

PECS vs. iPad Intervention for Students with Autism Spectrum Disorders: A Literature Review

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Abstract Autism Spectrum Disorders (ASD) refers to a neurodevelopmental disorder that affects communication, behaviour and socialization of the individuals diagnosed with ASD. In children, ASD is considered as a high incidence disability since it affects one in eight children. In regard to functional communication skills of the children, effective augmentative or alternative communication process and device is highly important to facilitate positive outcomes. Both Picture Exchange Communication System (PECS) and the iPad with its communication applications are considered emerging treatment children with autism spectrum disorders (ASD). The purpose of this literature review is to compare the effectiveness of low tech intervention (through the utilization of PECS) and high tech intervention (through the utilisation of iPad). The study was conducted by selecting electronic articles from several databases which were published between 2008-2018. The findings show that PECS is highly effective for increasing intentional communication skills and independence in requesting and making decisions as well as beneficial for non-English speakers. Meanwhile, iPad-based intervention is beneficial to solve children's literacy problems, to reduce stressors during interventions, and to increase the children's effective intra-verbal responses. It is then suggested that teachers, parents and care givers employ the combination of both low tech and high tech interventions as combining the two will lead to better outcomes.

Keywords: Autism Spectrum Disorders, PECS, iPad, communication intervention

1. Research background

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which affects socialisation, behaviour and communication (American Psychiatric Association, 2013). The incidence of autism in children, as reported by the Centers for Disease Control (2012) is quite high, specifically one in eight children. It is deemed an urgent public concern, especially in public health, since it can impact all individual regardless of races and social groups. Many children with autism have a lack of functional communication skills and gestures or even do not speak (Ganz et al., 2009). Hence, effective augmentative or alternative communication process and the device is highly essential in facilitating positive outcomes.

Spoken language, for many children with autism, is difficult to process leading to the children lack comprehension and demonstrating frustration (Buotot & Myles, 2011). Many prominent individuals with as high functioning autism, one of which is Dr Temple Grandin, described their thinking process as visually-based which means that they mostly rely on conveying information visually (Grandin, 2011). Such visual aids and supports could be in the form of line drawing, photographs or even real objects. In an educational context, the visual supports are used to help teachers set behavioural expectations, to provide environmental structure, to provide carefully developed task instructions as well as to request certain items (Forst & Bondy, 2009).

The Picture Exchange Communication System (PECS) has been widely used to teach functional communication skills in children with ASD, developed by Frost and Bondy (2009). The PECS utilises the principles of Applied Behaviour Analysis (ABA) and is a

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picture-based, low-tech augmentative and alternative communication strategy. The training occurs in six phases, through a one-to-one instructional approach, utilising powerful reinforcers in a discrete trial format. In Phase I, children are taught how to communicate and move through five other phases, followed by increasing distance from the communicative partner (Phase II), picture discrimination (Phase III), sentence structure (Phase IV), responding to "What do you want?" (Phase V), and commenting (Phase VI).

Meanwhile, iPad applications are designed to facilitate effective communication in children with ASD, one of which is Proloquo2Go providing augmentative and alternative communication (AAC) for individuals having difficulty speaking. Proloquo2Go provides text-to-speech voices, over 7000 vocabularies and colour picture symbols (Apple, 2011). Some advantages of utilising iPad with its Proloquo2go are it could be applied for individuals of all ages, cheap (compared to other devices) and convenience.

The notion of how assistive technology could sustain the communication skills of children with autism spectrum disorders (ASD) has widely been discussed over the last decade because communication impairments is a core feature among them. Technology, naturally, forms two different poles of interventions by which the communication problems be addressed. The Picture Exchange Communication System (PECS), for example, is considered as a low-tech intervention while the iPad-based intervention is considered as a high-tech one (Hill and Flores, 2014). It has been argued that the limitation of iPad-based intervention is the error in rapid succession of the request because it is hard to redirect behaviour through one-tap (word) application (Hills & Flores, 2014, pp. 8-10). On the other hand, many have also challenged the efficacy of PECS when parents are engaging in the intervention due to the inevitable dependency of the children which resulted from the incorrect use of the system (Ganz et al., 2012, p. 351). However, both the PECS and the iPad have been shown as the two emerging

treatments for autistic children according to the National Autism Centre (2009).

