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**Developing the Language Ability of Children with Autism
Spectrum Disorder (ASD) Using Assistive Technology and
a Picture Exchange Communication System (PECS) through
Adapting elements of the Australian Educational Environment
on Inclusive Public Schools in Saudi Arabia**

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Developing the Language Ability of Children with Autism Spectrum Disorder (ASD) Using Assistive Technology and a Picture Exchange Communication System (PECS) through Adapting elements of the Australian Educational Environment on Inclusive Public Schools in Saudi Arabia

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Abstract

Autism Spectrum Disorder (ASD) has a significant impact on the social development and educational achievement of affected students. In the Kingdom of Saudi Arabia (KSA), students with ASD still face a number of challenges, including stigmatization and poor academic achievement. The current study thus seeks to develop the language ability of children with ASD using assistive technology (AT) and a Picture Exchange Communication System (PECS) through adapting elements of the Australian educational environment on inclusive public schools in KSA. Five studies published in peer-reviewed journals between 2010 and 2015 were identified and reviewed through a systematic review approach. The study established that the uses of PECS and AT in most Australian inclusive public schools do not produce the desired outcomes because of a lack of a conducive policy environment, insufficient trained and experienced teachers and speech-language pathologists (SLPs) in PECS and AT, poorly designed and implemented PECS and AT, negative perceptions of most teachers towards the inclusion of children with ASD in mainstream classrooms, and barriers to service access. However, the study findings indicate that the use of PECS and AT in the Australian educational environment had been successful because most of the inherent gaps attributed to the planning and implementation of PECS and AT had been addressed. Therefore, borrowing from the Australian lessons, the study recommends the need to enhance the effective and successful design and implementation of PECS and AT in inclusive public schools in KSA by improving service access, developing service inclusion policies, training staff and improving SLPs' expertise in PECS and AT, improving access of children with ASD to AT, adopting a user-centered design of PECS and AT, adopting a collaborative approach to implementing PECS and AT, as well as understanding ASD-related challenges.

Keywords: inclusive public schools, PECS, AT, ASD

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تطوير القدرة اللغوية للأطفال ذوي اضطراب طيف التوحد باستخدام التكنولوجيا المساعدة ونظام بكس عن طريق تكيف عناصر البيئة التعليمية الاسترالية على المدارس السعودية

هادية علي جميل^(*)

المخلص باللغة العربية

لاضطراب طيف التوحد تأثير كبير على التواصل الاجتماعي واللغوي والتحصيل الدراسي على الأطفال ذوي التوحد. في المملكة العربية السعودية، لا يزال الكثير من الأطفال ذوي التوحد يواجهون الكثير من التحديات بما في ذلك السمة السائدة عنهم بالإضافة إلى ضعف التحصيل الأكاديمي المرتبط بضعف التحصيل اللغوي. تهدف هذه الدراسة إلى تقنين عناصر البيئة المدرسية الأسترالية على المدارس السعودية لتطوير القدرة اللغوية للأطفال ذوي التوحد باستخدام التكنولوجيا المساعدة ونظام بكس.

الكلمات المفتاحية: التوحد، التكنولوجيا المساعدة، نظام بكس، المدارس السعودية، المدارس الأسترالية، البيئة المدرسية.

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Section One: Introduction

This section provides a brief background of the study, states the research problem, provides a brief description of the study, outlines the research objectives, describes the rationale of the study, and provides a summary of the chapter.

Background of the Study

Autism Spectrum Disorder (ASD) poses a significant challenge to the development and social wellbeing of an individual (Mirenda, 2001). According to Diagnostic and Statistic Manual of Mental Disorders (DSM-V), “autism spectrum disorder (ASD) is a developmental disorder characterized by deficits in social communication and social interaction, and the presence of restricted, repetitive patterns of behaviour, interests, or activities that can persist throughout life” (Association, 2013).. The National Institute on Deafness and Other Communication Disorders (NIDCD, 2010) observes that approximately 25% of individuals with ASD cannot use natural speech for primary communication. Such challenges persist throughout the life span of the person with ASD, thus significantly hindering his/her social wellness. However, advanced prognosis and early intervention can improve the situation of persons with ASD (Van der Meer et al., 2012).

The number of children with ASD has increased significantly over the last two decades and is currently estimated at 2 in 91 children (Flippin, Reszka, & Watson, 2015). Similarly, the number of students with autism participating in regular classroom settings for at least 80% of school time rose from 9% in 1993 to 31% in 2006 (USDOE, 2010). Overall, the population of students with ASD enrolling in regular classrooms is estimated

to have increased by 244% between 1993 and 2013 (Costantino & Bonati, 2014). The participation of such students with ASD in regular classrooms is expected to increase by 65% in the next ten years (Turki, 2012).

Children with ASD usually have special needs, which if not addressed adequately, are likely to affect their social communicative functions, conceptual development, as well as their academic achievement (Somaily, Al-Zoubi, & Majdoleen, 2012; Keen, 2009). Most children with ASD have difficulties in engaging in the classroom environment and attending to the necessary aspects of the learning environment (Parsons et al., 2011). In cases where such children are not motivated, they are likely to avoid certain tasks and in some cases, develop disruptive behaviours such as crying, being violent to their communication partners or colleagues, running away, etc. (Parker & Kamps, 2011). In addition, children with ASD may have difficulties in learning new material in the classroom environment and/or at home (Denning, 2013). This is common in cases where such new materials pose significant demand on the cognitive flexibility and/or processing speed of such children (Eack, 2018; Dijkhuis, 2020). In addition to being unable to learn effectively within the learning environment, children with autism also find it difficult to complete classroom assignments (Koegel, Singh, & Koegel, 2010). This is largely attributed to the deficiency of executive functioning in such children (Ozonoff & Strayer, 2011). According to Denning (2013), executive functioning plays a critical role in enhancing an individual's ability to coordinate goal-directed behaviour.

