014; Marshall & Rossman, 2016). According to Creswell (2014), the goal of the coding is "to make sense out of text data, divide it into text or large image segments, label the segments with codes, examine codes for overlap and redundancy, and collapse these codes into broad themes" (p. 243). Frequently occurring themes were analyzed, and this helped to ensure the depth of the quantitative results (Creswell, 2014; Marshall & Rossman, 2016; Miles & Humberman, 1994) and to allow for elaboration, enhancement, illustration, and clarification (Creswell & Clark, 2011; Hesse-Biber, 2010).

The last step was to find an answer to the fourth research question, how do the perceived barriers affect teachers' abilities to use AT within the classroom. This section contained open-ended questions. Participants were asked two core questions, the purpose of which was to investigate teachers' perspectives about how these barriers affect the use of AT. Themes and categories were analyzed for each item by using the MAXQDA qualitative data analysis computer software package to manage the data.

The qualitative data sourced from nine open-ended questions were analyzed using thematic analysis, as described in Braun and Clarke (2006). The first step involved uploading all participant responses into MAXQDA software and repeated reading of the data within the program. This step aided the researcher in understanding and organizing the transcript and noting ideas for possible themes and coding. The next step in the process was to generate initial codes from the data. The

MAXQDA was used to develop specific codes by classifying and identifying information related to the purpose of this study. The third step in the analytical process was to search for themes in all codes that have been identified in the previous step. The themes were developed to provide a deeper understanding of teachers' perspectives on assistive technology use barriers. After identifying overarching themes, the researcher reviewed the themes and refined some themes. Once this process was completed, the researcher found distinctions between themes. In Step 5, themes were adjusted and organized so that they were consistent, and categories were identified to separate out the information. After completing these five steps, the researcher began the description of the data and write-up of the report.

**Ethical Considerations**

Prior to conducting this research, the researcher provided all pertinent and applicable forms to the IRB of the University of South Florida for approval. After obtaining permission from the IRB, the researcher got consent to conduct this study from the General Administration of Public Education in Riyadh, Saudi Arabia to authorize completion of the study with teachers of students with ASD. The researcher adhered to the ethical standards of research throughout the study. Creswell (2009) indicated that a researcher should protect confidential data, that informed consent must be obtained from participants, and that a participant's rights must be protected. All participants received an informed consent letter that explained the purpose of the research, stated the ways in which their participation will be used only for this study. Furthermore, to preserve the confidentiality of the data, personally identifiable information was not revealed in the results of this study, nor shared with anyone. Finally, the data collected will be destroyed after a 5-year period.

**Summary**

The aim of the study was to provide insight into the barriers affecting Saudi teachers' use of AT for teaching children with ASD. This chapter outlined the research methodology that were employed in this study. Namely, an embedded mixed-methods approach that included a survey and open-ended questions focused on teachers of students with autism in Saudi Arabia. The major concept of using an embedded mixed-methods approach was that qualitative data supported and corroborated the quantitative data (Creswell & Clark, 2010; Hesse-Biber, 2010). The targeted population for data collection was teachers of students with ASD in Saudi Arabia. The instrument of study categorized the barriers according to first-order and second-order barriers. In addition, this chapter indicated the procedures of data collection and analysis, and the validity and reliability. Chapters 4 and 5 will present the results and analysis of these data.

# CHAPTER FOUR: RESULTS

## Overview

Research suggests that the use of Assistive technology (AT) is essential to effectively teach students with Autism Spectrum Disorder (ASD) (Lancioni & Singh 2014). Specifically, it can increase the achievement levels of a student with ASD when used for the betterment of many skills, such as academic, social, and communication skills (Ayres, Mechling, & Sansosti, 2013; Clark, Austin, & Craike, 2014; Ennis-Cole & Smith, 2011; Goldstein & Naglieri, 2013). However, the effective use of AT in the classroom can be influenced by many factors, one of which is how teachers apply it in their classrooms (Papanastasiou & Angeli, 2008). The effective use of AT is still a concern and a critical issue for many special education teachers (Zhao & Bryant, 2006) because they face many barriers that impede the effective application of AT with students with ASD (Bouck, 2016; Gallo & Beckman, 2016).

These barriers must be examined from perspectives drawn from teachers of students with ASD (Burke, 2014; Gaffner, 2015; Gentry, Wallace, Kvarfordt, and Lynch, 2010; Kopcha, 2012). Information gleaned from studying this issue will allow a better understanding of the barriers to AT use, which can assist teachers to perform their tasks to fulfill the needs of students with ASD. Furthermore, exploring teacher views about the barriers that affect their abilities to effectively use AT can provide important data to policymakers, educational leaders, and administrators in the ministry of education in Saudi Arabia. These data will assist administrator to make informed decisions to reduce or eliminate these barriers, which can in turn increase AT use with students with ASD.

**Purpose of Study**

The purpose of this mixed methods study is to identify the barriers that inhibit teachers of students with ASD from using AT by examining the lived experiences of Saudi teachers. The aim is to provide valuable information to the Special Education Department of the Saudi Arabia Ministry of Education and contribute to the body of literature concerning the barriers of AT use with students with ASD. To comprehensively identify which barriers influence teachers' use of AT for teaching students with ASD, this study employs the following central research question to guide the development of the research design:

What barriers do teachers identify as hindering their ability to use AT for teaching children with ASD?

To investigate this question, four subquestions are formulated:

1. How often do Saudi teachers use AT in the classroom with students with ASD?

2. What extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

3. What intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD?

4. How do the perceived barriers affect teachers' abilities to use AT within the classroom?

To answer these four research questions, this study employed an embedded a mixed methods approach to explore the barriers affecting teachers' adoption of AT to teach students with ASD in the classroom. An online survey instrument was used to collect data. The purpose of using embedded mixed methods research, compared to a quantitative or qualitative method by itself, was to better comprehend the research questions and the problem (Creswell, 2013). A mixed methods approach helps a researcher to gain the strengths of each approach and avoid the weaknesses to

ultimately develop a better understanding of a research problem (Terrell, 2012; Creswell & Plano-Clark, 2007).

By utilizing both a quantitative and a qualitative approach, the research questions for this study can be addressed (Creswell, 2014). This study included two types of data: quantitative data through the use of a Likert scale and qualitative data gathered via open-ended questions. Therefore, the elements of an embedded mixed methods design have the potential to develop a complete understanding of the practices of AT and the barriers that are often influential factors in its effective use in the classroom (Doyle & Byrne, 2009).

Chapter 4 is organized as follows: First, an overview of the research problem, the purpose of the study, the research questions, and the methods are presented. The overview summarizes the information presented in Chapters 1 and 3 to review the direction guiding this research. Prior to presenting the results of the study, the data collection and data analysis procedures are summarized to fully understand the gathered data in accordance with the study approach. Next, the demographics of the study and response rate are presented, along with the measure of internal consistency coefficient. Finally, the findings are presented and organized according to the four research questions of this study. I conclude the findings section with a summary of the chapter.

**Review of Data Collection Procedures**

As previously described in Chapter 3, prior to the data collection, I obtained approval from the IRB of the University of South Florida. Then, I requested consent from the General Administration of Public Education in Riyadh, Saudi Arabia, to authorize completion of the study with teachers of students with ASD. Upon agreement, the education department and I invited all teachers of students with ASD (by email) to participate in this research. The email included the purpose and nature of the study, a link to the survey, the average time for completion, the security

procedures to protect confidentiality, and IRB approval to protect participants' human subject rights. Teachers who agreed to voluntarily participate were able to click a link to a web-based questionnaire (Qualtrics) that directed them to share responses regarding the instrument of study.

The data collection process took place over three months, beginning in July, 2020 and ended on the 1st of October, 2020. Data were collected from the 85 participants who were enrolled in the study which was adequate for the purpose of research design in order to answer the research questions. The instrument included used a mixed methods approach to obtain both quantitative and qualitative data. It contained 48 items/questions, which consisted of four main parts: participants' demographic information, the frequency of AT use, the barriers to AT use, and the effect of these barriers on AT use.

**Review of Data Analysis Procedures**

Both quantitative and qualitative databases were downloaded from Qualtrics to SPSS and MAXQDA. The quantitative data were analyzed via SPSS for data description. All responses were analyzed using frequency and percentages to describe the sample of the study. To answer the first research question of the study, descriptive statistics including percentages, frequency, mean, and standard deviation were utilized. To answer the second and third research questions, descriptive statistics including the mean and standard deviation were utilized.

The qualitative data from all four research questions of the study were analyzed through a method involving the important themes and categories. The MAXQDA software was utilized to manage the data and search for word frequency. The findings of the data analysis are presented and described in detail in this chapter.

**Demographics of the Study**

The sample for this study consisted of 98 teachers currently working with students with autism in Saudi Arabia. Of those teachers, 85 completed their responses to the survey, and there were 13 uncompleted responses that were excluded from statistical analysis. Using participants' demographic information was not necessary to answer the research question; rather, it used frequency and percentages to describe the sample of the study. Tables 2, 3, 4, and 5 present and describe the participants' demographic information as follows: (1) sex, (2) age, (3) number of teaching experience years, and (4) offices of education. The demographic data of participants were analyzed via SPSS.

**Sex**

Table 2 shows a comparison of the sex of participants in the study; the majority of participants were male teachers (57.6%, n = 49), while 42.4% (n = 36) were female teachers. These results are in keeping with the ratio of male to female teachers in the education department of Riyadh city: 114 (59%) male and 79 (41%) female teachers (Education department of Riyadh, 2019).

**Table 2**

*Sex*

|       |        | Frequency | Percent |
|-------|--------|-----------|---------|
| Valid | Male   | 49        | 57.6%   |
|       | Female | 36        | 42.4%   |
|       | Total  | 85        | 100%    |

**Age**

The next demographic question asked teachers to identify their age from five categories. As Table 3 indicates, the largest age group who participated in the study was 31–40 years old, representing 50.5% (n = 43) of participants. The rest of the age groups were as follows: 17.6% (n = 15) of participants were 20–30 years old; 29.4% (n = 25) were 41–50 years; and 2.3% (n = 2) were 51–60 years. This study sample did not contain any 61–70-year-olds.

**Table 3**

*Age*

|  |  | Frequency | Percent |
|---|---|---|---|
| Valid | 20–30 | 15 | 17.6% |
|  | 31–40 | 43 | 50.5% |
|  | 41–50 | 25 | 29.4% |
|  | 51–60 | 2 | 2.3% |
|  | 61–70 | 0 | 0% |
|  | Total | 85 | 100.0 |

**Years of Experience**

Table 4 lists the number of years of experience that the teachers have been working with students with ASD. Based on the responses, 14.1% (n = 12) of participants had 0–5 years of experience; 28.2% (n = 24) had 6–10 years of experience; 25.9% (n = 22) had 11–15 experience years; 21.2% (n = 18) had 16–20 years, and 10.6% (n = 9) had 21 years or above.

**Table 4**

*Years of Experience*

|  |  | Frequency | Percent |
|---|---|---|---|
| Valid | 0–5 years | 12 | 14.1% |
|  | 6–10 years | 24 | 28.2% |
|  | 11–15 years | 22 | 25.9% |
|  | 16–20 years | 18 | 21.2% |
|  | 21 years and above | 9 | 10.6% |
|  | Total | 85 | 100.0 |

**Offices of Education**

The education department of Riyadh Region has 30 offices of education, all of which are under the supervision of the education department. Each office of education is responsible for all schools within its district, and some offices in Riyadh city have no schools with teachers of students with autism. Participants in this study indicated 11 offices of education in which they work.

Table 5 lists the offices of education in which the teachers worked in their schools. The largest teacher group that participated in the study was from the Office of Education in Alrawdah District, with 23.5% (n = 20) of participants, followed by the office west of Riyadh, with 22.3% (n = 19) of participants. The smallest teacher group that participated in the study was from the Office of Education in Alaziziyah District, with 1.17% (n = 1) of participants, followed by the offices east of Riyadh and in Alsuwaidi District, each with 2.3% (n = 2) of participants.

**Table 5**

*Offices of Education*

|  |  | Frequency | Percent |
|---|---|---|---|
| Valid | Office of Education in Albadiah District | 4 | 4.7% |
|  | Office of Education in Alrawaby District | 12 | 14.11% |
|  | Office of Education north of Riyadh | 9 | 10.5% |
|  | Office of Education west of Riyadh | 19 | 22.3% |
|  | Office of Education south of Riyadh | 4 | 4.7% |
|  | Office of Education east of Riyadh | 2 | 2.3% |
|  | Office of Education in Alrawdah District | 20 | 23.5% |
|  | Office of Education in Alsuwaidi District | 2 | 2.3% |
|  | Office of Education in Alaziziyah District | 1 | 1.17% |
|  | Office of Education in Qurtoba District | 7 | 8.2% |

**Table 5**

*Continued*

|  | Frequency | Percent |
|---|---|---|
| Office of Education in Alraed District | 5 | 5.8% |
| Total | 85 | 100.0 |

**Reliability Analysis**

The internal consistency coefficient (Cronbach's alpha) was used to ensure that the items of the instrument relate to one another as a group (Gay, et al., 2006). I set the reliability score of 0.70 or higher in each category of the instrument to estimate the internal consistency (Nunally, 1978). The internal consistency coefficient of this instrument was evaluated for seven categories: (1) lack of resources, which consisted of six items; (2) lack of time, which consisted of three items; (3) lack of training, which consisted of five items; (4) Lack of support, which consisted of four items; (5) lack of teachers' beliefs and attitudes, which consisted of five items; (6) lack of confidence, which consisted of five items; and (7) lack of knowledge or skills, which consisted of four items.

Table 6 presents the level of internal consistency for all subscales; the results are as follows: First, for the lack of resources subscale, the coefficient alpha (Cronbach's alpha) determined a reliability of .79, thus indicating an acceptable level of internal consistency. Second, for the lack of time subscale, the coefficient alpha determined a reliability of .79, which also indicates an acceptable level of internal consistency. Third, the coefficient Alpha determined a reliability of .76 for the lack of training subscale, thus demonstrating an acceptable level of internal consistency.

Fourth, the coefficient alpha for the lack of support subscale determined a reliability of .72, suggesting an acceptable level of internal consistency. Fifth, for the subscale concerning the lack of teachers' beliefs and attitudes, the coefficient alpha determined a reliability of .91, which indicated an excellent level of internal consistency. Sixth, the coefficient alpha determined a reliability of .72 for the lack of confidence subscale; this result indicated an acceptable level of internal consistency. Seventh, the coefficient alpha for the lack of knowledge or skills subscale determined a reliability of .93, thus suggesting an excellent level of internal consistency.

Finally, I collected the internal consistency coefficient for all items (n = 32) to ensure that the items of the instrument relate to one another as a group. The findings revealed an excellent level of internal consistency for all items of the instrument, with Cronbach's alpha being .93.

**Table 6**

*Reliability Statistics*

| Scales | Cronbach's Alpha | N of Items |
|---|---|---|
| Resources | .79 | 6 |
| Time | .79 | 3 |
| Training | .76 | 5 |
| Support | .72 | 4 |
| Teachers' beliefs and Attitudes | .91 | 5 |
| Confidence | .72 | 5 |

**Table 6**

*Continued*

| Scales | Cronbach's Alpha | N of Items |
|---|---|---|
| Knowledge/skills | .93 | 4 |
| Scale: ALL VARIABLES | .93 | 32 |

**Findings**

The findings are presented according to the four research questions. The findings of the first, second, and third research questions of this study are divided into two sections, consisting of quantitative data and qualitative data, while the findings of the fourth question have qualitative results. Tables are presented to show the descriptive analysis for each research question. Moreover, the tables present the themes and categories for qualitative analysis.

**Findings of Research Question 1. How Often Do Saudi Teachers Use AT in the Classroom with Students with ASD?**

This first question concerns the frequency of reported weekly use of AT. To address this question, teachers were asked to respond to three items of the survey (Numbers 5 through 7), which addressed three types of AT: low-tech, mid-tech, and high-tech AT. Respondents had five choices: Do not Use = 1, 1 Time or Less a Week = 2, 1 to 2 Times a Week = 3, 3 to 4 Times a Week = 4, and 5 Times and More a week = 5. When investigating the frequency, percentage, mean, and standard deviation for each item of AT use, the findings revealed the following: On Item 5 regarding the frequency of reported weekly use of low-tech AT, 24.7% (n = 21) of teachers reported that they use low-tech AT three to four times a week. On the other hand, 12.9% (n = 11)

reported that they do not use low-tech AT (see Table 1). On Item 6 concerning the frequency of reported weekly use of mid-tech AT, 34.1% (n = 29) of teachers reported that they use mid-tech AT one to two times a week. Only 8.2% (n = 7) of teachers reported that they use mid-tech AT five times and more a week (see Table 1). However, on Item 7 pertaining to the frequency of reported weekly use of high-tech AT, 30.6% (n = 26) of teachers reported that they use high-tech AT five times and more a week. Few teachers (7.1%, n = 6) reported do not using high-tech AT (see Table 1).