According to National Autism Center (2009), the use of high tech intervention (iPad) and low tech intervention (one of which is PECS) are tow among twenty-two arising treatments for children with ASD. Therefore, the purpose of this study is to investigate these two emerging treatments (iPad and PECS) as applicable communication interventions. This paper compares the PECS and the iPad-based interventions by examining the effectiveness of both interventions to the children's speech abilities. The paper also includes the limitation of several pieces of research supporting both PECS and iPad-based interventions. Also, it provides several studies comparing the efficacy of both interventions. Finally, the paper proposes an option of combining the PECS and the iPad systems during the intervention.

2. Method

In conducting the literature review, 17 papers were selected through several electronic databases, including Scopus, Science Direct, Proquest, and Host. The keywords used were (Picture Exchange*OR PECS*low tech) AND (iPad*OR high tech) AND (speech intervention*OR school intervention OR communication intervention) AND (children with autism OR ASD children*OR autistic children). The inclusion criteria include: 1) English-language articles; 2) published between 2008 and 2018, the years during which the use of iPad in educational context reached its peak; 3) the contents of the articles are related to the research topic. Meanwhile, those who do not have complete article structures were eliminated.

3. Results

3.1 Several Studies Towards PECS

Increased Intentional Communication Skills

The Picture Exchange Communication System (PECS) is understood as an adequate intervention, albeit it is an expensive training since many aspects of children's communication skills could be addressed through the PECS. For example, verbal utterance and the length of the children of the

request performed are increasing by using the system during interventions. Travis and Geiger (2010) conducted a pilot study in South Africa, examining the efficacy of PECS in children's intentional communication. The result of this study indicates that there is a remarkable increase in children requesting skills while parents and teachers gave a positive response toward the system (Travis & Geiger, 2010, p. 39). However, the limitation of the study is the repeated measurement of the effectiveness which made the participants be trapped in a routine setting so that the finding becomes less reliable.

Independent in Requesting and Making Decision

Evidence point to the fact that, in general, the PECS-based intervention leads to children become more independent in requesting as well as making a decision. According to Conklin and Mayer (2011), behaviour problems harboured by people with ASD can be tackled by the time they become more independent, then, PECS is one of the best methods to which the positive outcome could be met, compared to the other. Conducting a study towards three adults with severe communication deficits, Conklin and Mayer (2011) conclude that independent initiation can be gaining through the PECS training. They further state that PECS also has a collateral effect on the behavioural domain of people with communication disorders (Conklin & Mayer, 2011, pp. 155-160).

Improved Communication Skills

In light of active social-communicative skills of children with autism spectrum disorders in educational settings, many proponents of the PECS argue that teachers can easily track the improvement of students' communication skills during the intervention. Indeed, moving from one phase to another (from Phase I - VI) paves the way for teachers to provide a systematic as well as a controlled environment for the students (Learna et al., 2012). Learna et al. (2012) gave a thirty-minute-session of intervention using PECS during six-month Conventional Language Therapy (CLT) through eight preschool autistic children, concluding that communication skills of the participants were improving during the

intervention which was indicated by significant improvements in their post-test scores compared to the pre-test. Apart from that, however, the data collected was quite unreliable since there had been lack of everyday interaction setting among the participants and adults involved which led to the lack of randomization of the treatment (Learna et al., 2012, pp. 613-616).

Examining the effectiveness of PECS in improving children with autism communication skills from teachers' perspective, Howlin and colleagues (2008) conducted a school-based training session towards elementary school teachers for five months. The study also involved 84 students with an average age of 6.8 whereby the students were divided into three groups, namely immediate treatment, delayed treatment and no treatment. The result of the study indicates moderate effectiveness of PECS teacher training. Also, there was an increase in the students' use of symbols in classrooms. This study also demonstrates that there is a high possibility to conduct a control trial of educational provision in a naturalistic setting with ample resources.