Saudi Arabia is one of the countries in the Middle East (ME). This country, which mainly subscribes to the Islamic faith and Sharia law, has seen its education system evolve from being reserved for elite and wealthy families

to a right for all members of the society (Alquraini, 2011; 2013). The government, through the Ministry of Education, facilitates the schooling of all children, including those with disabilities. In addition, it establishes new schools, oversees curriculum development, develops training programs for teachers and offers adult literacy education (Ministry of Education, 2008).

While the Sharia law on which the KSA is founded demands dignity and education for all (Alquraini, 2011; Zeina, Al-Ayadhi, & Bashir, 2014), the provision of special education in the KSA did not receive the requisite attention from key stakeholders until after the 1960s, when a number of legislations regarding people with a disability were enacted (Alquraini, 2013). For instance, the Legislation of Disability (LD) 1987 guarantees people with disabilities the educational rights equal to other members of society and clarifies programs for assessing the effectiveness of special education services (Ministry of Health Care, 2010). Similarly, the Disability Code 2000 guarantees people with disabilities equal and free access to appropriate educational, social, psychological and rehabilitation services offered in public institutions (Alquraini, 2011; 2013). Other important legislation focusing on people with disabilities in the KSA include the Regulations of Special Education Programs and Institutes (RSEPI) 2001 (Alquraini, 2013). Despite the development of the special education sector in the KSA, the status of educational service provision to children with ASD in the KSA is still underdeveloped (Zeina, Al-Ayadhi, & Shahid, 2014). A review of the existing literature shows that limited effort has been directed towards the development of the language ability of children with ASD in the KSA (cited in Zeina, Al-Ayadhi, & Shahid, 2014), hence the need for the current study.

Statement of the Problem

Autism Spectrum Disorders (ASD) are very common neurodevelopmental disorders that occasion a number of social and developmental malfunctions, especially among children (Howlin, 2005). While a number of studies have been conducted on ASD etiology in different countries across the world, including Saudi Arabia (Al-dawaideh & Al- Amayreh, 2013; Abdulhade & Obaidat, 2013; Alnahdi, 2014; Al-Dawaideh, 2013; Altaf, Al-Ayadhi, & El-Ansary, 2014), very little regarding ASDs is known in most developing countries such as the Kingdom of Saudi Arabia (Mohammadi & Akhondzadeh, 2007; Grafodatskaya, Chung, Szatmari, & Weksberg, 2010). In such countries, children with ASD are still viewed as outcasts and denied the necessary social and developmental support (Zeina, Al-Ayadhi, & Shahid, 2014). The number of people with autism is expected to increase significantly over the next few years, with some health organizations (Shamsi-pour, Yonesian, & Mansouri, 2010; Peters-Scheffer et al., 2011) suggesting that about 67 million people across the world are will have autism.

Despite being one of the most well-known prevalent neurodevelopmental disorders, not just in KSA but across the world, ASD has not received the necessary attention it deserves, especially in the KSA (Zeina, Al-Ayadhi, & Shahid, 2014). Families with children with ASD in the KSA are normally stigmatized and stressed as they deal with the demands of ASD (Boesch et al., 2013). Most of these families are forced to spend a significant amount of their productive time and energy as well as financial resources caring for such autistic children. There is little information on how to develop the language ability of students with ASD in the KSA, owing to

the absence of an advanced study on the effectiveness of available language development methods for students with ASD in KSA (Sathiya prakash et al., 2011). In addition, most students with ASD in KSA find it difficult to cope in the inclusive classroom environment due to discrimination by the other students and the negative perceptions of classroom teachers about children with ASD (Abdulhade, 2013). Most of the teaching methods employed in the inclusive classroom environment in most inclusive schools in KSA are also not pro-children with ASD (Elsheikh, & Alqurashi, 2013). It is against this backdrop that the current study seeks to explore how the language ability of children with ASD could be developed using AT and PECS. Therefore, the impact of these both strategies on the language ability of children with autism as well as the benefits of the Australian educational model in inclusive public schools of the KSA will be determined.

Aim of the Study

The aim of the current study is to improve the learning abilities of children with ASD by providing AT and PECS as well as adapting the elements of success of the Australian educational environment in inclusive public schools of the KSA. The AT will include speech generating devices such as iPads, smart-phones, as well as other computer-assisted interventions/ technologies.

Objectives of the Study

In light of the above aim, the study seeks to achieve the following specific objectives:

- i) To identify existing gaps in the use of PECS and AT in inclusive public schools in KSA.

- ii) To explore the elements of success in the use of PECS and AT attributed to the Australian educational environment.
- iii) To determine how the elements of success of the Australian educational environment can be adopted by inclusive public schools in the KSA for the purpose of developing the language ability of children with ASD.

Rationale of the Study

Given the increasing number of children with ASD in KSA, considering that a number of existing teaching methods in most inclusive schools in KSA are not pro-children with ASD, and aware of the criticality of inclusive classroom settings in enhancing classroom participation and the academic achievement of children with ASD, there is need to adopt appropriate measures to enhance the communicative ability of such children through augmentative and alternative communication systems (AAC) such as PECS and AT. The current study thus makes significant contributions to the achievement of this goal.

Significance of the Study

The current study makes significant contributions to the improvement of the existing database on available supports for people with autism in the KSA, especially with regard to the development of the language ability of children with ASD using PECS and AT. The findings of this study are also likely to inform the development of policy on the effective teaching of children with ASD in inclusive public school settings in KSA. In addition, the study findings are likely to play an important role

in informing future studies. Furthermore, the study findings generate useful information and insights for the design and development of future theory-based intervention research on the use of PECS and AT in developing the communicative abilities of children with ASD. The most important of all is that students with autism will be able to understand classroom material; they will be confident enough to the same level like their other classmates by overcoming the barriers they may face; some are visual thinkers who will be significantly benefited by these technologies..