As listed in Table 7 regarding the mean and standard deviation for the three types of AT, the highest mean of items related to the frequency use of AT was for high-tech AT (M = 3.62, SD = 1.24). On the other hand, the lowest mean of the item was for mid-tech AT (M = 2.60, SD = 1.20). Based on these results, teachers indicated that they do not often use mid-tech AT, as high-tech and low-tech AT were used. This leads to describing the weakness regarding the use of mid-tech AT.

**Table 7**

*Descriptive Statistics for Frequency of Reported Weekly Use of Assistive Technology*

| Items | | Do not Use | 1 Time or Less a Week | 1 to 2 Times a Week | 3 to 4 Times a Week | 5 Times and More a Week | *M* | *S D* |
|---|---|---|---|---|---|---|---|---|
| **Q5** Low Tech | N | 11 | 16 | 20 | 21 | 17 | 3.2 0 | 1.3 1 |
| | % | 12.9٪ | 18.8٪ | 23.5٪ | 24.7٪ | 20٪ | | |

**Table 7**

*Continued*

| Items | | Do not Use | 1 Time or Less a Week | 1 to 2 Times a Week | 3 to 4 Times a Week | 5 Times and More a Week | *M* | *S D* |
|---|---|---|---|---|---|---|---|---|
| **Q6** Mid Tech | N | 19 | 20 | 29 | 10 | 7 | 2.60 | 1.20 |
| | % | 22.4٪ | 23.5٪ | 34.1٪ | 11.8٪ | 8.2٪ | | |
| **Q7** High Tech | N | 6 | 11 | 18 | 24 | 26 | 3.62 | 1.24 |
| | % | 7.1٪ | 12.9٪ | 21.2٪ | 28.2٪ | 30.6٪ | | |

**Qualitative findings.** To address Research Question 1, the participants were given a chance to add information related to the use of AT. These responses revealed teachers' perceptions about the most useful AT and the frequency of use. Teachers of students with ASD were required to respond to the open-ended question, Item 8, which asked, "What assistive technologies are you currently using? Among them, which assistive technology you think is the most useful for students with ASD? how many times do you use the assistive technology per week?" This qualitative question aimed to explore how teachers express the types of AT devices to use in their classrooms. I reviewed all participants' responses to this question; then, statements were coded via MAXQDA software. These codes were sorted and categorized to create themes, each of which was categorized or grouped into categories. An analysis of the transcripts from responses revealed themes and categories regarding teachers' experiences with AT devices. As listed in Table 8, an analysis of this question resulted in three themes: 1) low-tech AT, 2) mid-tech AT, and 3) high-tech AT.

Under the first theme, low-tech AT devices were grouped into two categories: 1.1. visual materials and 1.2. motor tools. Under the second theme, mid-tech AT devices were grouped into two categories: 2.1. SGDs and 2.2. audiobooks. Under the third theme, high-tech AT devices were grouped into two categories: 3.1. portable and 3.2. non-portable. All themes and categories are explored next.

*Low-tech AT.* These devices do not require electricity because they do not use electronic components, and they are usually inexpensive. Participants in this study highlighted the importance of this type of AT. Most of the responses mentioned two types of low-tech AT tools: visual materials and motor tools.

*Visual materials.* Most of the teachers who reported the importance of low-tech AT tools mentioned using a picture exchange communication system (PECS) to improve communication skills and academic achievement. A teacher mentioned using "… the picture exchange communication system and visual schedule with three students daily because they need to develop communication skills, and I use the reinforcement visuals for the rest of the students who have a high level of communication skills." Another response was, "I usually use low-tech AT with my students with autism constantly because of its importance in increasing their academic achievement, especially the visual schedule, by presenting it in the class in a way that attracts students to learn and manages their time and activities."

The use of low-tech AT has increased due to its ease of availability in the schools, and its price is also not expensive. A teacher mentioned, "I believe technology based on pictures is the most important type of assistive technology for two reasons: first, my students with autism like to learn via pictures, and second, the technology is easy for me to bring to the classroom. I use these

tools on a daily basis." The teacher also mentioned employing "visual strategies and cartoons on a daily with my students because they are useful and inexpensive."

*Motor tools.* A few teachers indicated the use of AT tools with students who face difficulties with motor skills. These tools help and facilitate the work of students with ASD. One of the most important tools they mentioned was the use of the pencil grip; a teacher said,

> "There are types of assistive technologies that are impossible to work without because they help children with autism in learning; for example, a pencil grip to help students to handwrite. So I am very careful to provide it to students who need it because without it, they will face difficulties in learning to write."

*Mid-tech AT.* These devices do not have mechanical features, and they are manually operated. Furthermore, to work, they require at least a battery or to be connected to a power source. Despite their cheap price, few teachers mentioned their use of mid-tech AT devices with students with ASD. Only two of the participants mentioned the benefit of this type of AT in teaching students with ASD.

*SGDs.* One of the teachers said, "I use speech-generating devices with one of the students on a daily basis."

*Audiobook.* Another teacher pointed out the importance of using audiobooks: "I borrow an audiobook from the resource room and use it with my students to develop their language, which is very useful for them because they love to work on it."

*High-tech AT.* These devices require a power source on which to run, and they have sophisticated electronic equipment. High-tech devices are flexible, offer further mobility, and are used for multiple tasks. Most of the participants indicated the importance of using these types of devices more than low- and mid-tech AT.

*Portable.* Most of the teachers reported using portable computers in the classroom, mentioning that they always use a laptop to teach students with ASD. A teacher stated, "Using a

laptop to teach children with autism is very important. I think it is the most beneficial assistive technology, more than any other type of assistive technology." Some teachers also mentioned the following: "I like to use computer programs to develop a child's language skills, and I use it at varying times," and "I use my laptop in order to present some educational lessons to my students. Also, I show them some educational videos that are interesting to them." Other teachers reported that they use computers in designing educational lessons for students with ASD: "I design some learning activities through the laptop, and this is a catalyst for teaching students with autism."

Some of the participants commented on the importance of using a laptop, with a teacher stating, "The most assistive technology that I use with my students is the laptop because it allows and helps me to create lesson plans. Also, I notice that my students with autism like to use the laptop more than the computer in the classroom because the desktop computer is old and slow. So I had to bring my own laptop to school every day." Another participant explained the features of the laptop: "I use a new and advanced laptop that easily allows me to connect with other devices such as projectors and TVs."

In addition, many teachers mentioned using tablet devices as being as important as using portable computers. The majority of participants reported using the iPad to teach students with ASD. A teacher commented,

> "I was used to using the desktop computer constantly that is available in my classroom, but now I find the iPad more useful to me and students. It is easy to carry and moved easily with it. Also, my students have a higher level of skills in using the iPad than a computer or laptop. However, it needs constant charging because of the battery draining fast; that makes me fear for my students from the danger of the charger wire. For this reason, I use it at specific times, and this makes it a little difficult because children with autism do not want to wait while charging. But the great thing about it is that students love to learn on the iPad. This makes it easier for me to attract students to focus and pay attention to the tasks that are required of them."

Another comment explained the usefulness of the apps on the iPad, especially English apps. A teacher commented,

> "I use the iPad five times a week, as it is highly effective in teaching children with autism. The iPad makes it easy for me as a teacher to download many educational applications for students. I hope to enrich the Arabic content with more applications because I find many wonderful English applications, but I can only use it with one student who has more linguistic knowledge in English because he watches movies and listens to songs in English, and his brothers at home speak English. I always find the iPad more effective with him than his peers because the iPad has many applications and educational games in the English language."

Teachers had positive comments about using apps. A teacher stated, "I use gaming apps that help students with autism to develop the skill of paying attention through the iPad, and my students love these games, so I use them every day of the week." Another teacher said, "Sometimes, I use audiobooks that are downloaded on the iPad, and I find they have great benefits for developing language skills."

*Non-portable.*Participants noted the importance of having a TV in the classroom for the education of children with ASD. A teacher commented, "I used a video modeling strategy, which showed cartoon videos on TV to teach them daily life skills." Another participant added, "... TVs are among the most common tools I use with my students due to their availability in school." A few teachers mentioned that they used a desktop computer with their students in the classroom; a teacher stated that "The desktop computer is always used to design learning lessons and print pictures of letters or numbers to implement some techniques and educational strategies with my students." There were teachers who indicated the use of desktop computers in the evaluation process for students; for example, "Currently, I use the desktop computer every school day to assess the levels of students' skills. I also use it to communicate with their families."

The teachers also pointed out the importance of having a smartboard in the classroom, with a teacher saying,

"Recently, a smartboard was added in the classroom, and I started to learn to use it to facilitate the learning process for my students. I needed a long time to learn it. Also, at the beginning, students with autism found it difficult to learn and use it, but in general it was very useful to them and for presenting some lessons in an attractive way to all students."

**Table 8**

*Themes and Categories in Responses to Question 8*

| Themes | Categories |
|---|---|
| 1. Low AT | 1.1. Visual Materials |
| | 1.2. Motor Tools |
| 2.Mid AT | 2.1. SGDs |
| | 2.2. Audiobooks |
| 3.High AT | 3.1. Portable |
| | 3.2. Non-portable |

**Findings of Research Question 2. What Extrinsic (First-Order) Barriers Affect Saudi Teachers' Abilities to Use AT for Teaching Children with ASD?**

The second research question of the study explored the first-order barriers to using AT to teach students with ASD. The 18 items were designed to collect participant responses to measure those barriers, which were presented to respondents, who were then asked to rate their level of agreement or disagreement on each statement regarding what influences their use of AT for teaching students with ASD. The first-order barrier items were divided into four categories:1) lack

of resources (six items), 2) lack of time (three items), 3) lack of training (five items), and 4) lack of support (four items); these categories were organized according to the framework of this study.

To answer Research Question 2, I asked teachers to quantify their answers on a five-point Likert scale: strongly disagree = 1, disagree = 2, undecided = 3, agree = 4, and strongly agree = 5. Tables 9, 10, 11, and 12 present the descriptive statistics for each category pertaining to the first-order barriers. The data collected from the survey items were input into SPSS to identify the mean and the standard deviation of each barrier. Lower scores indicated disagreement with positive statements of the survey, and higher scores indicated agreement with positive statements.

**Lack of resources.** Table 9 displays the descriptive information for six items, which measured lack-of-resources statements on using AT with students with ASD. With a low score (M = 2.36, SD = 0.81), teachers responded most to disagreement on items. According to the responses, the lack of resources was a barrier to using AT for teaching students with ASD. The majority of participants in the survey responded negatively on Item 14, "I think my school is budgeting money for purchasing assistive technology" (M = 1.99, SD = 1.09). The highest mean of items related to a lack of resources was Item 11: "High Tech devices are available at my school" (M = 2.69, SD = 1.34).

**Table 9**

*Descriptive Statistics for Lack of Resources*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q9** Low Tech devices are available at my school. | 2.29 | 1.28 |

**Table 9**

*Continued*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q10** Mid Tech devices are available at my school. | 2.60 | 1.11 |
| **Q11** High Tech devices are available at my school. | 2.69 | 1.34 |
| **Q12** I think assistive technology devices is inexpensive. | 2.36 | .99 |
| **Q13** As far as I know, all teachers have easy access to assistive technology devices in my school. | 2.22 | 1.08 |
| **Q14** I think my school is budgeting money for purchasing assistive technology. | 1.99 | 1.09 |
| Average Mean | 2.36 | |
| Std. deviation | .81 | |

**Lack of time.** Table 10 displays the descriptive information for three items that measured lack-of-time statements on using AT with students with ASD. With a low score (M = 2.68, SD =

0.98), most teachers indicated disagreement on items. According to the responses, lack of time was a barrier to using AT for teaching students with ASD. Participants in the survey responded negatively on Item 17, "My school provides more time to experiment with new types of assistive technology" (M = 2.01, SD = 0.99). The highest mean of items related to lack of time was Item 15: "I have enough class time to use assistive technology with my students with ASD" (M = 3.12, SD = 1.24).

**Table 10**

*Descriptive Statistics for Time*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q15** I have enough class time to use assistive technology with my students with ASD. | 3.12 | 1.24 |
| **Q16** I have enough school time to improve my skills in using assistive technology. | 2.91 | 1.26 |
| **Q17** My school provides more time to experiment with new types of assistive technology. | 2.01 | .99 |
| Average mean | 2.68 | |
| Std. deviation | | . |
| | | .98 |

**Professional training.** Table 11 displays the descriptive information five items that measured lack-of-training statements on using AT with students with ASD. With a low score (M = 2.70, SD = 0.81), most teachers indicated disagreement on items. According to the responses, lack of training was a barrier to using AT for teaching students with ASD. The majority of participants in the survey responded negatively on Item 18, "I learned how to use assistive technology from my university courses" (M = 2.24, SD = 1.10). The highest mean of items related to training was Item 22: "I gained most of my knowledge in using assistive technology for students with ASD through self-training" (M = 4.01, SD = 1.06).

**Table 11**

*Descriptive Statistics for Training*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q18** I learned how to use assistive technology from my university courses. | 2.24 | 1.10 |
| **Q19** My school district offers adequate training opportunities for me to use assistive technology for students with ASD**.** | 2.34 | 1.26 |
| **Q20** My previous training experiences taught me how to competently use assistive technology**.** | 2.44 | 1.08 |

**Table 11**

*Continued*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q21** My teacher preparation program taught me how to use assistive technology using hands-on experience**.** | 2.49 | 1.14 |
| **Q22** I gained most of my knowledge in using assistive technology for students with ASD through self-training**.** | 4.01 | 1.06 |
| Average mean | 2.70 | |
| Std. deviation | | .81 |

**Lack of support.** Table 12 displays the descriptive information for four items that measured lack-of-support statements on using AT with students with ASD. With a low score (M = 2.45, SD = 0.82), most teachers indicated disagreement on items. According to the responses, lack of support was a barrier to using AT for teaching students with ASD. The majority of the participants in the survey responded negatively on Item 24, "My school readily provides technical support to fix malfunctioning assistive technology" (M = 1.93, SD = 0.88). The highest mean of items related to lack of support was Item 23: "My school leader encourages me to use assistive technology in the classroom" (M = 3.00, SD = 1.31).

**Table 12**

*Descriptive Statistics for Support*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q23** My school leader encourages me to use assistive technology in the classroom**.** | 3.00 | 1.31 |
| **Q24** My school readily provides technical support to fix malfunctioning assistive technology | 1.93 | .88 |
| **Q25** I know how to fix malfunctioning assistive technology by myself**.** | 2.35 | 1.07 |
| **Q26** Most of the assistive technology devices in my classroom are still working in good condition**.** | 2.54 | 1.13 |
| Average mean | 2.45 | |
| Std. deviation | | .82 |

**Qualitative findings.** To address Research Question 2, the participants were offered an opportunity to write down their perspectives regarding first-order barriers. Instrument Items 27, 28, and 29 asked teachers to respond to open-ended questions. The responses provided an in-depth explanation of the barriers affecting teachers' ability to use AT to teach students with ASD. I reviewed all participants' responses to this question, and the statements were then coded via

MAXQDA software. These codes were sorted and categorized to create themes, each of which was categorized or grouped into categories.

Teachers who taught students with ASD were asked to respond to the open-ended question, Item 27, "What can make it difficult to access and use assistive technology devices in your school?". This qualitative question aimed to explore the barriers that teachers face in acquiring AT devices in their classrooms. The transcripts from responses were analyzed to provide themes and categories regarding barriers to accessing AT devices. Table 13 lists the two resulting themes: 1) availability and 2) devices. The first theme was grouped into three categories: 1.1. not enough, 1.2. sharing, and 1.3. request. The second theme included three categories: 2.1. old devices, 2.2. malfunction, and 2.3. cost.

*Availability*. AT use for teachers who work with students with ASD varied according to AT device availability in their schools. The limited resources in teachers' classroom affect the frequency of AT use. Participants discussed the impact of limited availability of AT resources as one of the difficulties in accessing and using AT in the classroom. Most of the teachers described a lack of resources as an obstacle to their successful use of AT for students with ASD. Their explanations of the barriers related to availability were provided in the following three different formats:

*Not enough.* Teachers reported the number of resources, which did not match with their needs and students. They commented on the large number of students compared to a limited number of AT devices. A teacher said that "There are no assistive technology devices, and if we have them in the classroom, unfortunately, the number of devices is not enough for the number of students with ASD." Another teacher stated the following: "insufficient equipment with the number of students in the classroom. I have in class nine students with autism, and the available

devices cannot be used individually with each student." Another teacher indicated lacking classroom storage for AT devices: "The school does not provide it; I have to bring it myself, and there are no designated places to keep it or save it." One of the difficulties in accessing AT devices in schools that the teachers expressed was related to the lack of device peripherals, such as Internet services and device batteries. Teachers mentioned, "… no support for the computer with its other important accessories, such as a printer, speakers, a projector, or the Internet." Another participant described a complete lack of the Internet: "I have a computer in the classroom, but there is no Internet in the school, which greatly limits the use of the computer in terms of downloading programs or connecting to the Internet to view video." Moreover, a teacher commented on unsupported mid-tech AT, stating that "Some devices need to their batteries changed frequently; batteries are not cheap, and the school does not provide support in that, so I always avoid using devices that rely on batteries."