Beneficial for non-English Individuals

Visual aids such as PECS could highly support both expressive and receptive communication of children with ASD (Ganz et al., 2012). It is an important fact that PECS could provide a worldwide effect as it focuses on supporting functional means of communication (Sulzer-Azaroff et al., 2009). Analysing 34 peer-reviewed reports on PECS, Sulzer-Azaroff et al. (2009) conclude that PECS is a promising system which enables non-English speaking individuals to communicate functionally with a broader range of listeners. However, the limitation of the analysis lays on the reliability of the observation as the result of any publication should be observed simultaneously (Sulzer-Azaroff et al., 2009, pp. 90-99).

3.2 Several Studies Towards iPad-based Intervention

Solving Literacy Problems

Technology plays a pivotal role in the way that children with autism spectrum disorders are being given any interventions, one of the useful inventions is the iPad-based intervention. Not only does the iPad sustain the communication skills of children with ASD, but it has also been proved to solve literacy problems children face. Spooner, Ahlgrim-Dezell, Kemp-Inman and Wood (2014), for instance, conducted a study by implementing the iPad2 to examine elementary school children's early literacy skills through shared story. The limitation of the study is that all of the participants were categorised into autism so that the result could not be generalised to all of those with developmental disabilities. However, overall, there is a linear correlation between the use of iPad2 and students' positive responses towards social stories (Spooner et al., 2014, pp. 30-46).

Reducing Stress

Providing a broad range of applications, the iPad-based intervention has become more popular recently. Children tend to respond enthusiastically to the intervention since it could reduce their stress. At the average of five-day-period, approximately children with ASD use iPad for five to six hours in total (Clark, Austin & Crake, 2015, p.174). Unfortunately, Clark et (2015) found that professionals rarely use iPad during interventions despite their positive attitudes toward some applications on the iPad. There are several factors to be importantly noted such as the efficacy of a certain application for children with ASD so that the children will not be overwhelmed by the applications (Clark et al., 2015, pp. 174-181).

Effective Intraverbal Responses

High technology devices have been increasing rapidly over the last decades and it leads to the greater interest of people to use the high-tech device such as iPad as a means of intervention, specifically, for those who are diagnosed with autism. Regardless of the popularity, not ample researches have been conducted towards the acquisition of demand repertoire (Lorah, Karnes, & Speight, 2015, p. 555). Considering that, Lorah et al. (2015) evaluated the intra-verbal responding of two

school-age autistic children, using application as a speech-generating device (SGD). As a result of the study, the participants did enhance effective intraverbal responses since 95% of the participant responses were accurate. Next, Lorah et al. (2015) concluded that the much more positive reinforcement given during intervention, the better the result could be (Lorah et al., 2015, pp. 560-566).

Considering the efficacy of any intervention cannot be separated to whether the intervention is time-consuming or not. Concerning this consideration, the iPad-based intervention has been proved to be the most efficient one since the system requires only a one-step request which enables children to do more task (Lee et al., 2015). Further, Lee et al. (2015) concluded that iPad-assisted intervention has the same level of effectiveness as the intervention conducted by therapists (Lee et al., 2015, pp. 97-102). However, it is important to note that over-excitement through technology could hinder the original aim of the system. McNaughton and Light (2013), for example, argue that the isolated focus on the technology hinders the actual goal of AAC. People using iPad are over excited through the mainstream technologies in the iPad at the expense of the essential function of the AAC itself (McNaughton & Light, 2013, pp. 107-116).