Summary and Transition

In summary therefore, this study seeks to develop the language ability of children with ASD using AT and PECS through adapting elements of the Australian educational environment on inclusive public schools in the Kingdom of Saudi Arabia (KSA). In so doing, it identifies existing gaps in the use of PECS and AT in inclusive public schools in KSA, explores elements of success in the use of PECS and AT attributed to the Australian educational environment, and determines how these elements of success of the Australian educational environment can be adopted by inclusive public schools in the KSA for the purpose of developing the language ability of children with ASD. This section has thus provided the background of the study, outlined the aim and objectives of the study, and has explained the rationale and significance of the study. The subsequent sections review the relevant scholarly literature, explain the method adopted by this study, outline and discuss the study results, as well as conclude the study and make appropriate recommendations for the improvement of the current situation in KSA's inclusive public schools.

Section Two: Literature Review

Introduction :

This section identifies and reviews the existing body of literature that is relevant to the study, with a view to identifying existing knowledge gaps that the study hopes to fill. It covers the literature on inclusive public schools, the use of AAC such as PECS and Sound Generating Devices (SGDs), with a particular focus on Saudi Arabia, and ultimately identifies the existing gaps in practice.

Inclusive Public Schools

The establishment of inclusive schools is mainly aimed at addressing the plight of vulnerable students, including those with disabilities, who for a long time had been treated differently by the mainstream education system (Waitoller & Artiles, 2013). While the composition of inclusive schools and what constitutes inclusive education differ from one country to another, Denning (2013) observes that the primary aim of inclusion is to expand the scope of the equity agenda by allowing students with disabilities equal and free access to the general classroom environment. However, one of the concerns of the concept of inclusion has been whether it guarantees students with disabilities quality education (Slee, 2011; Waitoller, Artiles, & Cheney, 2010; Luciak & Biewer, 2011; Löser & Werning, 2011; Fernández-López et al., 2013; Fenson et al., 2007).

One of the categories of students with disabilities commonly exposed to regular classrooms is students with ASD. With a number of previous studies (Parker & Kamps, 2011; Koegel, Singh, & Koegel, 2010; Asaro-Saddler & Saddler, 2010; Soto-Chodiman et al., 2012) indicating that the

number of students with ASD has been increasing over the years (currently estimated to stand at 2 in 91 children), parents and other stakeholders remain concerned about the ability of inclusive classroom settings and teaching methods therein to enhance the educational achievement of students with ASD (Denning, 2013).

Despite the challenges facing the inclusion of students with ASD in inclusive public schools and the potential threats to the academic achievement of such students, certain countries, such as Australia, have registered significant progress and success in implementing the concept of inclusion of students with ASD in public schools (Soto-Chodiman et al., 2012; Anderson, Balandin, & Stancliffe, 2014). For instance, through the development of innovative teaching methods and the creation of an effective supportive legal and policy environment, Australia has been able to increase the enrolment of students with ASD in inclusive settings, keeping the transition rate of such students higher as well (Farrell et al., 2010). Training programs for teachers dealing with students with ASD and placing a significant focus on improving social and/or communication skills using inter alia, AAC, are just some of the initiatives that characterize the successful Australian inclusive program (AABASD, 2010). Augmentative and alternative communication (AAC), which entails the supplementation/replacement of natural speech/writing via alternate means of communication (Harding et al., 2011), has been found to be an effective method for addressing the communication deficits associated with ASD in Australia and other successful countries such as the U.S. (Boesch et al., 2013). Some of the methods for implementing AAC include PECS and IT such as iPads and speech-generating devices (SGDs) (Al-dawaideh & Al-

Amayreh, 2013; Anderson, Balandin, & Stancliffe, 2014; Anneke, Angelika, & Moore, 2012; Van Der Meer et al., 2013; Baxter et al., 2012). While Australia has registered significant progress in the inclusion of students with ASD in regular settings, the situation in KSA has not been promising. Zeina, Al-Ayadhi and Shahid (2014) observe that stigmatization, lower transition rates, and mediocre academic achievement among students with ASD is still a major phenomenon in the KSA inclusive public schools.

Picture Exchange Communication System (PECS)

ASD are common forms of disabilities/disorders in the Kingdom of Saudi Arabia (Al-dawaideh & Al- Amayreh, 2013). For instance, as at 2006, 4-6 children out of 1000 children born in KSA were diagnosed with autism (Al-jarallah, et al., 2006). The children with severe or low-functioning autism lack the ability to develop functional speech and communicative skills (Liedel, 2008;Roche et al., 2014). A number of approaches have been developed in KSA to enhance the teaching of AAC and develop the communicative ability of children with ASD (Boesch et al., 2013; Anneke, Angelika, & Moore, 2012; Van Der Meer et al., 2013;Harding et al., 2011). According to the American Speech-Language and Hearing Association (ASHA) (2005), AAC is “a research area in educational and clinical practice that strives to explore and correct temporary or permanent impairments, limitations, as well as communicative and social restrictions of individual with severe speech-language disorders” (p.1).

Some of the strategies associated with AAC include PECS (Dogoe, 2008; Bondy & Frost, 2002). PECS, an aided AAC developed by Bondy and Frost in 1994 is used to enhance the communicative ability of

individuals having autism (Liddle, 2011). PECS is mainly founded on applied behavioral principles, which calls for the use of differential reinforcement, shaping, and transferring of stimulus control to aid the development of the functional communicative skills of children with autism (Flippin, Reszka, & Watson, 2010; Hart & Banda, 2010). Unlike a number of traditional speech development programs that require an autistic individual to possess certain skills such as eye contact, the administration of PECS does not require an individual to possess such skills. It mainly strives to address the key deficiencies, including social deficiencies, in an individual with ASD. In so doing, it focuses on improving an individual's requesting skills and tangible reinforcement (Bondy & Frost, 2001; Ganz & Simpson, 2004). Unlike other traditional AAC strategies, Costantino & Bonati (2014) observe that PECS requires the communication partner of an individual with ASD to demonstrate fewer complex motor movements and does not require the individual with ASD to be acquainted with an extra language such as sign language (Bondy & Frost, 2002).