*Sharing.* An issue that teachers reported as adding difficulties to accessing AT devices in schools was that devices have to be shared among all teachers. This is evident in the following statements by teachers: "Some assistive technology devices are borrowed from teachers in the school. This causes delays or cancels much of the successful implementation of plans." A teacher also expressed that "Assistive technology devices are not available to all teachers at the same time, which makes us spend a lot of time coordinating between us on the exchange of devices. This is an additional burden on us." A respondent further described that

> "Teachers borrow assistive technology devices from my classroom and return it to me when it is broken. This makes me constantly embarrassed when I try to refuse their request. Also, what makes matters more difficult is that I know that their students need these devices."

In addition, a teacher indicated having difficulties and a lack of time to move to some equipment in the resource room: "The hardest thing is if I want a computer or projector, I must

move to another classroom to use it." Another teacher described this issue as follows: "When I want to use video modeling, I need to go to the resource room to use the necessary equipment there, which increases the difficulty of moving there. especially because I need to use video modeling with one or two students, and the rest of the students do not need that." Teachers also highlighted issues related to the importance of time and movement of students from one place to another. For example, a teacher explained

> "going to the resource room due to the presence of most of the assistive technologies there, which entails preparing in advance and scheduling it with the supervisor at school and the rest of the teachers. This consumes a lot of time, and it is difficult to transfer students from the classroom to the resource room."

*Request.* Additional difficulties were expressed regarding access to AT devices; these barriers related to requesting items from the education department and schools to meet classroom needs. A teacher mentioned

> "the lack of policies, a system, or a list of tools and devices that I have the right to request from the education department in order to use in the classroom with my students with autism. What is available is some simple assistive technology. Most often, the teachers buy it with their money."

 A teacher commented on the "delay in accepting applications to obtain assistive technology devices from the Education Department." Another teacher reported "difficulty communicating with the education department to request devices that are needed."

*Devices.* The second theme of this question is teachers' expression of the problems with devices. Teachers in this research identified several difficulties that hinder them from successfully accessing AT devices in the classroom. These barriers were organized into three broad categories: old devices, malfunctioning devices, and the cost of devices.

*Old Devices.* Most teachers clearly reported that the most significant challenges to AT use with students with ASD were related to old devices in schools. Old devices are preventing teachers

from using new teaching strategies that are based on new technology. A teacher said, "There is a computer in my classroom, but this is not enough, because it is an old computer. We need an update in order to use new programs." Another example of the problem of old devices is that

> "… the devices and tools are old; for example, there is a TV, but it is very old, and I cannot use a video modeling strategy through it due to the difficulty of linking it to the smartphone or the iPad. I need a smart TV that is easy to connect through mobile pairing."

A teacher mentioned "… the lack of equipment and tools in the school, and also the computer is old and cannot accept some new programs."

*Malfunctions* .Malfunctioning AT devices and equipment were also reported in teachers' responses under this open-ended question. The study participants indicated that damaged or broken tools were a significant barrier that made their work more complex. Teachers commented that "Assistive technology devices cannot be obtained and used continuously due to malfunctions or defects, outdatedness, or students' multiple use of the devices. "Teachers cited the lack of technical support as the main reason for the malfunction of AT devices, with a teacher stating,

> "There is no urgent maintenance. To get technical support we needs to raise a request to the education department, but unfortunately it takes a long time. So there are teachers in the school who volunteer their time to solve basic technical problems because they have experience in repairing broken devices."

Another teacher suggested that "Our schools need a technical support team that helps the teacher to run devices in the classroom."

*Cost.* Most teachers mentioned cost as one of the major barriers they faced when they needed AT devices for teaching students with ASD. They explained that schools budgets are not accommodated to meet all AT categories in the classroom. A teacher stated that "The school budget allocated to this category of assistive technology is not available," and another said, "The school budget is not sufficient to purchase devices that meet the needs of students and teachers." Additional difficulties were expressed regarding cost, where teachers commented that they try to

purchase the AT devices with their own money due to a lack of school budgets. However, the prices of some devices are expensive. A teacher pointed out that "There is no provision of many requirements from the education department. I try to buy some tools on my own account, but they are very expensive, and I cannot pay for them on my own." Another teacher stated that "Some tools and devices are very expensive, and I cannot purchase them for all of my students."

A teacher also added that the problem is not limited to purchasing devices; it is also related to the purchase of electronic programs:

> "lack of resources and financial support to buy some programs and devices are barriers. For example, I needed to use speech-generating devices with students, but there were many malfunctions. That's why I turned to using some applications that can be downloaded on the iPad. They are very useful to teach a student with autism, but at the same time, these applications are not completely free. After a certain period or limited use, the application requests that I pay money to subscribe. I asked the school leader for support, but she told me that there is no special budget from the school or the education department to buy applications on the iPad."

**Table 13**

*Themes and Categories in Responses to Question 27*

| Themes | Categories |
|---|---|
| 1.Availability | 1.1. Not enough |
| | 1.2. Sharing |
| | 1.3. Request |
| 2. Devices | 2.1. Outdated devices |
| | 2.2. Malfunction |

**Table 13**

*Continued*

| Themes | Categories |
| --- | --- |
| | 2.3. Cost |

Teachers who have students with ASD were asked to respond to the open-ended question, Item 28, "What was the most useful training experience to use assistive technology that you have had?". This qualitative question aimed to explore participants' views regarding the best training they have received on AT use. I excluded all statements that indicated a lack of training. The transcripts from responses were analyzed to identify themes and s categories regarding the most useful training. As listed in Table 14, two themes resulted from this analysis: 1) self-learning and 2) other training. Self-learning was grouped into two categories: 1.1. online and 1.2. books. The second theme related to other training included two categories: 2.1. workshops and 2.2. teachers' cooperation.

*Self-Learning.* Teachers require useful training to successfully use AT with students with ASD. The lack of training provided to teachers affects their frequency of AT use in their classroom. The most common responses pertained to self-learning in using AT, where most of the teachers discussed a lack of training as a major reason to learn by themselves. Their comments on self-learning resources were provided in two different formats as follows:

*Online.* A majority of the participants indicated the benefits of online learning regarding the use of AT in the classroom. Social media websites accounted for the largest share of teachers' comments. A teacher reported, "It was by following professors in the autism field on the Internet through Twitter; they explained some of the assistive technology and how to use it with students."

Although information is limited, social media is the most common way to receive information about AT use; a teacher described

> "following up on some specialists in the autism field on social media, such as Facebook or Twitter, although the information provided is simple and not explained in detail, but it helps me to know what is new and try to use it in the classroom."

Some participants pointed to non-Arab websites and online videos as a useful way to increase their knowledge about the use of AT. A teacher stated, "I learn by myself through some international sources on the Internet" while another described seeking knowledge "through the internet and videos on YouTube." A few of the responses also indicated the benefit of online courses: "Not many training sessions have been beneficial; I think self-learning from online courses was more beneficial to me."

*Books*. Participants added that books about AT were useful resources to learn how to use it with students with autism. A teacher commented: "I improve my skills to use assistive technology through reading books; it is the best way to learn." Another response referred to "reading some books, but unfortunately the implementation of assistive technology with students is different from what I found in the books. But overall, I am learning from books a lot about the types of assistive technologies."

*Other training*. Useful training from courses was also reported in teachers' responses to the related open-ended question. Participants indicated attending the courses provided by the education department or local conferences as one of the best forms of training for them. Furthermore, a few teachers stated that the teacher preparation program was most useful in using AT. Participants also expressed the importance of cooperation with experienced teachers in the use of AT.

*Workshops.* From some teachers' comments, courses at local conferences played an important role in increasing teachers' skills. A teacher said, "A useful training experience was attending a workshop at a local conference. The experience was enriching, useful, and provided me with the information and skills I needed to use the best assistive technology with students with autism." A teacher reported that "There aren't many real experiences, but I did attend one workshop on using video modeling, and it was pretty helpful." Another teacher expressed his experience with the training courses: "I think that the best training courses are paid courses, better than the free courses offered by the education department." One teacher mentioned that one of the education department courses was the most beneficial experience for her: "The education department provided the training on using the smart board 9 years ago; it was the best." Despite the limited information in teacher preparation program courses, some participants stated that the university period was the best experience regarding AT. A teacher explained, "During the university period, it was theoretical education from one course, but it had the most benefit in terms of knowledge of assistive technology types." Another teacher agreed, stating that "The best training was through one of the courses I studied in the teacher preparation program at the university, but it taught me a limited number of assistive technology"

*Teachers' cooperation.* Some participants indicated that they receive help from teachers at their school, and they expressed this as one of the available ways in which to learn about the use of AT. A teacher reported,

> "I usually try to take advantage of teachers with high experience in the school by asking them to allow me to observe them in their classroom. It is the best way to learn how to use assistive technology with students with autism."

One participant, when asked about the useful training she had received, responded as follows: "by asking some teachers who have experience about how to implement and use assistive technology."

**Table 14**

*Themes and Categories in Responses to Question 28*

| Themes | Categories |
|---|---|
| 1. Self-learning | 1.1. Online |
| | 1.2. Books |
| 2. Other training | 2.1. Workshops |
| | 2.2. Teachers' cooperation |

Teachers with students with ASD were asked to respond to the open-ended question, Item 29, "How does your school support you in using assistive technology with your students?". The qualitative question aimed to explore teachers' perspectives on the types of school support for using AT to teach students with ASD. As listed in Table 15, after a review of all participants' responses, the types of school support were revealed under three categories: 1.1. high support, 1.2. limited support, and 1.3. no support. These categories are explored next.

*High support.* A number of teachers expressed that they received full support from their schools to use AT to teach children with ASD. This support was described in several ways, such as providing AT devices or giving sufficient time to attend training courses. A teacher stated, "My

school provides classrooms equipped with assistive technology devices and tools that help me to teach students with ASD." Teachers also commented that the school leaders communicate with the education department to address classroom needs, with one teacher explaining that

> "The school works according to its available capabilities, and when I request any device, they send my request to the Education Department to provide it to me, and it also reminds me of the importance of using the computer that is available in the classroom."

In another statement, a participant explained that "They support me in the requests, which are processed by the Education Department." Additionally, some responses indicated that school leaders were encouraging collaboration between teachers to successfully use AT with students with ASD. As a teacher reported, "School leaders ask teachers who have experience inside the school to help us to choose the best tools and devices that are appropriate for students with autism. And sometimes we borrow these tools from these teachers." One teacher also expressed the support he was receiving in the form of time: "My school encourages me and gives me free time to attend courses on using assistive technology devices."

*Limited support.* Participants indicated that there is limited support from the school in providing for basic needs, such as computers, and allocating small budgets for the purchase of devices; a teacher reported,

> "The school is trying to provide a small amount of money to buy assistive technology tools we need, but these tools are damaged, and we cannot repair or replace them because we personally buy them and not through contracts with companies that can provide warranties or permanent maintenance."

Most of the responses suggest that teachers buy AT devices with their own money. Furthermore, a teacher mentioned that creating a budget by all teachers is one form of support. Another teacher discussed the following: "School leaders encourage us and try to collect money from the teachers to purchase some assistive technology tools in the school."

Many responses indicated that teachers did not receive the school's support, because the school also needed support from the education department or the Ministry of Education; for example, "The school leader always tries to provide the equipment in the school, but his attempts are not always successful. We as teachers feel his desire to help and motivate us." A teacher explained that "They try to provide support as much as possible, but their endeavors do not always succeed, because there are no policies that guarantee support for teachers and meet all their needs so that they can better teach students." Another teacher noted the school leader doing what he can: "The school leader tries to motivate us and support us with what he is able to do; we as teachers have learned not to ask him for anything that is out of his control."

*No support.* The majority of participants indicated that they did not receive any kind of support to use AT with students with ASD. A teacher said, "School encourages me verbally, but when I start to apply assistive technology to teach my students, the school does not support me or provide tools or help with technical support. This is what causes many teachers to hate using it." Another teacher noted that "… there is no effective support; they just ask us to use it without providing the assistive technology devices or training courses." Teachers also feel that they do not receive technical support, with one teacher reporting, "I can't get much support; the computer broke down in the classroom, and I fixed it with my own money." In addition, teachers expressed their annoyance with schools' job evaluation process for using AT in the classroom without providing support. A teacher described that "I don't receive much support. They just evaluate the teacher and ask us to use technology and assistive technology with students. There is only an old computer and projector in my classroom." Another teacher stated, "They believe the annual assessment for jobs is support, without providing any tools to use assistive technology, " and that "There is no support;

the school only evaluates me, but it does not provide me with any courses within the school or

provide the equipment that I need."

**Table 15**

*Themes and Categories in Responses to Question 29*

| Themes | Categories |
|---|---|
| 1. School support | 1.1. High support |
| | 1.2. Limited support |
| | 1.3. No support |

**Findings of Research Question 3. What Intrinsic (Second-Order) Barriers Affect**

**Saudi Teachers' Abilities to Use AT for Teaching Children with ASD?**

The third research question of the study concerns the second-order barriers that influences

teachers' use of AT for teaching students with ASD. The 30 to 43 items were designed to measure

those barriers. Similarly to the second question, the items for the third question presented the list

of barriers and asked respondents to rate their level of agreement or disagreement on each related

statement. The intrinsic barrier items were divided into three categories: teachers' beliefs and

attitudes (five items), lack of confidence (five items), and lack of knowledge (three items); these

were organized according to the framework of this study.

To answer the question, I asked participants to quantify their responses on a five-point

Likert scale in the following format: strongly disagree = 1, disagree = 2, undecided = 3, agree = 4,

and strongly agree = 5. Tables 16, 17, and 18 present the findings of each category pertaining to

second-order barriers. The data were entered into SPSS to measure the mean and standard deviation of each intrinsic barrier. Lower scores indicated disagreement, while higher scores indicated agreement with positive statements.

**Teachers' beliefs and attitudes.** Table 16 displays the descriptive information on five items that measured statements relating to teachers' beliefs and attitudes about using AT with students with ASD. With a high score (M = 3.97, SD = 0.90), teachers were mostly in agreement on the items. According to the responses, teachers' beliefs and attitudes were not a barrier to using AT for teaching students with ASD. The majority of participants in the survey responded positively on Item 34, "I prefer to learn more about new assistive technology devices" (M = 4.20, SD = 0.91). The lowest mean of items related to teachers' beliefs and attitudes was Item 33: "I enjoy learning about assistive technology from professional development activities" (M = 3.73, SD = 1.15).

**Table 16**

*Descriptive Statistics for Teachers' Beliefs and Attitudes*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q30** Assistive technology can enhance the learning of students with ASD. | 4.06 | 1.00 |
| **Q31** Using assistive technology can meet the learning needs of students with ASD. | 3.92 | 1.00 |

**Table 16**

*Continued*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q32** Assistive technology can create more learning opportunities for students with ASD. | 3.94 | 1.11 |
| **Q33** I enjoy learning about assistive technology from professional development activities. | 3.73 | 1.15 |
| **Q34** I prefer to learn more about new assistive technology devices. | 4.20 | .91 |
| Average mean | 3.97 | |
| Std. deviation | | .90 |

**Confidence.** Table 17 displays the descriptive information for five items that measured statements regarding teachers' confidence in using AT with students with ASD. With a high score, most teachers agreed with the items (M = 3.58, SD = 0.75). According to the responses, teachers' confidence was not a barrier to using AT for teaching students with ASD. The majority of participants in the survey responded positively on Item 38, "I think my knowledge of assistive technology can be improved" (M = 4.14, SD = 0.83). The lowest mean of items related to teachers' confidence was Item 35: "I am confident that I can use assistive technology with students with ASD" (M = 3.22, SD = 1.23).