3.1 Comparing PECS and iPad

Looking at the effectiveness of the training session of PECS and iPad-based interventions, Lorah et al. (2013) evaluate the level of independent respond of five autistic preschool boys (average age of 4.5). The result indicates that the iPad-based intervention generated the greater degree of independence compared to that of the PECS, shown by 85% and 64% of independent responding for the iPad and PECS based respectively. However, the limitation of this study is the training was focused on assisting children to choose or exchange a particular picture at a time at the expense of focusing on selecting the correct image. This limitation leads to the study harbours lack of discrimination training, whereas, the discrimination training is an essential part of any AAC training, enabling a

speaker to request a wide variety of items (Lorah et al., 2013, pp. 637-649).

Another study on evaluating the efficacy of the training was conducted by van der Meer, Didden, O'Reilly, Lancioni, and Sigafoos (2012). They selected four children with DD from different child care centres, teaching them to choose their preferred items independently in terms of using iPad, PECS and manual signs (MS). The result of this study suggests that students with DD could hone their functional communication skills through the three systems used, however, the technological-based intervention is the most preferred one among the participants surpassing the other which was indicated by three out of four participants chose iPad rather than PECS and manual signs during the intervention. The limitation of the study is that PECS requires two-steps request while the two other need only one step so that the measurement of the study is not equivalent. However, van der Meer et al. (2012) propose a good suggestion by stating that assessing children's preference of AAC as a means of enhancing communication skills can enable teachers and parents to provide suitable AAC-based intervention in the future (van der Meer et al., 2012, pp. 451-464). In addition to that, as noted by Beck et al. (2008), once a child masters the iPad task, he or she will quickly achieve the mastery criteria of independent requesting in the third phase of PECS (Beck et al., 2008, p. 198).

Regarding the preference of AAC (usually iPad, PECS and Manual Signs), a finding by Achmadi et al. (2014) shows that at the early stage of development, children with DD unclearly perform their preferences. Through a study in which 18 month-post intervention was conducted towards four boys with developmental delays, Achmadi et al. (2014) conclude that the unclear preference results from the fact that children with developmental disabilities, including autism, tend to have different preference over time. Gevarter et al. (2014) even claim that the acquisition might be influenced by the configuration of individual application designs, especially when it comes to the iPad-based intervention (Gevarter, 2014, p. 2471).

Furthermore, Achmadi et al. (2014) suggest that the assessment of AAC preference should be conducted at the early stage of intervention so that parents along with clinicians could provide a suitable system for children in the future (Achmadi et al., 2014, pp. 577-580).

Several body of researches have been conducted to evaluate the effectiveness of both iPad and PECS based interventions for children with autism spectrum disorders. Conversely, the implementation of the two interventions toward preschool children has yet to be enough. Therefore, Agius and Vance (2016) evaluate whether the two systems could still be effective when they are implemented to the preschool children. Agius and Vance (2016) selected the sample of three preschool children in Malta, all of them are categorised into autism and are performing limited functional speech. The result of this study leads to a conclusion that both of the AAC options were equally effective to ameliorate children requesting, consistent with the previous finding by Flores et al. (2012). Concerning efficiency, however, PECS is outperforming the iPad since the latter requires more sessions (Agius & Vance, 2016, p. 65).

It has been shown that while several findings lead to the conclusion that low-tech intervention such as PECS is more efficient than the high tech, others have proposed the opposite result. Hill and Flores (2014), then, come up with a good solution after evaluating the effectiveness of the two interventions. They conclude that the iPad as well as PECS are effective means of intervention system. However, the latter is more efficient than the former when it comes to the early stage of intervention since teaching children to request using iPad is perhaps more complicated as children could hardly overcome the difficulty of learning through physical instruction without further assistance. Furthermore, Hill and Flores (2014) suggest that introducing PECS before the iPad-based intervention will generate a better result of intervention especially if children are being taught communication reciprocity skills (Hill & Flores, 2014, pp. 45-52). According to Beck et al. (2008), once motoric elements of the iPad task are being

mastered, children will quickly deal with the next step of intervention. Therefore, combining both systems might lead to a better result. Specifically, children should learn phase 1 to 3 of the PECS to master the motoric skills before using iPad (Beck et al., 2008, 198-210).