A number of previous research studies have demonstrated the effectiveness of PECS in developing the language ability of children with ASD. For instance, in their study, Al-dawaideh & Al-Amayreh (2013) found that Arabic-speaking children with autism who were introduced to PECS registered significant development in their requesting skills and speech. All the participants in the study were able to maintain the acquired PECS skills several weeks after receiving the training (Al-dawaideh & Al-Amayreh, 2013). However, Anneke et al. (2012) found that parent-implemented PECS training was characterized by significant levels of errors (i.e. incorrect vocal prompts and a lack of timely reinforcement) and in most

cases, failed to enhance the development of the communicative ability of children with ASD. When using PECS with their children affected by autism at home, most parents often engage in vocal prompting and incorrect utilization of the 4-step error correction strategy, a phenomenon that occasions prompt dependence among such children (Anneke et al., 2012).

A number of previous studies have also found that learning PECS enhances the spoken language development of children with ASD. For instance, Bondy & Frost (1994) found that most children who were introduced to PECS were able to make requests using ten pictures they had been given within an average of three months. Most children who had joined the PECS program without functional speech were also able to communicate by exchanging pictures. In their study, Kravits et al. (2012) found that PECS led to spontaneous speech production and communication among autistic children. Charlop-Christy et al. (2012), on the other hand, found that PECS led to the improvement of verbal speech skills and social communicative behaviour among children with ASD. In addition, Ganz & Simpson (2004) found that PECS led to an improved number of word utterances among children with ASD. These words utterances were used by the children to make a range of requests for their daily needs. In another study by Marckel et al. (2006), it was found that PECS led to significant improvement in the requesting skills and communicative ability of children with autism. While investigating the effect of using PECS in enhancing interactive communication between students with ASD and their teachers, Carr and Felce (2007) found that the total number of words of these children increased significantly after being exposed to the PECS program. A study by Dogoe (2008) also found that children who underwent training

in PECS developed an ability to maintain and generalize the use of PECS in different settings and with different communication partners.

Assistive Technology (AT)

Assistive Technology (AT) such as computers, smart-phones and iPads continue to be used by speech-language pathologists (SLPs) to diagnose and treat communication disorders in individuals with ASD (Al-Khateeb, 2005; Al-Dawaideh, 2013). AT is defined by the Individuals with Disabilities Education Act (IDEA) (1997) as “... any items, equipment, or systems, which are used for the purpose of increasing, maintaining, or improving the functional abilities of disabled individuals” (section 2 of the IDEA). AT has been used in different jurisdictions such as the U.S., Australia, the U.K, and even the KSA to teach individuals with varying disabilities, develop the communicative skills of individuals with communication disorders (Van der Meer et al., 2012), and in some cases, design individualized education programs (IEPs) (Robyn & Posselt, 2012). A number of previous empirical studies have demonstrated the significant potential of AT in enhancing the learning, quality of life, academic achievement, communicative skills, self-esteem, as well as the independence of individuals with ASD (Reed, 2007; Leigha, 2014; Andreja & Spela, 2014; Robyn & Posselt, 2012).

AT is now regarded in most parts of the world as an integral tool for developing the communicative ability of individuals with ASD. This is based on its efficiency in motivating students, facilitating the increased academic achievement of such students (Leigha, 2014), making their school and home-related tasks easier to perform, and improving their social communication

behaviours (Robyn & Posselt, 2012). According to Green (2011), AT facilitates a range of learning styles for individuals with ASD and accords them a greater degree of independence and timely feedback. A range of devices and IT tools have been adopted to treat communication disorders, including speech generating devices (SGDs), telephones, videophones, communication software, as well as telephones (Green, 2011).

In their study, Boesch et al. (2013) found that SGDs like PECS enhanced the development of initial requesting skills of children with ASD. However, the authors pointed out that such initial requesting skills were only achievable when appropriate instructional strategies are adopted and adhered to (Boesch et al., 2013). Van Der Meer et al. (2013), while comparing “the acquisition of requesting skills and social communicative behaviour across three AAC” (i.e. PECS, manual signing (MS) and SGDs), found that all the participants using the three AAC devices registered significant improvement in their requesting ability as well as their social communication behaviour. The participants also showed varying preferences for the AAC devices. However, while assessing barriers and facilitators to the use of high technology AAC devices, Baxter et al. (2012) identified a lack of awareness of the barriers and facilitators to the successful use of AAC devices among practitioners and inadequate or a lack of continuous technical support and staff training as some of the factors that affect the successful usage of AAC in enhancing the communicative ability of individuals with ASD.

In another recent study, Anderson et al. (2014) found that the successful implementation of SGDs was jeopardized by barriers to service access such as service exclusion policies, an inadequate or a lack of expertise in SGD

practice among SLPs, as well as long waiting lists. The study concluded that timely and effectively coordinated and family-centered support was essential in enhancing the successful usage of SGDs in developing the communicative skills of children with ASD. In a study to investigate the perception of SLPs regarding the level of competence needed for the effective use of AT, Al-Dawaideh1 (2013) found that most SLPs considered training, experience, level of education, and place of work as key determinants of the effective usage of AT. The study further found that in most cases, AT failed to deliver the required outcomes because most SLPs had a “low” ability to utilize AT (AlDawaideh1, 2013). However, the study found no correlation between gender and ability to use AT. The use of computer-based interventions, such as DVDs, was also found by Robyn & Posselt (2012) to improve the ability of individuals with ASD to recognize emotions. However, the researchers noted that the ability of such interventions to enhance such improvements was largely dependent on the content of the interventions.

Existing Gaps in Practice

In light of the aforementioned, there is clear evidence of the ability and effectiveness of PECS and AT to enhance the development of the communicative skills and social communicative behaviour of children with ASD in inclusive public schools in Saudi Arabia. However, these strategies often fail to deliver the intended outcomes due to social, environmental, technical, legislative, and economic barriers, including but not limited to, incorrect vocal prompts, inappropriate contents of computer-based interventions, the adoption of and adherence to inappropriate instructional strategies, a lack of awareness of the barriers and facilitators to the successful use of AAC devices among SLPs, inadequate or a lack of

continuous technical support and staff training, barriers to service access, as well as low levels of competence required for effective usage of AT.