**Table 17**

*Descriptive Statistics for Confidence*

| Items | Mean | Std. Deviation |
|---|---|---|
| **Q35** I am confident that I can use assistive technology with students with ASD | 3.22 | 1.23 |
| **Q36** It is easy for me to use assistive technology with students with ASD. | 3.24 | 1.18 |
| **Q37** I am sure of my ability to use assistive technology with my students with ASD. | 3.58 | 1.18 |
| **Q38** I think my knowledge of assistive technology can be improved. | 4.14 | .83 |
| **Q39** I am confident in selecting assistive technology that would best meet my students' learning needs. | 3.75 | .97 |
| Average mean | 3.58 | |
| Std. deviation | | .75 |

**Lack of knowledge and skills.** Table 18 displays the descriptive information on four items that measured statements about the lack of knowledge or skills to use AT with students with ASD. With a mid-range score, teachers responded moderately on items ($M = 2.65$, $SD = 0.93$). According

to the responses, a lack of knowledge or skills was a moderate barrier to using AT for teaching students with ASD. The highest means of items related to this lack were Item 42, "I have sufficient knowledge of most assistive technology devices appropriate for students with ASD" (M = 2.74, SD = 0.97), and Item 43, "My skill level in using assistive technology is high". The lowest mean of items related to a lack of knowledge or skills was Item 40: "I have enough knowledge about using assistive technology for students with ASD" (M = 2.68, SD = 1.09).

**Table 18**

*Descriptive Statistics for Knowledge or Skills*

| Items | Mear | Std. Deviation |
|---|---|---|
| **Q40** I have enough knowledge about using assistive technology for students with ASD | 2.68 | 1.09 |
| **Q41** I can identify what type of assistive technology is most appropriate for students with ASD | 2.72 | 1.03 |
| **Q42** I have sufficient knowledge of most assistive technology devices appropriate for students with ASD | 2.74 | .97 |
| **Q43** My skill level in using assistive technology is high. | 2.74 | 1.02 |
| Average mean | 2.65 | |
| Std. deviation | | .93 |

**Qualitative findings.** To continue addressing Research question 3, the participants were given an opportunity to write down their perspectives about second-order barriers. Instrument Items 44 and 45 asked teachers to respond to open-ended questions, and the responses provided an in-depth explanation of the internal barriers affecting teachers' ability to use AT to teach students with ASD. I reviewed all participants' responses to this question, and statements were then coded via MAXQDA software. These codes were sorted and categorized to identify themes, which were categorized or grouped into categories.

Teachers with students with ASD were asked to respond to the open-ended question, Item 44, "What specific skills do you need to better use assistive technology for your students with ASD?". This qualitative question aimed to explore the skills and knowledge that teachers require to improve AT usage. The transcripts from responses were analyzed to provide themes and s categories regarding different skills. As listed in Table 19, the analysis revealed two themes: 1) assistive technology skills and 2) general skills. The first theme was grouped into two categories —1.1. use and 1.2. choice and assessment—and the second theme also included two categories: 2.1. computer skills and 2.2. classroom management.

*Assistive technology skills.* One of the most significant barriers that teachers of students with ASD face when using AT is a lack of skills to use it in their classrooms. Most participants reported the lack of AT usage skills because of limited practice on AT devices in training courses. Some also pointed to a lack of practice during the teacher preparation program, leading limited improvement in their skills. The second skill that teachers expressed as a need is the ability to select the best AT technology to meet a student's needs.

*Use.* The majority of participants indicated that they did not practice using AT devices or tools. A teacher said, "I need to practice using the assistive technology before employing it with

my students or in the classroom." Another teacher also commented that the courses are not specialized in the field of autism: "Some courses offer the use of assistive technology with all groups of people with special needs and are not specialized in autism, which reduces its usefulness, so we need specialized courses." Moreover, there were participants who indicated that they need more than that: "bringing specialists on assistive technology to the school to set up special courses for teachers with their students in a practical way to be more realistic than theoretical speech in external training courses." Additionally, a teacher stated, "We need to have intensive courses within the school with students." In addition, lack of practice is not limited to professional development. Participants indicated a lack of practice in the teacher preparation program as well. A teacher said, "The teachers preparation program was based on observation only and reading. So I did not see any types of assistive technology devices during my university study. I think we need practice on assistive technology before working with students with autism."

*Choice and assessment.* Teachers indicated that they are facing difficulties in identifying the appropriate AT devices for their students. A teacher reported,

> "I think I need to know what the best assistive technology is to increase students skills. When I look for assistive technology to use with my students, I find a lot of options, and I cannot decide what is the best and most appropriate. I am the only one who prepares the individual educational plan, and this is why it is so difficult for me."

Some teachers attributed the difficulty of identifying appropriate AT devices to the multitude of options, as well as the lack of training courses to increase their knowledge about new AT devices and services. A teacher reported that "Assistive technology devices with children with autism are constantly developing; there are also many new technologies, so I need to continuously develop my skills in the same line with the speed of technology development."

In addition, the teachers indicated the difficulty in evaluating which devices and tools meet the needs of students. A teacher described that,

"… all I need to know is the evaluation of the assistive technology and the extent to which my students need it. There are many devices, but they do not participate with me in choosing the right one for my students. It is important to activate the role of the family and the rest of the teachers in designing the individual educational plan."

Another stated, "I need to know how I assess students' performance for their use of the assistive technology."

*General skills.* The lack of teachers skills is not limited to AT devices and services, but includes other types of skills, such as computers skills and classroom management. Each teacher has a different level of skills that must be developed to successfully use AT with students with ASD.

*Computer skills.* A few of the respondents expressed their need for computer skills. A teacher reported, "I need computer skills and knowledge of the use of technology with children." Another participant described the lack of computer skills, stating that

"In my opinion, the problem with the use of assistive technology is not limited to learning how to use the tools and devices of assistive technology. We are trying to learn computer skills and how to connect devices with other devices, turn them on, and maintain them."

When a teacher was asked about what kinds of skills he needed, he mentioned "technical skills to install programs on computers, to fix malfunctioning devices, and to use computer accessories."

*Classroom management.* The lack of resources and the large number of students in classrooms increase a teacher's need for classroom management skills. A teacher described that "I want classroom management skills with my students. The presence of many tools in the classroom causes students to interfere with one another and quarrel. I prefer some tools that are used collectively to avoid this matter."

**Table 19**

*Themes and Categories in Responses to Question 44*

| Themes | Categories |
|--------|------------|
| 1. Assistive technology skills | 1.1. Use |
|  | 1.2. Choice and assessment |
| 2. General skills | 2.1. Computer skills |
|  | 2.2. Classroom management |

Teachers with students with ASD were asked to respond to the open-ended question, Item 45, "How would you describe the importance of assistive technology in meeting the needs of students with ASD?". This qualitative question aimed to explore teachers' beliefs and attitude toward AT usage for teaching students with ASD. The transcripts from responses were analyzed to identify themes and categories regarding different skills. As shown in Table 20, one major theme emerged: importance. This theme was grouped into two categories: 1.1. importance for students and 1.2. importance for teachers.

*Importance.* Assistive technology devices and services are important sources of knowledge and education for students with ASD. Moreover, AT has strongly ensured that students with ASD have access to quality education. A positive belief among teachers of students with ASD toward the importance of AT positively influences the effective implementation of the technology in their classrooms. Teachers believe in this importance from two points of view: for students and for teachers. Both are discussed next:

*Importance for students*. Most participants pointed out the benefits of AT for students with ASD. However, they differed in describing the importance of assistive technology in meeting the needs of such students. A teacher indicated the functional capabilities: "If chosen appropriately, assistive technology will have a significant impact on improving the functional capabilities of students with autism." Another teacher indicated the importance of the technology for improving behavioral skills: "Assistive technology has benefits to improve sensory and behavioral skills. It could also help students with autism to keep attention on the learning process more than traditional education." Furthermore, a teacher mentioned the importance of AT for increased communication and language: "… especially important in developing communication and language skills." Teachers also reported the academic skills of students with autism, with one teacher saying, "The presence of assistive technology in the classroom is very important to develop the academic skills of students with autism. Every teacher must sense this is important because it's impossible to use it."

In addition, teachers explained that students with ASD enjoyed using AT. A teacher reported, "It is very useful because students with autism interact and learn effectively with the use of assistive technology." Moreover, a teacher said,

> "I think the use of assistive technology is more useful for teaching students in the classroom. My students are always eager to learn through assistive technology more than any other method. Some skills are impossible to improve without assistive technology devices."

A teacher added, "… assistive technology is very important, and students with autism love to learn from it." Some teachers described the use of AT as fundamental for teaching children with ASD because "… without it, students with autism cannot learn correctly and quickly." Another teacher stated, "Every student with autism needs assistive technology to improve their skills."

*Importance for teachers.*A number of teachers' responses indicated that AT devices and services aid the teacher in achieving educational goals with their students. Teachers' responses indicated that the use of AT facilitates teachers' work. One teacher said, "Assistive technology has a great benefit in facilitating a lot of the teacher's work with children with autism," and another teacher stated, "I enjoy using assistive technology devices to teach my students. The devices facilitate the learning process for them. " Furthermore, a teacher reported that the use of AT has benefits for teachers' time: "Assistive technology could help with shortening the time and effort required to teach children. In addition to being more interesting for students than using traditional methods, it allows me to provide quick feedback for all students."

**Table 20**

*Theme and Categories in Responses to Question 45*

| Themes | Categories |
| --- | --- |
| 1. Important | 1.1. Importance for students |
| | 1.2. Importance for teachers |

The majority of teachers reported barriers that caused them to avoid using AT in teaching students with ASD in the classroom. As shown in Table 21, the largest barriers are first-order-barriers: Drawing from the results of the survey, a lack of resources was the most significant barrier to using AT for teaching students with ASD (M = 2.36, SD = 0.80), followed by a lack of support (M = 2.45, SD = 0.81). In contrast, teachers' beliefs and attitudes were positive in terms of AT usage in the classroom (M = 3.96, SD = .89629); Therefore, it does not represent a barrier to using

AT with students with ASD. Moreover, teachers displayed a high level of confidence in using AT

(M = 3.5859, SD = .75010), and confidence is hence also not a barrier.

**Table 21**

*Descriptive Statistics for Both Barriers*

| Scales | Mean | Std. Deviation |
|---|---|---|
| Resources | 2.36 | .81 |
| Time | 2.68 | .98 |
| Training | 2.70 | .80 |
| Support | 2.45 | .82 |
| Teachers' beliefs and Attitudes | 3.97 | .90 |
| Confidence | 3.58 | .75 |
| Knowledge/skills | 2.65 | .93 |

Teachers with students with ASD were asked to respond to the open-ended question, Item

number 46, "What other barriers impede your use of assistive technology for students with ASD?"

This open-ended question explored new barriers by painting a verbal picture of participants that

was not mentioned in the quantitative section. This question sought a better understanding of other

obstacles that teachers face when using AT to teach students with ASD. The transcripts from

responses were analyzed to identify themes and categories regarding other barriers. As shown in Table 22, two themes emerged from the analysis: 1) external barriers and 2) internal barriers. The first theme was grouped into four categories: 1.1. the number of students, 1.2. sharing family, 1.3. IEP, and 1.4. training. The second theme included two categories: 2.1. knowledge and 2.2. beliefs.

*External barriers.* The majority of participants indicated that external barriers as one of the difficulties to use AT in the classroom. The teachers added many barriers related to the first -order barriers. It will mention as follows:

*The number of students.* Many teachers reported that having a large number of students with ASD in the classroom hinders them from the effective use of AT. This large number of students creates other difficulties that affect the work of the teacher. For example, as a teacher reported, there is an effect on time: "There are more students with autism than there are available resources in the classroom, which makes it difficult to manage the time and devices with all students." Another said, "The number of students in the classroom is high. This hinders the use of assistive technology with all students simultaneously." Another participant believes that the lack of a paraprofessional teacher in the classroom limits the use of AT: "The number of students is too great; this limits the teacher's creativity because of the absence of a paraprofessional teacher in the classroom. Students with autism need special attention and continuous follow-up. The teacher cannot do all of this alone." Teachers further pointed out the difficulty of implementing individual educational plans, stating, for example, that "The number of students in the classroom is large; I have nine students with autism. Each student needs an individual educational plan as well as the use of different assistive technology devices than others."

*Sharing family.* The teachers discussed that some AT tools should be shared with students' parents. However, as a teacher reported, the lack of resources and support limits the use of AT

tools among students with ASD at their home: "the inability to share some supporting technology tools with the student's family; for example, I have a student who needs pen grips for writing, but he finds it difficult to write when goes home without the pen grip." Other participants also mentioned the difficulty of sharing tools with the family, with a teacher stating,

> "The family does not participate in the use of assistive technology. I have a student who needs to improve his skill to communicate through the picture exchange system, but the tools remain in the school, so he cannot use it with his family at home. When the family buys the picture exchange system, the pictures are different, which increases the difficulty of the student's learning."

*IEP*. Teachers of students with ASD with an IEP team make the decision regarding whether students need AT devices. Each decision is made for every student with ASD individually. Some participants indicated that there is no IEP team working with them in making AT usage decisions. A teacher reported "the lack of participation of the individual educational plan team in determining the appropriate assistive technology for each student."

*Training*. Regardless of the number of training courses in AT use, the technology will be worthless if teachers do not receive appropriate training to implement it in their classrooms. Teachers indicated that the courses they took did not fit with practices in the classroom. A teacher reported,

> "The training courses provided by the education department show how to use assistive technology with students with high-functioning autism, and they are totally different from some of my students with low-functioning autism. So when I return to work with my students, I find it difficult. There was a big difference between what I learned in the training course and the real reality of the classroom."

A lack of time for teachers to attend courses also increases the severity of the training barrier. A teacher reported, "I cannot attend all workshops or training courses on assistive technology, because time does not allow me to always go outside of school to attend workshops. I am content with self-effort at my home." Some also pointed to the need to increase Arabic content

on the websites, with a teacher mentioning "the limited Arabic resources that explain how to use assistive technology with students with autism."

*Internal Barriers*. Most of the statements under this open-ended question pertained to external barriers. This is because external barriers are easier for teachers to express than internal barriers, since the latter are related to the fundamental personality of teachers who work with students with ASD. Participants' comments related to internal barriers included two difficulties, which are described next.

*Knowledge*. One of the most significant barriers that teachers face when using AT is a lack of knowledge. Participants in this study reported that a lack of training is the primary reason for their limited knowledge. A teacher cited a "lack of experience in how to use assistive technology devices. I need training courses on the new assistive technological tools." Another teacher mentioned that

> "I need skills in the correct way to utilize an iPad for educational purposes to teach students with autism. Sometimes, I don't trust when I give my students the iPad to learn some words, because I am not sure if this app is appropriate for them or not!!?"

*Beliefs*. The negative attitudes and beliefs of teachers regarding AT usage are a central barrier. A teacher said, "One of the characteristics of students with autism is the tendency to routine, and this is the biggest barrier. Assistive technology devices are not appropriate to use with them."

**Table 22**

*Themes and Categories in Responses to Question 46*

| Themes | Categories |
| --- | --- |

**Table 22**

*Continued*

| Themes | Categories |
| --- | --- |
| 1. External barriers | 1.1. The number of students |
|  | 1.2. Sharing family |
|  | 1.3. IEP |
|  | 1.4. Training |
| 2. Internal barriers | 2.1. Knowledge |
|  | 2.2. Beliefs |

**Findings of Research Question 4. How Do the Perceived Barriers Affect Teachers'**

**Abilities to Use AT within the Classroom?**

To address Research Question 4, participants were given an opportunity to explain their

experiences with barriers. Instrument Items 47 and 48 asked teachers to respond to open-ended

questions, and the responses provided an in-depth explanation of how these barriers affect teachers'

ability to use AT to teach students with ASD. I reviewed all participants' responses to this question,

and statements were then coded via MAXQDA software. These codes were sorted and categorized

to identify themes, and each theme was categorized or grouped into categories.

Teachers with students with ASD were asked to respond to the open-ended question, Item

47, "Please describe your experiences of those barriers and how those barriers affected your ability

to use assistive technology for students with ASD?". This qualitative question aimed to explore

how teachers express the effect of the barriers they face in using AT devices in their classrooms. The transcripts from responses were analyzed to identify themes and categories regarding teachers' experiences of barriers. As listed in Table 23, the analysis revealed two themes: 1) description of external barriers and 2) description of internal barriers. The first theme was grouped into four categories: 1.1. resources, 1.2. training, 1.3. time, and 1.4. support. The second theme included two categories: 2.1. skills and 2.2. confidence.

**Description of external barriers.** The majority of teachers described their experience with first-order barriers. Their comments focused on the lack of resources, the lack of training, the lack of time, and the lack of support.

*Resources.* The majority of participants described in depth the impact of the lack of resources. Most of their comments indicated that this lack of resources reduces or prevents AT usage in the classroom. A teacher described that

> "When I have a passion, I use some tools and devices and make an effort to learn assistive technology. I believe it is important for my students, but the school cannot provide it for teachers and their students because of the high price, and this is very frustrating."

Another teacher stated, "Lack of resources push me to use a limited number of assistive technology devices." Some teachers indicated the futility of training courses if the AT resources were not available. A teacher reported,

> "I had a great desire to use some of the technologies that I know my students need. At the same time, I attended workshops that helped me to acquire the full knowledge and skills necessary to use them. But the lack of availability and high prices prevented me from using them, which made me lose the skills I gained from the workshop."