Van der Meer and colleagues (2014) specifically proposed a suggestion that the decision, in regard to which AAC system to be implemented, could be based upon an assessment of individual preferences. Results of van der Meer and colleagues' (2014) preference-enhanced communication intervention indicate that providing students an opportunity to choose their preferred AAC system will positively affect their progression in learning to communicate and maintaining their current acquired AAC skills.

Meanwhile, in the case of the use of iPad, or any other high-tech devices, in an Indonesian school context, many have to be considered. In spite of the majority view that the iPad intervention is having a major impact on speech development of children with ASD, there is a growing chorus of concern. Many agencies felt that the so-called "intervention highway" was too expensive for middle-income countries that are still "building ordinary roads", Indonesia is included (Wagner, 2016). There is little doubt that major investment will be made in ICT in the near future. That said, finding the room in the educational budget to purchase the iPad is not always easy. Providing pricey iPads to the students with ASD may even mean making cuts elsewhere, impacting other aspects of classroom instruction programs (Moretti, 2011).

Additionally, not every teacher has the technical knowledge to quickly pick up on the iPad-based interventions. Switching over from the PECS to the iPad means spending time and money on additional teacher training sessions. Teachers may also need extra training to figure out how to adapt iPad learning to different younger age groups or special need types (Wagner, 2014).

5. Conclusion

This study is a literature review study examining the effectiveness of PECS and iPad

based interventions in children with autism. Comparison of the effectiveness of low tech and high tech intervention to support children with autism spectrum disorders, through using PECS and iPad respectively, provides provides information about the benefits of implementing the two interventions in educational settings. Teachers, parents and care givers are then suggested to employ the combination of both low tech and high tech interventions as combining the two will lead to better outcomes. In fact, offering a choice between intervention formats may be beneficial. Future research, however, in which child-specific characteristics predictive of better performance with or without the use of an iPad needs to be further conducted.

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Reference	Study Design	Sample/ Participant	Goal	Setting	Result
Achmadi et al. (2014)	Longitudinal study	Four children diagnosed with autism and DD	To compare the effectiveness of learning through manual signing (MS), picture exchange (PECS) and a speech-generating device (SGD).	The initial sessions took place in the participants' homes while the follow-up sessions took place in the school environment.	The participants preferred speed-generating devices to the PECS and manual sign.
Agius& Vance (2016)	Adapted alternating treatment design embedded in a multiple baseline design	3 pre-school-aged children diagnosed with ASD.	To compare the relative efficacy of of PECS and iPad in three pre-school-aged children diagnosed with ASD in Malta.	In a pre-school setting	Both PECS and iPad could be appropriate foe teaching requesting skills to beginning communicators.
Beck et al. (2008)	Alternating treatment single subject design	Four pre-school children who were either non-speaking or limited in their ability to speak and did not use an AAC system to communicate functionally.	To compare the use of PECS and iPad in children who were either non-speaking or limited in their ability to speak.	In a pre-school setting six hours daily for four days a week during 4-weeks of the summer school session.	Participants learned PECS in relatively short time period, preferences for a mode of communication are unpredictable, and the influence of the communication system on each participant's verbalizations varied.
Clark et al. (2015)	Exploratory study	90 parents whose children were diagnosed with ASD	To examine parental and professional attitudes and behaviours toward ICT-based support	At the parents' homes and at the speech pathologists' clinics.	Parents reported high use of iPads by their children, and professionals reported some, albeit limited, utilization as part of their practice.
			materials generally and iPad application use specifically for use by children with ASD.		
Conklin & Mayer (2011)	Multiple baseline design	Three adolescences with ASD and severe communication deficits	To evaluate the effects of PECS on the independent initiations.	Secondary school settings	The participants increased their independence and choice making.