Research Questions

The current study seeks to answer the following questions:

- i) What are the elements attributed to the successful use of PECS and AT in the Australian educational environment?
- ii) How can the elements of success from the Australian educational environment be adopted in inclusive public schools in KSA for the purpose of enhancing the development of the language ability of children with ASD?

Section Three: Methods

Introduction

This study seeks to explore the elements of success in the use of PECS and AT attributed to the Australian educational environment and to determine how these elements of success of the Australian educational environment can be adopted by inclusive public schools in the KSA for the purpose of developing the language ability of children with ASD. This chapter explains the research design and methodology that was adopted to collect the data which was needed to answer the research question.

Research Design

Given its review nature, this study adopts a systematic review approach to research in accordance with the Cochrane Collaboration Handbook on Systematic Reviews of Health Promotion and Public Health Interventions (Jackson, 2011).

Study Participants

The study participants included (a) the teachers, and (b) the children suffering from autism at the Saudi inclusive public schools. The experiences of teachers with implementation of AT and PECS as well as the effectiveness of these technologies by assessing the improvements in language abilities of children were scrutinized. Informed consent will be obtained from participating teachers and the guardians of special children after briefing the aims and advantages of the research project to them. All study procedures were in accordance with the ethical standards of the respective institutional and/or national research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Materials

Instruments

The AT and PECS considered in this study included speech generating devices such as iPads, smart-phones, as well as other computer-based interventions. Although it is quite tough to decide which instrument will be suitable for the training of all students with autism but teachers can assess the students' capabilities and can consider the best one effective for each student.

Electronic Databases

In order to discover the elements attributed to the successful use of PECS and AT in the Australian educational environment and to adopt them in inclusive public schools in KSA for the purpose of enhancing the development of the language ability of children with ASD, eight main

electronic databases were used which include (Koler Povh, Južnic, Turk & Turk, 2011) namely: (i) Web of Science (WOS); (ii) Google Scholar; (iii) Scopus; (iv) Embase; (v) Medline; (vi) ERIC; (vii) PSycinfo and (viii) Cochrane Library.

The search terms used related to conditions (e.g. learning disability and children with ASD), impairment (e.g. language disability and communication disorder), commonly utilized devices (e.g. PECS and AT), and outcome terms (e.g. successful, effective, improved communicative skills, and social communicative behavioural change). In addition to the searched electronic databases, the reference lists of the included studies were scrutinized for additional literature to supplement the databases. Table 3.1 summarizes the searched databases and the dates they were searched

Table 3.1: Electronic Databases Searched

No.	Database Name	Date Searched
1.	Web of Science	10 May 2015- 30 May 2015
2.	Google Scholar	12 May 2015- 30 May 2015
3.	Scopus	11 May 2015- 30 May 2015
4.	Embase	13 May 2015- 30 May 2015
5.	Medline	10 May 2015- 30 May 2015
6.	Cochrane Library	12 May 2015- 30 May 2015

Journals and Surveys

The review was limited to studies conducted in the Australian educational environment, involving school-aged children with ASD (either directly or indirectly through their parents, teachers, SLPs, or other caregivers), and focusing on the use of PECS and AT to enhance the development of language ability of children with ASD (excluding those conducted outside the Australian educational environment or those not involving children with ASD). In addition, only published studies in peer reviewed journals between 2010 and

2015, and which were reported in the English language were included for review. The selected journals included the European Journal of Special Needs Education; Research in Autism Spectrum Disorder; Dev Neurorehabil; Action Research; Intervention in School and Clinic; Australasian Journal of Special Education; and J Med Syst. However, no restrictions were put on the design or quality of the retrieved studies since the review was intended to be a state-of-the-art review (Grant & Booth, 2009).