Some teachers discussed that having resources in the school is not sufficient; AT devices and tools must be available in the classroom all the time. A teacher reported, "The difficulty of moving from the classroom to another place to access some of the assistive technology tools increases the difficulty of the matter. Sometimes, I waste a lot of time moving from place to place,

which makes it difficult." Another mentioned the difficulty of moving some equipment: "Some types of assistive technology devices are heavy, resulting in physical pain when I move the devices on a daily basis. This affects my level of use of assistive technology."

*Training*. Many participants indicated numerous challenges with availability of appropriate training courses to develop their skills. Teachers expressed that not enough courses have been specified in the field of autism. A teacher reported,

> "I attended three courses about assistive technology. Two of them contained just basic information about the types of assistive technology and importance. All three courses explained how to use assistive technology with students with a disability, for example trainers explaining hearing devices to students with hard hearing or how to support students who need wheelchairs. I am a teacher of students with autism; I did not find anything in the workshops to help me use assistive technology devices with children with autism."

Others also pointed to obstacles in self-learning for using AT with students with ASD. A teacher described the obstacles related to online videos: "Lack of training pushes me to research the use of assistive technology on YouTube. Most of these videos are very long, unprofessional, and low quality, which causes me to be distracted while following them."

*Time*. Participants described the time barrier in different ways, commenting on the lack of time to use AT with students with ASD. A teacher reported that

> "The use of assistive technology takes more time than I expected because students need more time to learn on such a device, which sometimes forces me to end the use of it with students faster to attend to the rest of the students."

Teachers also cited the lack of time to attend training courses. For example, a teacher stated,

> "The school leader asks me to attend the morning education department courses and return to school on the same day after finishing the course. But I do not have enough time to go to education department courses that help explain how to use assistive technology."

In addition, some teachers indicated that they spend their own time learning about AT or sharing some information with students' parents. A teacher mentioned the following:

"When sharing some assistive technology tools with the family of children with autism in order to use it at home, their parents lack the skill to use the tools, which forces me to explain it to them over the phone, resulting in taking my own time that I should spend with my family and kids. So I stopped explaining it to them and just shared web links to them including explanations of how to use assistive technology tools with children with autism. But unfortunately, there are not enough articles in Arabic on the websites."

*Support*. The lack of technical support is one of the major issues reported by teachers in this study. A teacher explained that

"Lack of technical support is the biggest barrier that negatively impacts me. The implementation and use of assistive technology are not limited to preparing teachers or their skills; I spend a lot of time with every student to teach them how to use one of the assistive technology tools. In other words, I spend a long time self-learning about one type of assistive technology. After that, I have to spend more time teaching my students how to work with it. Also, these tools or devices stop working after this substantial investment of time and effort (this is very frustrating)."

Another teacher described a malfunctioning device problem: "When the device stops working and I am waiting for another teacher to find free time to help me fix it, that means all effort is wasted." Similarly, another teacher also said, "I have a broken computer in the classroom that hasn't been repaired for 7 months, preventing me from using many effective programs with students. " Another agreed, saying, "I have malfunctioning devices in the classroom, and I do not know how to repair them, because there is no technical support available quickly. "

**Description of internal barriers**. A few participants described their experiences of internal barriers and how those barriers have affected their ability to use AT for students with ASD.

*Skills*. Lack of skills is not limited to AT use; sometimes, poor computer skills also affect the successful use of AT. A teacher described that

"Sometimes, it takes a very long time to learn to fix problems related to computers. I watch a half-hour video on YouTube explaining to me how to connect the projector with the computer. I have to watch many videos on YouTube for long hours just to update the computer. We as teachers have more tasks than these problems. Sometimes, I find myself not continuing watching the video because of its length and because I have a second job with my students."

*Confidence.* Teachers' level of confidence with AT should be high. When teachers of students with ASD are faced with a lack of support from the IEP team, their confidence in using AT to teach their students diminishes. A teacher described

"confidence barrier; I determined programs and assistive technology devices for students by myself. No one from the IEP team helped me. I sometimes feel that my choice of some devices and tools does not meet the student's needs, especially if there was no improvement in the skill of the student. This makes me keep trying to change the type of assistive technology."

**Table 23**

*Themes and Categories in Responses to Question 47*

| Themes | Categories |
| --- | --- |
| 1. Description of external barriers | 1.1. Resources |
| | 1.2. Training |
| | 1.3. Time |
| | 1.4. Support |
| 2. Description of internal barriers | 2.1. Skills |
| | 2.2. Confidence |

Teachers of students with ASD were asked to respond to the open-ended question, Item 48, "Please describe how you overcame those barriers to better teach your students with the assistive technology?". The qualitative question aimed to identify what teachers do when confronted with these barriers. As shown in Table 24, based on the teachers' responses to this

question, I found two themes that describe how teachers react to barriers: 1. usage avoidance and 2.solutions. These reactions are clarified as follows:

**Usage avoidance**. Most participants in this study expressed that they avoid using AT when they face challenges out of their control. The teachers did not identify a single barrier, but rather mentioned a list of barriers that compel them to avoid the use of AT: lack of resources, lack of training, lack of time, lack of support, and high cost.

*Lack of resources*. A lack of resources is one of the key issues reported by participants in this study. Some teachers indicated that there are no AT devices and tools that lead to non-use with students with ASD. A teacher stated that "It is impossible to use assistive technology appropriately without support and the provision of new devices and tools. " Another teacher added, "I stopped using the desktop computer in the classroom because it is old and too slow. I feel working on it is tiring, cumbersome, and make me nervous." Teachers indicated that the education department should provide AT devices, with one teacher saying, "There is nothing I can do about it; the education department must consider our needs and the needs of students with autism."

*Lack of training*. Many participants commented on the weakness of the training courses regarding AT usage with students with ASD, saying that there was no benefit in attending those courses. A teacher stated, "Before I attend any course, I start to read the course agenda; if it does not include a practical explanation of the utilized devices, I do not attend it even if it is compulsory."

*Lack of time*. Some participants believed that alternative methods are better than using AT to avoid the time barrier. A teacher stated, "Assistive technology is difficult to use because it has many problems that waste the time of teachers and students to learn it. So I look for easy alternative methods."

*Lack of Support*. Some AT devices are fraught with many technical problems that need fixing by technicians. When participants were asked about how they deal with these technical problems, a teacher reported that "I do not like to use devices that have multiple technical problems." Another stated, "I avoid using or buying devices that are complicated or that may be quickly damaged or broken."

*High Cost*. Many of the participants indicated that they purchased AT devices with their own money due to the lack of budgets in the school. However, some AT devices are expensive. When participants were asked how they deal with the high price of devices, some indicated that they could not buy them. A teacher reported "trying to search for inexpensive assistive technology devices that I can buy for my students." Another teacher mentioned that

> "I try to choose assistive technology devices that are appropriate for most students, in addition to choosing devices that do not require additional cost, such as batteries or payment to subscribe, because my school does not give me a budget for it."

**Solutions.** Many of the participants commented that they were looking for solutions to help their students with ASD. After analyzing all statements, there were some solutions that were reported by teachers:

*Lack of resources*. Many teachers reported that they use their own devices, especially laptops and iPads. A teacher said, "I am using my own devices, such as a laptop," and another mentioned, "I use my own devices." Some participants also indicated that they are seeking alternatives to AT devices. A teacher reported, "I am trying to search for alternatives if I cannot find assistive technology devices. Also, I continue to use what is available to me. But unfortunately it is very little." Another teacher said, "If I cannot buy a picture exchange system, I usually try to create pictures by printing pictures and designing visual activity tables for students to improve their communication skills."

*Lack of training*. Most teachers cited self-learning about AT usage to make up for the lack of training courses. A teacher reported, "I compensate for the lack of training and courses by searching on the Internet about the correct approach of using assistive technology. Also, I buy those tools from online markets, especially those I had learned about from online international resources." Some teachers also said that they ask experienced teachers about the use of AT: "I collaborate with experienced teachers to understand how to use some types of assistive technology devices." Others commented that they were looking for courses that match the resources available in the classroom, as one teacher reported,

> "I attended many courses on the use of assistive technology. However, I could not implement AT because of the lack of resources in my classroom. Now, I follow a new strategy to choose the appropriate courses for me by attending ones that match what I have in my classroom."

*Lack of time*. Teachers commented that they took a long time to use AT when designing an individual educational plan; a teacher described the following:

> "The first use of new assistive technology devices usually takes more time with the student than I expect because some technical problems arise or the student needs more time. To solve this problem during the preparation of the educational plan, I planned for a long time to use these assistive technology devices."

*Lack of support*. A few teachers mentioned repairing multifunctioning devices by themselves. For example, a teacher said, "I usually repair computers by myself when they malfunction in the classroom." Another participant indicated that teachers repaired the devices voluntarily: "the lack of technical support for assistive technology devices. There are some teachers in the school who volunteer to fix malfunctioning devices. "

**Table 24**

*Themes and Categories in Responses to Question 48*

| Themes | Categories |
| --- | --- |
| 1. Usage avoidance | 1.1. Lack of resources |
| | 1.2. Lack of Training |
| | 1.3. Lack of Time |
| | 1.4. Lack of Support |
| | 1.5. High cost |
| 2. Solutions | 2.1. Lack of resources |
| | 2.2. Lack of training |
| | 2.3. Lack of time |
| | 2.4. Lack of support |

**Summary of Chapter**

The purpose of this study was to identify the barriers that inhibit teachers of students with ASD from utilizing AT by examining the lived experiences of Saudi teachers. Chapter 4 presented the results of this study. Overall, the findings were outlined according to the four research questions. The 85 teachers responded to 40 survey items, along with eight open-ended questions. They reported many barriers related to AT usage to teach students with ASD. The major barrier

was that teachers have insufficient resources to use and implement AT devices and services to meet the needs of children with ASD in their classroom.

The next chapter presents a discussion of these findings. It also contains the summary, implications, and recommendations for future research and for educational policymakers. Moreover, the limitations of the study are described. Finally, I provide the conclusions of the study.

**CHAPTER FIVE: DISCUSSION**

**Introduction**

In 2016, statistics of the CDC indicated that 1 in 54 children in the US has ASD (Maenner, Shaw, & Baio, 2020). In Saudi Arabia, the number of individuals with ASD is increasing dramatically because of increased individual diagnoses. While previous reports have indicated the number of individuals with ASD in Saudi Arabia, those studies have a noticeable discrepancy between their numbers. According to official statistics in the country, 53,282 children have been diagnosed with autism, and they comprise 0.26% of the population (General Authority for Statistics, 2017). Individuals with ASD have difficulties with social interactions, communication, and repetitive behaviors (Ji & Findling, 2015); therefore, children with ASD often need unique services to improve their skills.

The Saudi government is still working on improving the infrastructure of special education services for students with a disability, especially those with ASD. However, thousands of schools and teachers are still struggling to improve their work to help students with ASD to learn and be successful. Although the Ministry of Education of Saudi Arabia has made many efforts regarding the provision of appropriate education for individuals with ASD, complex processes remain in teaching such students. This promoted Saudi Arabia to continuously work to reform the educational system (Zeina, Al-Ayadhi, & Shahid, 2014). From 2007 to 2013, there was an educational reform project called Tatweer; it had a budget of $3.1 billion, and its main aim was to provide high-quality education to all students (Tatweer, 2010). However, the debate continued during and after the implementation of this project regarding whether Tatweer achieved its desired

goals (Allmnakrah & Evers, 2020; Alyami, 2014). The Kingdom of Saudi Arabia currently has the Saudi economic vision 2030 that began in 2016; it seeks to create comprehensive development for a country by implementing many reforming programs, such as economy-, health-, society-, and education-related programs (Saudi Economic 2030 Vision, 2016).

Due to the many benefits of AT, its use in the classroom is effective in supporting the variety of needs of students with ASD (Goldsmith & LeBlanc, 2004; Lancioni & Singh 2014). These benefits in the autism field have recently caused a dramatic increase in the number of studies that focus on many aspects (Benssassi et al., 2018; Cerga-Pashoja, Gaete, Shishkova, & Jordanova, 2019; DiGennaro Reed, Hyman & Hirst, 2011; Fteiha, 2017; Grynszpan et al., 2014; Keintz et al., 2014; Knight, McKissick, Saunders 2013; Mechling, 2011; Pennington, 2010; Ploog et al., 2013; Ramdoss et al., 2011; Ramdoss et al., 2012; Wainer & Ingersoll, 2011).

Although studies on the effects of using AT in the classroom have continued to grow, there is still limited research in Saudi Arabia regarding the perceived barriers of teachers who implement the technology in teaching students with ASD. This study was conducted to explore the external and internal barriers to AT use and to explain how these barriers affect teachers' success with the implementation of AT. The results of this study will contribute to improving the education process for students with ASD in Saudi schools in several significant ways and provide insights into the barriers to AT use in the classroom. Moreover, policymakers could utilize the findings to reform current practices. The results could also benefit education department administrators, school leaders, and teachers who have a direct and an indirect influence on reducing barriers to the successful use of AT.

This chapter begins by summarizing the present study with a review of the significance of the research, its purpose, the research questions, and the research design. Next, the findings

presented in Chapter 4 are interpreted and explained, and they will be tied to the literature review presented in Chapter 2. This discussion is followed by the implications for practice extracted from the results of the study. Furthermore, this chapter provides recommendations for future research and the limitations of this study. The chapter ends with the conclusions of this dissertation.

**Summary of the Study**

Potentially significant obstacles affect the level at which teachers use AT and form a major component in the success or failure of teaching students with ASD (Bouck, 2016; Edyburn, 2005a). This study was framed by Ertmer's concept of barriers in 1999: classified as first-order barriers (external) and second-order barriers (internal). This framework was built from the work of three preeminent educational change theorists: Roger's (1983) diffusion of innovation, Fullan's (1991) meaning of educational change, and Cuban's (1993) constancy and change. By identifying external and internal barriers, educational leaders will be able to reform current practices to improve the effectiveness of using AT to teach students with ASD by reducing and removing those barriers.

Limited studies have explored the barriers affecting teachers' adoption of AT to teach students with ASD in the classroom (Edyburn, 2013; Quinn, Behrmann, & Mastropieri, 2009). It is increasingly important to expand the number of studies that explore the teachers' difficulties using AT in the classroom (Burke, 2014; Gaffner, 2015; Gentry, Wallace, Kvarfordt, and Lynch, 2010; Kopcha, 2012). This study used a mixed-methods approach to investigate the barriers (Creswell, 2014), seeking to contribute to the body of literature related to these barriers that prevent teachers from using AT with students with ASD. Specifically, this study considered multiple aspects of the challenges faced during AT usage to teach students with ASD in the classroom. Three elements of the general research problem were investigated: what the frequency of AT use is, what the barriers to AT use are, and how these barriers effect AT use.

To this end, the following main research question guided the development of the research design: what barriers do teachers identify as hindering their ability to use AT for teaching children with ASD? This question was driven by four research questions. The first one asked, how often do Saudi teachers use AT in the classroom with students with ASD? It was concerned with assessing the frequency of reported weekly use of three categories of AT. The second research question asked, what extrinsic (first-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD? This question focused on four categories: lack of resources, time, training, and lack of support. The third research question was, what intrinsic (second-order) barriers affect Saudi teachers' abilities to use AT for teaching children with ASD? This question focused on three categories: teachers' beliefs and attitudes, confidence, and knowledge. The last research question was as follows: how do the perceived barriers affect teachers' abilities to use AT within the classroom? This question gave participants the opportunity to explain how these barriers affect the implementation of AT in the classroom.

These four research questions were addressed by analyzing data collected from the online instrument that 85 teachers responded to in Riyadh, Saudi Arabia. The instrument of this study was developed by the researcher, and it was reviewed by six experts in the education field to increase its validity. Furthermore, the back-translation method was used to consider the differences between the English language and Arabic. The online survey included 40 items to collect quantitative data categorized into multiple areas that match the purpose of this study. The data were analyzed using descriptive statistics, which included frequency, percentage, mean, and standard deviation. It also included eight open-ended questions that provided rich explanations and explorations of data to gain better insight into the barriers faced when using AT in the classroom.

In considering the most significant findings, this study revealed that teachers used high-tech AT more than other types of AT in their response to the first research question about the frequency of AT use. Overall, the findings of this study indicate that a lack of resources and a lack of support are teachers' greatest first-order barriers that hinder the use of AT with students with ASD. In addition, the results suggest that teachers have a positive belief and attitude regarding the effectiveness of using AT with students with ASD, although they felt they have a lack of knowledge about the successful use of AT in the classroom. The next section provides an in-depth interpretation and discussion of these findings from quantitative and qualitative data of this study, and it will link it to previous studies and the theoretical framework of this study.