Ganz et al. (2012)	Case study design (single subject)	A five year-old girl diagnosed with autism	To examine the use of PECS in children who lack sufficient functional communication skills.	During speech therapy sessions.	The participant continued to increase her vocabulary of icons and sentence strips as well as her functional communication skills.
Gevarter (2014)	Multi-element design	3 pre-school-aged males with ASD.	To compare mand acquisition across three different displays in two iPad applications	The sessions associated occurred in the participants' homes in rooms that the mothers considered appropriate areas to work on requesting skills.	AAC display and design elements influenced mand acquisition.
Hill & Flores (2014)	Single-subject alternating treatment design	5 pre-school children enrolled in extended school year service in a university-sponsored program.	To investigate iPad and PECS treatments as viable communication interventions to move students through PECS.	A university-sponsored program	Teaching low tech PECS prior to introducing the iPad is an effective progression in teaching communication reciprocity skills in students with ASD/DD.
Lerna et al. (2012)	Alternating treatment design by using PECS and Conventional Language Therapy (CLT)	18 pre-school children diagnosed with ASD.	To test the effects of PECS on social-communicative skills in children with ASD.	'Eugenio Medea' Scientific Institute, Italy, an institute for diagnosis and rehabilitation of developmental disorders	PECS intervention (Phase I-IV) can improve social-communicative skills of children with autism.
Lorah et al. (2013)	Multiple baseline design	4 children, aged 5-12 years old, diagnosed with autism.	To investigate the acquisition of participants' abilities to answer basic personal questions.	In a university-based speech therapy center.	The results demonstrate the effectiveness of a time-delay with full physical prompting as an instructional strategy.

Lorah et al. (2015)	Case study design	One boy and one girl both diagnosed with autism and previously received behaviorally based-intervention	To investigate two school-aged children were taught using a 5-s time delay with full-physical prompts to respond to an intraverbal statement regarding personal information, using the iPad and application Proloque2Go as a SDG	In a therapy room of a university center-based program for children with ASD.	The participants acquired ability to respond to three different intraverbal statements.
Lee et al. (2015)	Alternating treatment design	2 children with autism	To compare intervention delivered by a therapist to intervention delivered using an iPad.	A university-based autism clinic	- The iPad was associated with shorter intervention sessions, more time on-task and less challenging behaviour. - iPad assisted intervention can be as effective as therapist-implemented intervention.
McNaughton & Light (2013)	Extrapolations based on demographic data	One million children with complex communication needs	To investigate how to improve the design of AAC technologies to meet the breadth of communication needs for children, to ensure the effective translation of evidence-based AAC.	In a pre-school setting	Effective collaboration of a wide range of stakeholders is needed for future development of AAC technologies / applications.
Spooner et al. (2014)	Alternating treatment design	Four elementary school students diagnosed with autism with limited verbal ability.	To examine the effects of systematic instruction, including constant time delay and a modified system of least prompts, to teach grade-appropriate literature in a	During speech therapy sessions in the selected elementary school.	Increased in the numbers of independent correct responses on the task analysis from baseline to intervention.

			shared story format.		
Travis & Geiger (2010)	A mixed research design, including a quantitative component (a single subject multiple-baseline design) and a qualitative component.	Two children with ASD.	To investigate the effects of introducing PECS on the frequency of requesting and commenting and the length of verbal utterances.	A South African ELSEN (Education for Learners with Special Needs) school.	Highly effective treatment for requesting and mixed results for commenting and length of verbal utterances.
van der Meer et al. (2012)	Alternating treatment design	Four children with severely limited speech from a childcare center for children with ASD	To compare the acquisition of augmented requesting responses using an iPad-based versus MS.	The study was conducted in a small therapy room from the children's main classroom.	All of the participants learned to request preferred objects.
van der Meer et al. (2012)	Case study design through a preference-enhanced intervention.	A 10-year old boy with ASD, moderate intellectual disability, developmental co-ordination disorder, and epilepsy.	To examine the needs for systematic selection of an appropriate AAC system based on the child's preference combined with appropriate use of intervention strategies.	At the child's home.	The preference-enhanced intervention could facilitate development of spontaneous and socially oriented communication.