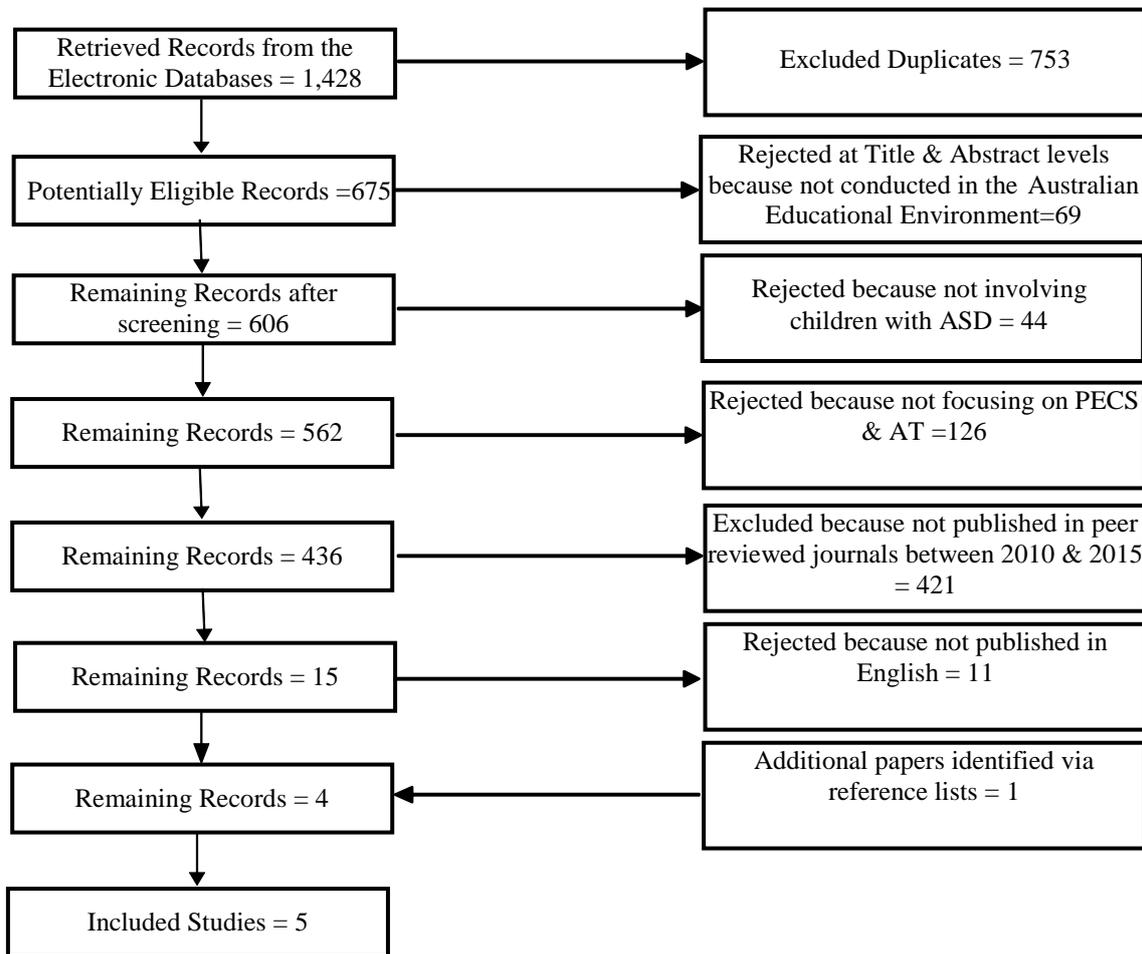


Figure 3.1: Summary of Included and Excluded Records.

All citations retrieved from the six electronic databases were downloaded to the Reference Manager database before being screened for relevance. The screening of the retrieved studies was done at the title and

abstract levels to determine the studies that met the inclusion criteria (i.e. the population and intervention requirements). Those that met the population and intervention criteria had their full texts appraised and data thereof extracted. The retrieved studies were selected using a Study Eligibility Form (see appendix). The process of including and excluding the retrieved studies is summarized in Figure 3.1 above.

Data Organization and Analysis

The data of interest in this study were those that related to the use of PECS and AT in the development of the language ability of children with ASD within the Australian educational environment. Data from the five included studies were extracted using an extraction table (see Table 2 in the results section). The extraction table comprised the study ID, the study location, study design, participants, study intervention(s), identified themes, and elements/successes/strengths identified by authors. Principles of thematic synthesis were used to analyze the extracted data (Thomas & Harden, 2008) to establish recurring elements of success across the included studies.

The thematic synthesis approach to data analysis was deemed appropriate for this study because it not only allows the inclusion of data from qualitative studies but also the inclusion of data generated using other designs such as intervention studies, case studies, and surveys, which provide a description of factors involved in the process of implementing a given intervention (Mason, 2002).

The thematic synthesis approach also allows the researcher(s) to compare and contrast data from the included studies in a similar manner to primary qualitative data analysis (Baxter et al., 2010; Ward, 2014; DePape

and Lindsay, 2016; Leedham et al., 2020). In this regard, the researcher is able to determine recurring findings across the included studies and/or use the extracted data to create meta-themes which may have been missing in the primary studies.

Validity and Reliability

Literature was reviewed constantly to measure and support the validity and reliability of the content. The scale of children language skills was used to assess the language capabilities of the students with autism before and after the implementation of assistive technology and picture exchange communication system. Moreover, a panel of referees specialized in special education, speech and psychology was employed to judge and validate the result outcomes of applied technologies. The K-fold test-retest was used to measure the reliability of utilized materials.

Section Four: Results

Introduction

The search of the six electronic databases yielded four papers that reported the use of PECS and AT for developing the language ability of children with ASD within the Australian educational environment. An additional paper was identified via reference lists as indicated in Figure 3.1. The publications were both of descriptive and analytical designs, and were either qualitative or quantitative in nature. This chapter thus presents the results of the study as derived from the included studies, and within the PICO (participants, intervention, comparison, and outcome) framework. The presentation of results using the PICO framework was deemed

necessary for the current study for the purpose of preventing repletion of findings from across the included studies and developing meta-themes.

The Study Findings

The results indicate that 80% of the included studies were conducted in 2011 and 2014 (two studies each), with 20% of the included studies being undertaken in 2012. No included study was carried out in 2010, 2013, or 2015. A summary of the included studies is provided in Table 4.1 below

Table 4.1: A Summary of Results and Characteristics of included Studies

No.	Study ID/Authors	Study Location	Study Design	Study Participants	Study Intervention(s)	Identified Themes	Elements/ Successes/ Strengths Identified by Authors
1.	Anderson, Balandin, & Stancliffe (2014)	Australia	Descriptive Analysis (i.e. Narrative analysis)	Parents of six children with ASD using SGDs in inclusive public schools.	Exploring parents' experiences of SGDs & existing support for families using SGDs.	Improved Service access; Development of service inclusion policies; Staff training; & Improved therapist expertise in SGD practice.	Timely, well-coordinated, and family-centered support is vital for enhancing service experience for families using SGDs as well as the successful use of such devices.
2.	Cumming, Strnadova, & Singh (2014)	Sydney, Australia	Action Research (i.e. the Inductive Content Analysis approach).	Classroom teachers, students with ASD, & ICT integration coordinator.	Investigating barriers & enablers of iPad technology in developing the communicative ability of students with ASD in	Improved access of students with ASD to ICT; High levels of professional expertise, Classroom experience; & Age of classroom teacher.	Improved access of students with ASD to a range of ICT devices/platforms (e.g. computer labs, laptops, iPads) enhances their ability to use such devices/platforms effectively & successfully. High levels of
					inclusive schools.		professional expertise is an essential determinant of effective use of iPads among children with ASD.
3.	Gianluca et al. (2011)	Australia	Case Study.	Three children with ASD and their classroom teachers.	Using Smart-Phones to compare the effectiveness of PECS & Pix Talk in developing the communicative ability of children with ASD.	Adoption of a usercentered design of AAC (e.g. PECS & Pix Talk) that gives attention to the needs, preferences, and limitations of the end users (e.g. children with ASD)	Computer-based interventions are more appropriate for developing the communicative ability of children with ASD compared to non-computerbased interventions. An effective AAC for developing the communicative ability of children with ASD should incorporate interventions that address the social,