**Discussion**

### Use of AT

Assistive technology devices are divided into three categories that teachers were able to use to teach students with ASD: (1) low-tech AT, (2) mid-tech AT, and (3) high-tech AT. Low-tech AT devices have no electronic parts, such as pencil grips and picture communication systems (Dell, Newton & Petroff, 2008; Canter, Jeffs, & Judge, 2008). In contrast, mid-tech AT has simple electronic components, such as personal spelling devices (Stachowiak & Estrada-Hernandez, 2010), while high-tech AT devices are sophisticated pieces of electronic equipment, such as computers, tablets, or interactive multimedia systems (Blackhurst, 2005; Floyd, Canter, Jeffs & Judge, 2008). High-tech AT devices are more expensive than both low-tech AT and mid-tech AT devices (Parette & Peterson-Karlan, 2007). An important finding of this study is that the teachers reported that they use high-tech AT more than other types of AT.

Interestingly, when comparing teachers' responses about weekly usage of the three categories of AT, different levels of use were revealed. They identified high-tech AT as the highest

weekly used technology, whereas low-tech AT was at the second level of use, and mid-tech AT had the lowest reported usage. Approximately 59% of the participants reported that they used high-tech AT three to four times a week or five times and more a week (M = 3.62, SD = 1.24), in comparison to a low percentage of participants (20%) using mid-tech AT (M = 2.60, SD = 1.20). This study attempted to grasp the essence of the types of AT that are useful for students with ASD by giving teachers the opportunity to express their experiences while using AT. The majority responded in the open-ended section that related to the most useful AT for students with ASD and the frequency of weekly use of laptops and tablets. Their explanations for their preference for using these types of devices focused on the laptop and iPad's ease of use and ease of carrying in or out of the classroom. They also indicated the multiple benefits of apps for teaching students with ASD. For example, one of the teachers said, "... the iPad is more useful to me and students. It is easy to carry, and we can move easily with it. Also, my students have a higher level of skills in using the iPad than a computer." Another teacher confirmed that "I use a new and advanced laptop that easily allows me to connect with other devices such as projectors and TVs." These findings are aligned with those of Cuban (1999), indicating that teachers adopt tools and devices that help them to achieve the educational purposes of teaching students in the classroom, and they avoid tools that make it more difficult to achieve their purposes.

Previous studies indicate that the iPad has many features and is highly effective in developing the skills of students with ASD (Fletcher-Watson et al., 2016; Kagohara et al., 2013; Muharib, Correa, Wood, & Haughney, 2019; Neelyet al., 2013) due to the development of tablets in general and iPad devices in particular in recent years. These devices have become multi-functional appliances that contribute to use as AT to teach students with ASD (Gentry et al., 2015). Tablet devices have many advantages that increase their potential to be used as effective

educational tools, including large touch screens, ease of portability, the ability to customize educational lessons, and many educational apps (Kagohara et al. ‹2013; Schuck et al., 2016; Shah, 2011). Previous studies have also confirmed the ability of tablets to increase independence for students with ASD through their practice on educational applications (Draper Rodriguez et al., 2014; Knight et al., 2013; Muharib et al., 2019).

Participants were asked what area of needs would benefit from AT, and based on the results of the study, most of them mentioned using visual support, such as a picture exchange communication system (PECS) to improve the communication skills of students with ASD. For example, a teacher noted, "I believe technology based on pictures is the most important type of assistive technology for two reasons: first, my students with autism like to learn via pictures, and second, the technology is easy for me to bring to the classroom. I use these tools on a daily basis." This result also supports the study by Cardon, Wilcox, and Campbell (2011), who examined AT use to support children with ASD in daily activities and found that AT based on pictures most supported children with ASD, according to most participants.

Most of the participants in this study indicated difficulties and barriers when they used a PECS, summarized in multiple aspects, such as the rapid deterioration of the materials, and teachers also faced a problem in sharing the same card sets with children's families. It should also be noted that funds are lacking to help the teachers buy card sets for their students because each individual with ASD has a different level of needs. These reasons explain why the results of this study indicate higher use of high-tech AT than low-tech AT despite the latter's ease of availability and inexpensiveness.

Therefore, many teachers tend to replace low-tech devices such as picture communication systems or mid-tech devices such as audio books with high-tech devices such as tablets or laptops.

Using tablets as AT has become highly effective in developing the skills of students with ASD, and they meet many areas of their needs, such as communication (Dallery et al., 2014; Hidalgo-Mazzei et al., 2015; Sean, Sinéad, Alan, & Noel, 2019). Lorah et al. (2013) compared the effectiveness of the Proloquo2Go communication application installed on an iPad on the one hand and a PECS on the other in teaching five children with ASD. The findings indicated that four children with ASD preferred Proloquo2Go more than picture exchange.

One of the disadvantages of using AT devices is that they sometimes stigmatize individuals with a disability because of society's misunderstanding of their capabilities or misconceptions about AT devices (Shinohara & Wobbrock, 2011). Replacing some low-tech AT and mid-tech AT with apps on tablets could help to reduce the stigma associated with AT device usage that sets individuals with ASD apart in society (Deng & Rattadilok, 2020; Ganz et al., 2014; Mintz, 2013).

In conclusion, the rapid development of tablets and mobile devices in recent years has contributed to the replacement of many AT devices with applications or programs (Lorah et al. 2013). Tablets have multi-functional applications that help in their multiple uses by teachers and their students with ASD in the classroom. Where research indicated the effectiveness of the adaptation of many AT devices to mobile devices such as the iPad and smartphone. These possible reasons explain the results of this study, which indicates the high use of high-tech AT in the classroom. Another possible explanation is that teachers are using technology such as computers for other tasks not directly related to teaching students with ASD. For example, teachers use their laptops in the evaluation process, for taking notes, or sometimes for communicating with the parents of students with ASD. Therefore, when the survey of this study contained a question about the weekly use of AT, it is possible that teachers thought of the computer or tablet as the device they utilized the most on a daily basis in their tasks within the school. The self-report measure does

not provide a clear picture of the rate of use by the participants (Creswell, 2014). Studies based on an observation approach are needed to measure practices within the classroom.

**External Barriers**

In addition to exploring the perceived frequency of weekly AT use in the classroom, the primary thrust of this study concerned external barriers and internal barriers described more fully in Chapter 1. The barriers to the successful use of technology in classrooms are divided into first-order barriers (external) and second-order barriers (internal) (Ertmer's, 1999; Ertmer et al. 2005, 2006, 2008, 2010). Analysis of the data collected revealed four external barriers identified by participants when they use AT in teaching students with ASD in the classroom. These barriers are discussed next, in sequence from the highest to the lowest barriers, as follows: 1) resources, 2) support, 3) time, and 4) training.

One of the most important foundations for the successful implementation of AT is closely related to the availability of AT resources for teachers in the classroom (Berry & Gravelle, 2013; Borg & Ostergren, 2015; Shaw, 2011). Considering the findings of the current study, lack of resources ranked as the greatest barrier for teachers in using AT in the classroom. Participants indicated that the inadequate number of AT devices was preventing them from effectively implementing AT in teaching students with ASD. This finding is similar to the results of previous research, which reported the lack of resources in schools as a major barrier for teachers (Al-Moghyrah, 2017; Sundeen & Sundeen 2013).

Although the Ministry of Education is responsible for providing resources in schools to provide free education (Ministry of Education, Saudi Arabia, 2002), most of the responses regarding the resources barrier included the schools' lack of funds for purchasing AT devices. The problem of the lack of resources has increased due to the lack of a special budget in schools that

allows school leaders or teachers to purchase AT devices that meet the needs of students with ASD. In addition, teachers' frustration with the education department led to feelings of disappointment that the department has not been able to provide AT devices in their school as the teachers have requested. Many of the teachers indicated that they must sometimes purchase AT devices with their own money. Previous studies (Ajuwon et al., 2016; Flanagan, Bouck, & Richardson, 2013; Stead, 2009) have indicated that the high cost of purchasing AT devices and the varying needs of each student with ASD increase the difficulty of providing devices in schools, which represents a challenge for many teachers in the classroom. Due to the high cost of AT devices, coupled with limited resources in schools, some participants in this study stated that they sometimes purchase inexpensive low-tech devices or use their own high-tech devices, such as laptops or iPads.

One of the important results of this study is that teachers reported the sharing of AT devices among all teachers in the school as a barrier. They indicated that access to some AT devices was highly competitive among all teachers. This results in time wastage in coordination between teachers to exchange devices and also leads to an increased likelihood of the breakdown of these devices. Teachers indicated the importance of each student having a device commensurate with their needs, as this will help teachers to successfully implement AT and facilitate their classroom management. Furthermore, the IEP team sometimes decides that students with ASD must use AT devices in their homes. Based on the results of this study, a teacher reported that the lack of resources and policies limits the use of AT tools among students with ASD in their homes.

An additional problem with the resources in the schools relates to malfunctioning devices and outdated devices. This finding reiterates what Alhazmi et al. (2010) advocated that there are many malfunctioning pieces of technology resources that require repair in Saudi schools. AT

device malfunctions constantly increase teachers' need for technical support within the school. Without fixing technical problems, teachers lose confidence in using AT with their students (Brinkerhoff, 2006; Demps, Lincoln, & Cifuentes's, 2011; Holden & Rada, 2011).

Teachers try to repair the malfunctioning equipment by themselves if they do not receive support from technicians; this increases the complexity of AT usage. According to Rogers' diffusion of innovation theory (1983), the decision to adopt innovation depends on the advantages and complications of innovation. In other words, if teachers face complexities related to technical problems with devices, they will likely decide to stop adopting those devices. As the findings of this study suggest, the lack of support for teachers in using AT to teach students with ASD has been a barrier. Most of the participants reported that their schools do not provide technical support to fix malfunctioning AT devices. In addition, in the analysis of the qualitative data, teachers added that the school must raise the request with the Education Department for maintenance to fix broken devices, but the procedures usually take a while, and the school waits a long time to receive a response. This results in some teachers repairing devices with their own money or by themselves.

In addition to the lack of technical support, most teachers in this study mentioned limited support by school leaders. Support in schools consisted of simple aspects, such as giving teachers time to attend education department training courses or encouraging experienced teachers to work with new teachers. Most teachers also indicated that the support of school leaders is limited to support in the verbal framework only. These results are compatible with previous studies that have reported that many teachers lack support from school leaders in using AT in the classroom (Alhazmi et al. 2010; Beeson, 2013; Brush, 2003). This lack of support in AT use has implications for teachers' performance in meeting the needs of students with ASD through effective use of AT devices to improve students' skills (Nees & Berry, 2013). School leaders play a fundamental role

in creating a collaborative environment for teachers to share knowledge and information on the use of AT. Hargreaves and Fullan (2012) emphasize the importance of developing social capital in schools.

Providing sufficient time for all teachers is a significant factor in the successful use of AT in the classroom (Ertmer et al., 2012; Hew & Brush, 2007; Kurbanoğlu et al., 2014; Machado & Chung, 2015; Tondeur et al., 2015). Lack of time constraints was the third barrier that was explored in the data analysis of this study. Based on findings, lack of time was reported in multiple ways. Moreover, as noted from the participants' responses, the time barrier is influenced by other factors. Limited time for teachers in the school day was not the main cause of the time barrier. In other words, when a teacher has difficulty accessing AT devices in the school, this increases the time barrier. Many teachers expressed that they move to the resource room to access technology devices, and this wastes time. For example, a teacher commented that "... I waste a lot of time moving from place to place, which makes it difficult." One teacher believes that to avoid the time barrier, alternative methods are better than using AT.

One challenge reported is that the high number of students with ASD in the classroom limits the use of AT because the teacher finds it difficult to manage class time. The teachers also pointed out that every student with ASD needs a long time to be trained in the use of AT, so they cannot expect the time it takes to implement AT with each individual with ASD. For example, a teacher said, "There are more students with autism than there are available resources in the classroom, which makes it difficult to manage the time and devices with all students." This finding is also compatible with Al-Moghareh (2017), who found that for Saudi teachers, the time required to use AT to teach students with a disability frequently takes longer than initially anticipated. When teachers use AT in the classroom, they usually spend a longer time than initially expected. Many

participants shared their need to experiment on AT devices before beginning work with their students. However, most of the teachers stated that their school does not provide time to experiment with new types of AT.

The teachers mentioned that they sometimes spend a longtime updating computer programs or linking technology devices, such as the projector, with one another. The more complex the device, the more time it would take to use it. This problem increases in the absence of a technical assistant inside the school. Today, schools and classrooms have much technical equipment, which increases the need for technical support within schools to preserve teachers' time spent on technical problems. According to Dexter, Anderson, and Ronnkvist (2002), teachers use more technology when they receive urgent technical support.

Lack of training was perceived as a barrier because teachers reported they did not receive enough training in AT usage for teaching students with ASD. This finding also supports most previous studies that have indicated a lack of training in using AT as a barrier (Kamei-Hannan et al., 2012; Seale et al., 2015; Yue-Ting & Morash, 2014; Zhou et al., 2012). To ensure the use of AT to teach students with ASD effectively in the classroom, teachers must receive appropriate training to acquire high levels of skills, knowledge, and confidence to use multiple types of AT tools (Gustafson, 2006). Teachers' knowledge is a substantial factor for successful integration of AT in the classroom, since they cannot accomplish AT usage with their students with ASD simply by asking the students to use it or providing AT devices in a classroom. Teachers require constant guidance and assistance to develop their AT skills and to keep up with the latest devices that can help them successfully perform their tasks (Cuban, 2001). A high quality of training must be readily accessible and meet teachers' needs.

Most teachers reported that they did not learn how to use AT in their University teacher preparation programs. This result is consistent with the results of previous studies that have indicated weak training on AT for pre-service teachers in teacher preparation programs (Abner & Lahm, 2002; Edyburn, 2005a; Lahm, 2005; Michaels & McDermott, 2003; Van Laarhoven & Conderman, 2011). The lack of training for pre-service teachers in the use of AT leads to the non-use of technology in the future (Judge & Simms, 2009; Marino, Sameshima & Beecher, 2009). The scholars indicated that many efforts in educational reform projects have not achieved their goals due to the lack of adequate professional education for teachers (Fullan & Miles, 1992).

In response to the open-ended questions of this study, participants explained the complexity of training courses related to AT. Some teachers felt that the training courses they attended for using AT were not consistent with the reality in the classroom. One of the participants noted that AT courses present the overview of all AT types without focusing on a specific type and explaining how to apply it with students with ASD in the classroom. Some research has thus indicated the need for technology training courses to be designed to match the needs and actual practices of the teacher in the classroom (Kopcha, 2012; Wells, 2007). Another issue that teachers reported regarding AT training courses is the need for workshops focusing on the use AT in the autism field because many AT courses only discuss AT usage with all students with a disability. Moreover, some teachers reported that they do not have time to attend courses, which hence increases the severity of the training barrier.

When asked how they overcame the training barrier to better teach their students using AT, many participants commented that the weakness of the AT training courses made them decide that there was no benefit in attending those courses. When training courses are not designed and are inappropriate for the needs of teachers, they turn to self-learning to compensate for the deficiencies

and increase their skills (Moeini, 2008). The most apparent finding is that teachers gained most of their knowledge about using AT for students with ASD through self-training (M = 4.01, SD = 1.06). The majority of the teachers indicated that they gained this knowledge and skills regarding the use of AT in the classroom from online resources and reading books, with social media platforms being the most common way in which to receive information about AT use. Findings in this study are similar to those of Alabbas and Miller (2019), who examined the level of AT training for caregivers of individuals with ASD in Saudi Arabia. In their study, 44% of the participants indicated that most of their AT training was gained from other resources such as online platforms, books, or colleagues, while 54% received little or no AT training.

In the open-ended section, the majority of participants responded that the most useful AT training was from social media platforms. Self-learning is one of the types of informal professional development (Drotner, 2008). Based on participants' responses, teachers' knowledge was more clearly linked to informal professional development. Informal professional development facilitates knowledge exchange between teachers and cooperation in relation to practice in classrooms (Indeed, Fox & Wilson, 2015). At present, teachers are increasingly using social media platforms, such as Twitter and Facebook, as sources of knowledge (Bergviken Rensfeldt, Hillman, & Selwyn, 2018; Pill, Harvey, & Hyndman, 2017; Schroeder, Curcio, & Lundgren, 2019; Trust et al., 2016). In this study, teachers indicated their need for more Arabic content designed to use AT. Some participants reported that they sometimes searched for English content on social media platforms to understand how to use AT with their students with ASD. Other participants pointed to obstacles in self-learning about using AT; they described these obstacles related to online training as unprofessional and long.

**Internal Barriers**

Apart from exploring the first-order barriers to using AT in the classroom, the primary aim of this study was also to identify second-order barriers. Previous studies on the use of technology in schools have reported that second-order barriers are still a significant issue for policymakers and special education teachers (Alkhawaldeh & Menchaca, 2014; Bausch, Ault, & Hasselbring, 2015; Ertmer et al., 2012; Peterson-Karlan, 2015). The findings of this study related to these barriers are discussed next, in sequence from the highest to the lowest barriers, as follows: 1) knowledge/skills, 2) confidence, and 3) teachers' beliefs and attitudes.

One of the most significant barriers that teachers face when using AT is a lack of knowledge on how to use it in their classrooms (Ashton et al, 2005; Bausch, et al., 2008; Parette et al., 2006; Wilcox et al, 2006; Okolo & Diedrick, 2014). In this study, participants responded moderately to items related to lack of knowledge or skills concerning AT use with students with ASD, represented by a mid-range score (M = 2.65, SD = 0.93). These results are close to those in a previous study conducted by Alkahtani (2013) to examine special education teachers' levels of knowledge regarding the use of AT for students with a disability in Saudi schools. The results indicated that 72.4% of special education teachers have little or no knowledge about AT.

Although descriptive analysis highlighted lack of knowledge and skills as a moderate barrier, the qualitative data gave teachers the opportunity to clarify this issue. Participants reported that the lack of training is the primary reason for their limited knowledge. Most teachers indicated a lack of their AT skills because of limited hands-on practice on AT devices in training courses.

The findings of the current study indicates that teachers are concerned about their limited knowledge in identifying the appropriate AT devices for their students with ASD. There are two reasons that make it difficult to choose the appropriate AT device for each student. First, teachers

reported that there is no IEP team cooperating with them to design an individual educational plan that fits the needs of each student. One of the IEP team's roles is to provide support to teachers for decision-making on what AT devices students need (Griffiths & Price, 2011) Second, there is a lack of sufficient and continuous professional development programs to emulate the rapid development of technology devices. Therefore, teachers find themselves facing multiple options with limited knowledge of these new technology devices. Previous studies have indicated a need for teachers to undergo continuous training to increase their knowledge of new technology (Ashton et al, 2005; DePountis et al., 2013; Flanagan et al., 2013; Okolo & Diedrick, 2014; Wong & Cohen, 2012) because rapid technological developments make teachers feel like beginner users (ChanLin, 2007; Ertmer et al., 2007; Eteokleous, 2008; Inan & Lowther, 2010; Mueller et al., 2008; Watson, 2005).

When teachers have high confidence in AT, they are more likely to use it than those with low confidence (Bausch, Ault, & Hasselbring, 2015; Inan & Lowther, 2010; Niederhauser & Perkmen, 2008). Considering the findings of the current study, teachers' confidence did not emerge as a barrier to using AT for teaching students with ASD. Most of the teachers are confident that their knowledge of AT can be improved. However, this finding is inconsistent with a prior study by Zhou et al. (2012), who found that 59.3% of teachers do not have confidence in using AT for their students.

The final exploration of the current study related to teachers' attitudes and beliefs regarding the use of AT for teaching students with ASD. Teachers' attitudes and beliefs play an important role toward practices and strategies determine their decisions to instructional use in the classroom (Cuban, 2001; Ringstaff & Kelley, 2002; Sandholtz, Ringstaff, & Dwyer, 1997; Savolainen et al., 2012; Sze, 2009). According to Ertmer et al. (2012), teachers' attitudes and beliefs are impacted

by first-order barriers, such as the availability of resources and appropriate training. Although teachers indicated resources, time, and training as barriers to the use of AT, this study found positive attitudes among teachers towards the use of AT. Teachers indicating a desire to learn more about new AT devices (M = 4.20, SD = 0.91). In addition, they agreed that AT can enhance the learning of students with ASD (M = 4.06, SD = 1.00). Within the qualitative analysis of this study, participants said they are convinced of the benefits and importance of using AT to teach students with ASD. The teachers were positive about the advantages of using AT for teachers and students in the classroom.

**Implications**

The focus of this study was on the barriers to teachers' use of AT for teaching students with ASD in schools located in Riyadh, Saudi Arabia, principally through the lived experience of teachers. The findings of this mixed-methods study contribute to the literature regarding teachers' perspectives on the barriers affecting their use of AT in the classroom. As previously described, the participants in this study reported many barriers facing them when they use AT to teach their students, such as a lack of resources, support, time, training, and knowledge. These results support the findings of previous studies discussed in Chapter 2. Identifying the barriers would benefit efforts to reform the education system (Fullan, 1993; Fullan, 2007), and reducing and eliminating these barriers in Saudi schools is of national importance for education reform.

The following section presents the implications of this study for policymakers in the Ministry of Education, as well as for legislators, leadership, the education department, universities, school leaders, AT trainers, and teachers.

Regulations of Special Education Programs and Institutes in 2001 and the Disability Code legislation in 2000 provided the right for all individuals with a disability to receive multiple free

services to develop educational opportunities for them (Alquraini, 2010; Prince Salman Center for Disability Research, 2004). However, these legislations require specific guidelines, and a standardized toolkit would aid administrators, professionals, and researchers in enhancing the best educational practices in Saudi schools (Mahmoud, 2019). This study suggests that legislators should revise the current legislation and regulations to develop overall policies regarding AT services and to subsequently conduct follow-up studies to assess these legislations. This will aid researchers, service providers, and the education and training fields related to AT usage in enhancing and ensuring that all students with a disability have the right to access AT devices and services.

In terms of reforming education systems associated with the use of AT in the classroom, policymakers and education departments' administrators hearing a teacher's voice in the decision-making process can speed up the change and eliminate the barriers to the successful use of AT in educational settings. Fullan (1991) reported that "Educational change depends on what teachers do and think---it is as simple and as complex as that." (P, 117), thus highlighting the crucial role that teachers play in the education reform process (Fullan 1991). Therefore, involving teachers in planning for education reform is important. Furthermore, the Tatweer project has faced criticism from researchers and educational leaders due to teachers' lack of participation with reform planners in the project (Alshibani, 2015). As previously noted, Saudi Arabia has a comprehensive reform plan to achieve the goals of the 2030 vision, so this study recommends providing an opportunity for teachers to participate in devising the education system reform plan.

More importantly, teachers should be provided with the opportunity to assess the AT devices that are used with their students with ASD in the classroom, especially in light of the rapid development of technology devices. In addition, continuous communication channels must be

opened between supervisors in the education department and teachers to share information about similar or other alternatives for AT devices when a school does not have sufficient financial resources to purchase the devices requested by teachers.

The findings of this study showed that for most teachers, the lack of AT resources is a major barrier preventing them from implementing AT services with their students with ASD. To address this problem, schools' budgets must either increase or be reconsidered to accommodate the needs of students with ASD for many AT devices. The Ministry of Education representing education departments should create clear procedures for schools and teachers to request AT devices. This would allow school leaders and teachers to understand the requirements for requesting devices and the types of AT devices that are available.

Based on the findings in this study, malfunctioning devices and outdated devices constitute one of the barriers that teachers face when they use AT devices. To address these problems, for each educational office, the education department should provide a technical assistant who is responsible for providing technical services to neighboring schools. This person will repair and maintain the devices continuously and quickly. Furthermore, teachers reported spending considerable time updating programs or linking some devices, such as the projector. Providing simplified versions of videos or manuals, which explain to teachers how they can handle common technical issues by following simple steps, is hence important.

In addition, the weakness of AT training courses leads to unqualified teachers and ultimately to the unsuccessful use of AT in the classroom, which is common when teachers lack the skills and knowledge needed to properly implement the practices with their students. Based on the findings of this study, many teachers of students with ASD need more training on using AT devices; without enhancing their professional skills, they often have difficulties using ASD with

their students. It is necessary for the education department to organize efficient and effective AT courses in a timely manner. According to the teachers' reports in this study, AT training courses should be related to the actual practices in the classroom. Moreover, these courses should include hands-on work with AT devices that affords teachers opportunities for modeling and exploration. It is not sufficient for most courses to consist of presentations on the AT categories or a series of comprehensive modules related to the importance or benefits of broad AT usage with all students with disabilities.

This researcher recommends that AT training, whether provided by workshops, local conferences, or professional development companies, should be consistent with teachers' needs.

One of obstacles in in-service training was that once teachers went back to their classroom, there was no follow-up on their implementation of AT services that were learned at the training center. Trainers or lecturers did not visit or contact teachers to assess whether they were able to successfully use AT with their students. Based on this study's findings, AT trainers in professional development programs should follow up on teachers' implementation of practices in their classrooms after taking the courses. This also helps to uncover the weaknesses of courses, which contributes to improving those courses in the future.

Teachers also expressed a challenge related to the morning timing of courses. The education department, organizations, or institutions should reconsider the timing of the courses that are provided to teachers, with increased course-time options to fit all teachers' schedules. One efficient way is to provide AT training through online courses that are designed to be understandable to all teachers. This study also suggests that school leaders grant teachers the opportunity to attend the courses they need and facilitate class scheduling if the course time

conflicts with the official working time. Summer can also be used an ideal time to provide workshops on the use of AT.

To increase teachers' skills and knowledge on the use of AT, school leaders must play an important role in creating AT training courses within their schools that match teachers' strengths and weaknesses (Cramer et al., 2015). In addition, school leaders should find appropriate ways to facilitate the sharing of experiences between expert teachers in the AT field and their colleagues with less experience (Fullan 2005). The more opportunities there are for teachers to learn from one another, the more effective schools will be (Hargreaves & Fullan, 2012).

Previous studies support the importance of cooperation between parents and teachers to enhance education for students with ASD (Cheung & Pomerantz, 2012; Lasky & Karge, 2011). Some teachers in this study indicated that there is no IEP team working with them to make AT usage decisions, even parents of students with ASD were not participated. To increase parents' participation in the IEP process, policymakers, educational leaders, education departments, researchers, school leaders, and teachers could create solutions after many studies on the causes of limited collaboration between parents and teachers.

Prior studies have found that teacher preparation programs must recognize the importance of providing pre-service teachers with an opportunity to improve their capability to use AT devices in the future (Edyburn, 2004; Judge & Simms, 2009; Marino, Sameshima, & Beecher, 2009; Parette, Peterson-Karlan, & Wojcik, 2005; Silver-Pacuilla, 2006). The teachers in this study reported a lack of AT courses in the teacher preparation program during their university period. One of the recommendations of this study is to ensure that pre-service teachers are more sufficiently prepared to use AT with students with ASD. These teacher education programs should allow teachers to do hands-on work to enable pre-service teachers to practice on AT devices.

Furthermore, teacher education programs must increase AT content in many course syllabuses. Collaboration between universities and the education department is also essential to improve and assess the current teacher education programs according to the needs of current teachers.

Finally, the findings of this study contribute to the body of literature and provide insights into the barriers affecting the successful use of AT in the classroom. These findings will be valuable for Saudi Arabian officials. Implications from this study can be used to reform current practices regarding the use of AT and to create strategic initiatives to eliminate these barriers. According to Fullan (2007), reducing barriers is the cornerstone of achieving successful educational reform. The results of this study may also prompt other researchers to explore further barriers.

**Future Research**

This mixed-methods research explored teachers' perceived obstacles and challenges that may prevent the use of AT in teaching students with ASD. By analyzing the data collected, the study reached many conclusions contributing to the body of literature that focuses specifically on the barriers that teachers faced when attempting to use AT in their classroom. Nevertheless, further research should continue to explore the barriers that hinder the effective use of AT and examine the reality of implementing technology in classrooms (Burke, 2014; Gaffner, 2015; Kopcha, 2012). There are still many aspects and other directions of research associated with the use of AT that must be investigated. The following section provides recommendations for future research based on the results of this study and the limitations.

Understanding all barriers and challenges aids in establishing a comprehensive reform plan for policymakers and officials to achieve successful education for all students, especially those with disabilities. Although previous studies and this study sought to explore the external and

internal barriers affecting teachers' use of AT for teaching students with ASD in the classroom, additional studies must be conducted because there is still limited research, particularly regarding Saudi Arabian schools.

The second recommendation for future research is to conduct a similar study across Saudi Arabia that may yield different results from the present study, which was conducted in a single geographic area. Moreover, most previous studies were conducted in Riyadh or Jeddah. Although Riyadh is the largest city in Saudi Arabia, replicating this research in other parts of the country, including schools in cities and rural areas, is important. This study also recommends that research centers or Saudi research institutions should establish a standardized instrument of measurement aimed at exploring the barriers that hinder teachers use of AT with students with disabilities in all Saudi schools. This standardized tool should be implemented at different periods to measure progress in removing barriers and also to discover new barriers early.

This study targeted Saudi teachers of students with ASD. Based on the results of this study, most of the teachers' responses referred to first-order barriers as the major obstacles preventing them from using AT with their students with ASD. First-order barriers are outside the teachers' control, such as resources or training. The third recommendation is that future research should include additional participants, such as administrators from education departments, school leaders, trainers in professional development programs, faculty members in teacher preparation programs, educational leaders, and parents of students with ASD. Understanding how these participants perceive administrative barriers and extrinsic factors is important because having a different perspective from participants who are outside of the classroom may allow for an overall viewpoint of obstacles, instead of reducing understanding of these barriers based on teacher's reports only.

AT usage differs from one student with ASD to another, and the AT device-related needs of students with disabilities also differ for each individual. For example, the types of AT devices needed by students with hearing impairments is different from a student with ASD or learning difficulties. This study focused on using AT with students with ASD only. The fourth recommendation is that future research should explore the barriers affecting AT usage with all categories of disabilities.

This study used a mixed-methods approach to explore the barriers that affect teachers' abilities to use AT for teaching children with ASD in Saudi Arabia. Utilizing both Likert scales and open-ended questions, the instrument asked teachers to self-report on second-order barriers such as belief, attitude, confidence, and knowledge, which are internal factors related to the fundamental personality of the participants. However, teachers may have found it difficult to openly express their attitudes and beliefs regarding an educational practice. The fifth recommendation is thus for future research to employ the triangulation approach by combining a survey, an interview, and observation, which may lead to a comprehensive investigation of AT barriers (Patton, 1999).

One of the major barriers from the findings of this study is a lack AT training, which supports the results from previous studies. The sixth recommendation is that additional research is required to examine teacher preparation programs at Saudi universities by evaluating the AT curriculum provided to pre-service teachers. Future research could include the examination of faculty members' knowledge in the AT field. Moreover, this future research could extend to examine professional development programs regarding the AT training that in-service teachers have received. This contributes to evaluating the strengths and weaknesses of AT training.

Apart from exploring barriers, this study attempted to determine the frequency of AT use with students with ASD in the classroom. The final recommendation of this study is to carry out additional studies that could focus on observing teachers implementing AT in their classrooms. Understanding the teachers' practices when using AT is essential for identifying the challenges in order to improve AT training courses and eliminate barriers that hinder the successful implementation of AT.

**Limitations**

This section presents the limitations of this study, which are as follows: This study was conducted in Saudi Arabia and only focused on a single geographical area of the nation. The participants were special education teachers in Riyadh city in the central region of Saudi Arabia, not encompassing other cities; thus, the results cannot be generalized to other districts. Further exploration of the barriers affecting teachers' use of AT in other cities in the country is required. Extending the scope of the study to include all teachers from Saudi cities would yield generalizable results and increase the findings' reliability.

As Hatch (2002) posits, "… participants are the ultimate gatekeepers" (p. 51). The results of this research depended on the teachers' honesty. However, the participants may have been reluctant to express the reality of their level of knowledge, training, and attitudes, as they may have been concerned that it could increase the number of internships and workshops. Therefore, the quality of teachers' responses in the survey items may be biased or may not reflect the reality of barriers due to denial.

It is also possible that teachers' perceptions of their knowledge of AT and technology skills do not accurately match what is applied in their classrooms. In addition, the self-report measure does not necessarily provide a clear picture of the rate of use of AT in the classroom (Creswell,

2014). This study gave participants the opportunity to determine their weekly frequency of use for all three AT categories. Despite these limitations, participants offered valuable information through their responses to the open-ended questions.

Since the instrument of this study was an online survey, it is more likely that teachers who are only comfortable with technology consented to participate. In contrast, teachers who do not feel positively about technology may have avoided participating in the study. Negative attitudes and beliefs toward AT could affect participants' responses, which should take into account that some teachers do not wish to use AT with their students.

Considering external barriers that influence teachers' decisions to use AT in the classroom, the participants in the study did not include school leaders, education department representatives, faculty members of teacher preparation programs, or parents. Collecting data from them would provide additional results. Due to the limited number of studies that discuss the barriers to AT use in Saudi Arabia, most of the literature reviewed in and related to this study is from the United States and the United Kingdom.