No.	Study ID/Authors	Study Location	Study Design	Study Participants	Study Intervention(s)	Identified Themes	Elements/ Successes/ Strengths Identified by Authors
							behavioral, and communicative deficits associated with ASD. Teachers' experience in AAC strategies
							(e.g. PECS and Pix Talk) is critical for the effective and successful implementation of such strategies.
4.	Harding et al. (2011)	Australia	Qualitative Study Design (i.e. using the Pre-Verbal Communication Schedule [PVCS] and observation).	Children with ASD	Determining the processes involved in the planning & implementation of AAC systems to developing the communicative ability of children ASD.	Need for understanding the level of cognition of a child with ASD (in relation to his/her receptive ability) when planning & implementing an AAC intervention; Need to adopt a collaborative approach in planning and implementing AAC interventions.	Effective and successful planning and implementation of AAC interventions is dependent on inter alia, language and communication assessment along with awareness of the functional communication in everyday contexts of a child with ASD, together with an appraisal of what such a child is able to do already.
5.	Soto-Chodiman	Western	Qualitative	Twelve (1 male	Developing an understanding of how	The need for teachers in inclusive classrooms to	Teachers in mainstream public schools who recognize and
	et al. (2012)	Australia	Study Design (using interpretivist framework and semistructured interviews).	& 11 females) public sector primary school teachers.	teachers in mainstream classroom settings can adapt to challenges associated with children with ASD and how to effectively use AAC strategies to enhance the communicative ability of such children.	recognize and accept the challenges associated with children with ASD; Need for such teachers to possess the requisite expertise for planning and implementing AAC strategies.	accept the challenges associated with children with ASD & possess the requisite expertise for planning and implementing AAC strategies are likely to be successful in planning & implementing such strategies.

The study participants in the included studies comprised children with ASD, classroom teachers of such children, parents of children with ASD using SGDs in inclusive public schools, an ICT integration coordinator, and public sector primary school teachers from different schools in Australia.

In terms of interventions, the included studies either sought to explore parents' experiences of SGDs & existing support for families using SGDs; investigate barriers and enablers of iPad technology in developing

the communicative ability of students with ASD in inclusive schools; compare the effectiveness of PECS & Pix Talk in developing the communicative ability of children with ASD; determine the processes involved in the planning & implementation of AAC systems to develop the communicative ability of children ASD; or develop an understanding of how teachers in mainstream classroom settings can adapt to the challenges associated with children with ASD and how to effectively use AAC strategies to enhance the communicative ability of such children. A number of themes and elements of success identified in the included studies are outlined in the subsequent sections.

Study Quality

While all the included studies lacked information regarding the piloting of survey instruments, the use of the Critical Appraisal Skills Programme (2006) checklist as a guide demonstrated that all the included studies were characterized by clear aims (despite limited reporting by 40% of the included studies on the selection and recruitment criteria of study participants). The type of AAC intervention used was clearly specified in all the included studies.

Key Themes

An analysis of the key themes in the included studies indicated a range of elements that have contributed to the successful use of PECS and AT in the Australian educational environment, as outlined below.

Improved Service Access

All the five included studies expressly or impliedly identified improved service access as one of the critical elements that have contributed to the successful implementation of AAC (i.e. PECS and AT)

within the Australian educational environment. For example, a study by Anderson, Balandin, & Stancliffe (2014) found that improved access to SGDs and one-on-one, home-based, and continued interventions played a significant role in the continued use of SGDs among most Australian families. Improved service access was also cited as an important element for success in Cumming, Strnadova', & Singh (2014). Anderson, Balandin, & Stancliffe (2014) concluded that timely, well-coordinated, and family-centered support is vital for enhancing the service experience for families using SGDs as well as the successful use of such devices.

Development of Service Inclusion Policies

Anderson, Balandin, & Stancliffe (2014); Gianluca et al. (2011); Cumming, Strnadova', & Singh (2014); and Soto-Chodiman et al. (2012) found that most of the successes registered by most Australian inclusive schools and families using PECS and/or AT to develop the communicative ability of children with ASD were largely attributed to progressive inclusion policies associated with the Australian educational system.

Staff training and Improved SLP Expertise in PECS and AT Practice

Staff training and the improved expertise of SLPs in PECS and AT was identified by Anderson, Balandin, & Stancliffe (2014); Cumming, Strnadova', & Singh (2014); Soto Chodiman et al. (2012). Cumming, Strnadova', & Singh (2014); and Soto-Chodiman et al. (2012) found that high levels of professional expertise is an essential determinant of the effective use of iPads among children with ASD.

Improved Access to ICT

Cumming, Strnadova', & Singh (2014) found that improving the access of children with ASD to a range of ICT devices/platforms (e.g. computer labs, laptops, iPads) was key in enhancing their ability to use such devices/platforms effectively & successfully.

Adoption of User-Centered Design of AAC

A user-centered approach to designing and implementing PECS and AT was identified by 60% of the included studies as an important aspect of the Australian educational system that has contributed to the effective use of PECS and AT in developing the communicative ability of children with ASD. For instance, Gianluca et al. (2011) found that adopting a user-centered design of AAC (e.g. PECS & Pix Talk) that gives attention to the needs, preferences, and limitations of children with ASD played a critical role in enhancing the successful usage of such AAC interventions.

Adoption of a Collaborative Approach to Implementing AAC Interventions

According to Harding et al. (2011), the use of PECS and AT has been effective and successful in the Australian educational environment because most teachers and practitioners in Australia adopt collaborative approaches in planning and implementing the interventions.

Need to Understand ASD-Related Challenges

According to Gianluca et al. (2011), an effective AAC for developing the communicative ability of children with ASD should incorporate interventions that address the social, behavioral, and communicative deficits

associated with ASD. Harding et al. (2011) found that most interventions involving PECS and AT in the Australian educational environment were successful because their approach to planning and implementation such interventions was rooted in the understanding of the level of cognition of children with ASD (in relation to their receptive ability). Soto-Chodiman et al. (2012) reported that most teachers who were successful in implementing PECS and AT to develop the communicative ability of children with ASD in inclusive Australian schools recognized and accepted the challenges associated with children with ASD.

Adoption of Australian model and Application in Saudi Schools

The use of AT and PECS was made successful by participation from all the people. A) The users i.e. the students with autism were the main participants who were benefited. B) The teachers acting as trainers were responsible to learn this technology and deliver it to their students. C) The referees were playing a supportive role during the process of implementation. D) Parents also played key role in motivating their children to utilize their full capabilities to understand the communication system. E) Specialists of this technology were the Australian representatives who worked to teach and train Saudi inclusive school teachers. Each participant contributed his part in the process of development, selection, learning and finally integrating this technology into User's routine life.

Section Five: Discussion

This study identifies improved service access, development of service inclusion policies, staff training and improved SLP expertise in PECS and AT practice, improved access to ICT, adoption of user-centered

design of AAC, adoption of a collaborative approach to implementing AAC interventions, and the need to understand ASD-related challenges as the key elements that have contributed to the effective and successful use of PECS and AT in developing the language ability of children with ASD within the Australian educational environment. The findings of this study have a lot in common with the findings of a number of previous studies. For instance, Johnson et al. (2006) reported that 86% of the SLPs participating in their study perceived improved service access as a critical element in the successful implementation of AAC interventions. Similarly, Ruggero et al. (2012) found that most Australian parents perceived improved service delivery as a major contributor to the successful implementation of AAC by SLPs.

With regard to policies, Carter, Cummings, & Cooper (2007) found that inclusive policies that allow families and schools using AAC to access multiple agencies simultaneously contributed significantly to the successful use of AAC interventions. A number of previous studies have also reported that having experienced SLPs and teachers in AAC interventions was an important element in ensuring effective and successful planning and implementation of AAC interventions. For instance, Iacono and Cameron (2009) found that experienced staff and SLPs in AAC such as PECS and SGDs provided critical sources of inspiration to parents and children with ASD in Australia, the U.S., and the UK. The current study establishes that in addition to improved service access and inclusive policies, the effective and successful use of PECS and AT in the Australian educational environment has also been attributed to the improved access of teachers, parents, and children with ASD to a range of ICT devices and platforms.

This finding is consistent with the findings of previous studies by Campigotto et al. (2013) and Logan (2012) which found that exposing students with ASD to ICT improved their interactivity with their communication partners as well as enhancing the development of their social and communicative skills. The finding regarding the need to adopt a user-centered design in the planning and implementation of PECS and AT is also consistent with the findings of studies by Ospina et al. (2008) and Toyama (2008), which established that a user-centered design led to the effective behavioral and developmental treatment of ASD because it focused on AAC interventions that addressed the behavioral, communicative, and social needs of the child with ASD. Such a design accords extensive attention to each stage of planning and implementing an ACC intervention (Toyama, 2008). Similarly, Beukelman and Mirenda (2005) pointed out that given the complex nature of ASD, its effective treatment using AAC interventions required a collaborative approach to the planning and implementation of such interventions. Finally, Konza (2008) found that for classroom teachers to effectively and successfully deal with students with ASD, they needed to approach the challenges presented by ASD from a social justice perspective. Forlin (2006) attributed the successful implementation of AAC interventions such as PECS and AT in Australia to the concepts of Building Inclusive Schools (BIS) and Building Inclusive Classrooms (BIC) programs by education policies developed by most Australian States.

Section Six: Conclusion and Recommendations

This study sought to develop the language ability of children with ASD using AT and PECS through adapting elements of success attributed

to the Australian educational environment on inclusive public schools in the Kingdom of Saudi Arabia (KSA). Considering the effectiveness of AT and PECS, their use in most inclusive public schools tend not to produce the satisfactory outcomes because of inter alia, lack of a conducive policy environment, less trained and experienced teachers and SLPs in PECS and AT, poorly designed and implemented PECS and AT, negative perceptions of most teachers towards the inclusion of children with ASD in mainstream classrooms, and barriers to service access. Nonetheless, the findings of the study indicate that the design and implementation of these interventions (i.e. PECS and AT) have been successful in the Australian educational environment because most of the identified gaps in the KSA's educational environment have effectively been addressed in the Australian context. Based on the lessons learned from the Australian educational environment, this study recommends the adoption of the following elements to enhance the effective and successful design and implementation of PECS and AT in developing the language ability of children with ASD in inclusive public schools in KSA:

Firstly, there is need to ensure the access of parents and teachers of children with ASD to services relating to PECS and AT. The service experience for families using PECS and AT should be enhanced by ensuring timely, well-coordinated, and family-centered support. In addition to improved service access, key stakeholders in the KSA's special education sector should advocate for the development of service inclusion policies. Staff and SLPs should also be subjected to regular training to enhance their expertise and classroom experience as well as experiences in PECS and AT practice.

Secondly, children with ASD should be exposed to a range of ICT devices (e.g. iPads, laptops, computer labs, etc.) and platforms to enhance their engagement and the development of their social, communicative, and behavioral skills. Thirdly, teachers and SLPs designing and implementing PECS and AT interventions for treating ASD should adopt a user-centered design approach by giving attention to the needs, preferences, and limitations of children with ASD. Such interventions should seek to address the social, behavioral, and communicative deficits associated with ASD. Fourthly, teachers and SLPs should strive to understand the level of cognition of a child with ASD (in relation to his/her receptive ability) when planning & implementing an AAC intervention. Similarly, the design and implementation of AAC interventions need to adopt a collaborative approach. Lastly, there is need for classroom teachers in inclusive settings to recognize and accept the challenges associated with children with ASD. In addition, such teachers should also be equipped with the requisite expertise for handling children with ASD.

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