**Summary**

Chapter 1 provided a comprehensive overview of the nature of this dissertation, followed by the research problem that the researcher sought to examine. The purpose and significance of the study were also presented, along with the conceptual framework and the research questions that guided the methodology. To clarify and understand the significant concepts of this dissertation, the chapter concluded by defining several key terms used throughout this study. Chapter 2 discussed previous studies related to the use of technology in the classroom and the associated barriers; it also provided a review of a group of topics related to this study, including the education system in Saudi Arabia, students with autism, teachers of students with autism in

Saudi Arabia, and legislation and regulations concerning AT. Chapter 3 explained the design of this dissertation, which included identifying the target population of the study and setting. It also presented the procedures for developing the instrument and its components, and it explained how the validity and reliability of the instrument were increased. Thereafter, procedures for data collection and analysis were presented. Chapter 4 concluded the findings of the study, which were presented and organized according to the four research questions. Chapter 5 discussed the results of the study and linked it with the literature review and the conceptual framework of the study. Finally, based on the dissection of this study, the researcher described the limitations of the study.

In conclusion, this study aimed to a) explore the perceived barriers to the use of AT and b) provide insight into why teachers are successfully or unsuccessfully using AT for teaching students with ASD, and it investigated how teachers respond to these barriers. It also attempted to determine the highest AT devices used by teachers in teaching children with ASD. The mixed-methods approach used in this study contributed to a better understanding of the research problem (Creswell, 2013). The 85 participants who work as teachers in Saudi schools located in Riyadh city provided rich data and deep insight into the barriers.

The analyses of teachers' responses to the survey instrument revealed that they face first-order barriers related to lack of resources, support, time, and training. Teachers' limited skills and knowledge are major second-order barriers. Conversely, the teachers displayed positive attitudes, beliefs, and confidence regarding the use of AT in teaching students with ASD. Most of the teachers expressed that they could not do anything when faced with these obstacles. Despite this, some teachers indicated that they use their own devices, such as laptops, to try to compensate for the lack of resources. Others pointed out their efforts to learn about AT devices through self-learning to compensate for the lack of training. One of the important findings of this study is that

teachers use high-tech AT more than both low-tech and mid-tech AT. An analysis of open-ended questions showed that tablets are the most-used type of AT among teachers.

Finally, the findings of this dissertation can contribute to the process of reforming the special education systems of Saudi Arabia and other countries. Eliminating these barriers to AT integration could allow teachers to perform their tasks to fulfill the needs of students with ASD, which will improve the academic skills, self-efficacy, independence, and quality of life of those students.

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# APPENDIX A: INSTITUTIONAL REVIEW BOARD

**UNIVERSITY of SOUTH FLORIDA**

EXEMPT DETERMINATION

June 26, 2020

Othman Alasmari
7039 trysail Cir
Tampa, FL 33607

Dear  Mr. Alasmari:

On 6/25/2020, the IRB reviewed and approved the following protocol:

| Application Type: | Initial Study |
|---|---|
| IRB ID: | STUDY000943 |
| Review Type: | Exempt 2 |
| Title: | Barriers to Reducing the Assistive Technology use for Students with Autism as Perceived by Special Education Teachers in Saudi Arabia |
| Funding: | None |
| Protocol: | • Protocol_V.1_May 5, 2020.docx; |

The IRB determined that this protocol meets the criteria for exemption from IRB review.

In conducting this protocol, you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Please note, as per USF policy, once the exempt determination is made, the application is closed in BullsIRB. This does not limit your ability to conduct the research. Any proposed or anticipated change to the study design that was previously declared exempt from IRB oversight must be submitted to the IRB as a new study prior to initiation of the change. However, administrative changes, including changes in research personnel, do not warrant a modification or new application.

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

**Institutional Review Boards  /  Research Integrity & Compliance**
FWA No. 00001669
University of South Florida  /  3702 Spectrum Blvd., Suite 165  /  Tampa, FL 33612  /  813-974-5638

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# APPENDIX B: CONSENT FORM

**UNIVERSITY OF SOUTH FLORIDA**

USF RESEARCH & INNOVATION

**Informed Consent to Participate in Research**
Information to Consider Before Taking Part in this Research Study
**Title: /Barriers to Reducing the Assistive Technology use for Students with Autism as Perceived by Special Education Teachers in Saudi Arabia/**
**Study # <u>STUDY000943</u>**

**Overview:** You are being asked to take part in a research study. The information in this document should help you to decide if you would like to participate. The sections in this Overview provide the basic information about the study. More detailed information is provided in the remainder of the document.

Study Staff: This study is being led by Alasmari, Othman who is a doctoral candidate in special education. This person is called the Principal Investigator. He is being guided in this research by Dr. Brenda Walker. Other approved research staff may act on behalf of the Principal Investigator.

Study Details: This study is being conducted at the central region of Saudi Arabia. The purpose of the study is to identify, explore, and interpret barriers to the use of assistive technology through the lived experiences of special education teachers. We believe that the information obtained from this study will help us gain a better understanding of the barriers to assistive technology use that could allow teachers to perform their tasks to fulfill the needs of students with autism. The instrument of this study consisted of a 48-item questionnaire that will take approximately 25-40 minutes from the teacher's precious time to complete.

Participants: You are being asked to take part because you are in-service teachers in the central region of Saudi Arabia, you teach students with autism. This is because teachers are experiencing a variety of barriers to using technology in classrooms. An understanding and a reflection on your perspective will assist policymakers, school districts, and principals in reducing those barriers.

Voluntary Participation: Your participation is voluntary. You do not have to participate and may stop your participation at any time. There will be no penalties or loss of benefits or opportunities if you do not participate or decide to stop once you start. Your decision to participate or not to participate will not affect your job status, employment record, employee evaluations, or advancement opportunities.

Benefits, Compensation, and Risk: Your participation is strictly voluntary. There is no cost to participate. This research is considered minimal risk. Minimal risk means that study risks are the same as the risks you face in daily life.

Confidentiality: Even if we publish the findings from this study, we will keep your study information private and confidential. Anyone with the authority to look at your records must keep them confidential.

**Why are you being asked to take part?**

**Appendix B: Continued**

The effective use of assistive technology in the classroom can be influenced by many factors, one of which is how teachers apply the assistive technology in their classrooms. Teachers play an important role in the success or failure of the use of assistive technology in teaching and learning processes. There are many obstacles and challenges facing teachers that impede the effective application of assistive technology. Therefore, it is necessary to investigate teachers utilization of technology and exploring all aspects that contribute to effective apply teaching with technology through their inquiries. The purpose of the research is to explore the barriers that affect teachers' abilities to use assistive technology for teaching children with ASD in Saudi Arabia.

### Study Procedures
If you take part in this study, you will be asked to complete an online survey that will take approximately 25-40 minutes. The instrument has 48 items to gather data. It will include 39 Likert items and nine open-ended questions, which consisted of four main parts that includes participants' demographic information, frequency of assistive technology use, barriers of assistive technology use, and how these barriers effecting in assistive technology use.

### Alternatives / Voluntary Participation / Withdrawal
You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time.  There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Your decision to participate or not to participate will not affect your job status, employment record, employee evaluations, or advancement opportunities.

### Benefits and Risks

You will receive no benefit from this study. This research is considered to be minimal risk.

### Compensation
This study won't provide compensation.

### Privacy and Confidentiality

We will do our best to keep your records private and confidential. We cannot guarantee absolute confidentiality. The only people who will be allowed to see these records are:
Principal investigator.
The advising professor.
The University of South Florida Institutional Review Board (IRB).

It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet.  However, your participation in this online survey involves risks similar to a person's everyday use of the Internet. If you complete and submit an anonymous survey and later

## Appendix B: Continued

request your data be withdrawn, this may or may not be possible as the researcher may be unable to extract anonymous data from the database.

Data collected for this research will be stored at the researcher's password-protected computer.

Once your participation in the research is over, your information will be stored in accordance with applicable policies and regulations. Your permission to use your personal data will not expire unless you withdraw it in writing. You may withdraw or take away your permission to use and disclose your information at any time. You do this by sending written notice to the Principal Investigator at the following address: oaa1@usf.edu.

While we are conducting the research study, we cannot let you see or copy the research information we have about you. After the research is completed, you have a right to see the information about you, as allowed by USF policies.

If you have concerns about the use or storage of your personal information, you have a right to lodge a complaint with the data supervisory authority in your country.

### Contact Information

If you have any questions, concerns or complaints about this study, call Othman Alasmari at +14078740268. Or you can contact my faculty advisor, Brenda Walker, Ph.D., through her email address brendawalker@usf.edu.

If you have questions about your rights, complaints, or issues as a person taking part in this study, call the USF IRB at (813) 974-5638 or contact the IRB by email at RSCH-IRB@usf.edu.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are. You can print a copy of this consent form for your records.

I freely give my consent to take part in this study. I understand that by proceeding with this survey, I am agreeing to take part in research and I am 18 years of age or older.

https://usf.az1.qualtrics.com/jfe/form/SV_0MWqzN0PvbHshNj

# APPENDIX C: APPROVAL LETTER FROM THE EDUCATION DEPARTMENT

المملكة العربية السعودية
وزارة التعليم
الإدارة العامة للتعليم بمنطقة الرياض
إدارة التخطيط والتطوير

الرقم: ................
التاريخ: ٢٦ / ١٠ / ١٤٤١هـ .
المشفوعات: ...............

وزارة التعليم
Ministry of Education

Planning & Development
إدارة التخطيط والتطوير

## " إفادة "
### بالموافقة على تطبيق أداة الدراسة في المدارس التابعة لإدارة التعليم بمنطقة الرياض

| الاسم | عثمان بن أحمد آل عثمان الأسمري | | |
|---|---|---|---|
| الرقم الجامعي | U16373829 | العام الدراسي | ١٤٤١ |
| الجامعة | جامعة جنوب فلوريدا | التخصص | التربية الخاصة |
| الدرجة العلمية | دكتوراه | عينة الدراسة | معلمو ومعلمات الطلاب ذوي التوحد |
| عنوان الدراسة | الحواجز التي تحد من استخدام التكنولوجيا المساندة لتعليم طلاب ذوي التوحد من وجهة نظر المعلمين السعوديين | | |
| نوع الإفادة | الموافقة على تطبيق الدراسة في المدارس التابعة للإدارة العامة للتعليم بمنطقة الرياض بدءً من تاريخ ١٩ / ١٢ / ١٤٤١ الموافق ٢٠٢٠/٨/٩ إلى تاريخ ١٤٤٢/٢/١٥ الموافق ٢٠٢٠/١١/١ خلال الفصل الدراسي الأول للعام ( ١٤٤١هـ/١٤٤٢هـ ) بحسب طلبه | | |

السلام عليكم ورحمة الله وبركاته          وبعد،

وبناءً على قرار سعادة مدير عام التعليم بمنطقة الرياض رقم ٣٨٩٢٠٧٩٣ وتاريخ ١٤٣٨/٦/٢٣هـ بشــأن تفويض الصلاحية لإدارة التخطيط والتطوير لتسهيل مهمة الباحثين والباحثات. وحيث تقدم إلينا الباحث (الموضحة بياناته أعلاه) بطلب إجراء دراسته بداية من تاريخ ١٩ / ١٢ / ١٤٤١هـ خلال العام الدراسي ١٤٤٢/١٤٤١ هـ ؛ عليه نفيدكم أنه لا مانع من تطبيق الدراســة خلال مدة زمنية محددة بـــــ (٩٠) يوماً بدءً من التاريخ المحدد أعلاه ، على نطاق مدارس منطقة الرياض، مع ملاحظة أن الباحث يتحمل كامل المسؤولية المتعلقة بمختلف جوانب البحث، ولا يعني سماح الإدارة العامة للتعليم، موافقتها بالضرورة على مشكلة البحث أو على الطرق والأساليب المستخدمة في دراسته ومعالجتها. وبناء على طلبه تم منحه الإفادة ، علما أنه تم الإطلاع على أداة الدراسة (الاستبانة)

### إدارة التخطيط والتطوير

ل. العراك

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# APPENDIX D: INSTRUMENT

**Section One: Demographic Information**

1.What is your sex?
▢ Male
▢ Female

2. What is your age?
▢ 20 - 30 years
▢ 31 - 40 years
▢ 41 - 50 years
▢ 51 - 60 years
▢ 61 - 70 years and above

3. How many years of experience do you have?
▢ 0 - 5 years
▢ 6 - 10 years
▢ 11 - 15 years
▢ 16 - 20 years
▢ 21 years and above

4. Please indicate your current offices of education

 ………………………………………………….

**Appendix D: Continued**

Section Two: Frequency of reported weekly use of assistive technology.

| N | | Frequency of use | | | | |
|---|---|---|---|---|---|---|
| | | Do not use | 1 time or less a week | 1 to 2 times a Week | 3 to 4 times a Week | 5 times and more a week |
| 5 | **Low Tech**<br>The devices do not require batteries or electricity. Such as picture exchange communication system (PECS), visual schedules,  clipboards, pencil grips, sensory-stimulating toys, break cards, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6 | **Mid Tech**<br>The devices do not have complex or mechanical features, and they are manually operated. Such as personal spelling devices, audiobooks, picture communication symbols (PCSs), portable word processors,  speech-generating devices (SGDs), etc. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7 | **High Tech**<br>The devices require a power source on which to run, and they have sophisticated electronic equipment. Such as videotaping, video games, interactive multimedia systems, tablets, interactive Storybooks, etc. | ☐ | ☐ | ☐ | ☐ | ☐ |

8. What assistive technologies are you currently using? Among them, which assistive technology you think is the most useful for students with ASD? how many times do you use the assistive technology per week?

**Section Three:**
Instruction: There are statements in this questionnaire about assistive technology use with students with ASD. Please think about each statement by itself and indicate how true it is by selecting one of the five choices. Do not be influenced by your answers to other statements.

*Resources:*
9. Low Tech devices are available at my school.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

10. Mid Tech devices are available at my school.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

11. High Tech devices are available at my school.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

12. I think assistive technology devices is inexpensive.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

13. As far as I know, all teachers have easy access to assistive technology devices in my school.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

14. I think my school is budgeting money for purchasing assistive technology.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

*Time:*
15. I have enough class time to use assistive technology with my students with ASD.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

16. I have enough school time to improve my skills in using assistive technology.

| ▫ Strongly Disagree | ▫Disagree | ▫ Undecided | ▫ Agree | ▫ Strongly agree |
|---|---|---|---|---|
| | | | | |

17. My school provides more time to experiment with new types of assistive technology.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

*Training:*

18. I learned how to use assistive technology from my university courses.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

19. My school district offers adequate training opportunities for me to use assistive technology for students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

20. My previous training experiences taught me how to competently use assistive technology.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

21. My teacher preparation program taught me how to use assistive technology using hands-on experience.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

22. I gained most of my knowledge in using assistive technology for students with ASD through self-training.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

*Support:*

23. My school leader encourages me to use assistive technology in the classroom.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

24. My school readily provides technical support to fix malfunctioning assistive technology.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|
| | | | | |

25. I know how to fix malfunctioning assistive technology by myself.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

26. Most of the assistive technology devices in my classroom are still working in good condition.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

27. What can make it difficult to access and use assistive technology devices in your school?

28. What was the most useful training experience to use assistive technology that you have had?

29. How does your school support you in using assistive technology with your students?

***Teachers' beliefs and Attitudes:***
30. Assistive technology can enhance the learning of students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

31. Using assistive technology can meet the learning needs of students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

32. Assistive technology can create more learning opportunities for students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

33. I enjoy learning about assistive technology from professional development activities.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

34. I prefer to learn more about new assistive technology devices.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

***Confidence:***
35. I am confident that I can use assistive technology with students with ASD.

| □ Strongly | □Disagree | □ Undecided | □Agree | □ Strongly agree |
|---|---|---|---|---|

| Disagree | | | | |
|---|---|---|---|---|
| | | | | |

36. It is easy for me to use assistive technology with students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

37. I am sure of my ability to use assistive technology with my students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

38. I think my knowledge of assistive technology can be improved.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

39. I am confident in selecting assistive technology that would best meet my students' learning needs.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

***Knowledge/skills***

40. I have enough knowledge about using assistive technology for students with ASD

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

41. I can identify what type of assistive technology is most appropriate for students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

42. I have sufficient knowledge of most assistive technology devices appropriate for students with ASD.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

43. My skill level in using assistive technology is high.

| □ Strongly Disagree | □Disagree | □ Undecided | □ Agree | □ Strongly agree |
|---|---|---|---|---|

**Appendix D: Continued**

44. What specific skills do you need to better use assistive technology for your students with ASD?

45. How would you describe the importance of assistive technology in meeting the needs of students with ASD?

46. What other barriers impede your use of assistive technology for students with ASD?

**Section Four:**

47. Please describe your experiences of those barriers and how those barriers affected your ability to use assistive technology for students with ASD?

48. Please describe how you overcame those barriers to better teach your students with the assistive technology?