Learning Social Skills with 2D Animated Social Stories for Children with Autism Spectrum Disorders

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Abstract

Autism Spectrum Disorders (ASD) are a group of neuro-developmental disorders caused by brain abnormalities which results in impaired social skills. There are five variants of the spectrum: Asperger Syndrome, Pervasive Developmental Disorder – Not Otherwise Specified, Autistic Disorders, Rett’s Syndrome and Childhood Disintegrative Disorders. These broad variants produce a wide variety of symptoms among children with ASD, where each child with ASD will have his own pattern of autism; however, all children with ASD will share the same deficits in the areas of social skills which include social interaction, verbal and non-verbal communication and unusual behavior/interest.

Research on treatment in helping children with ASD to improve social skills is growing as the cases of children diagnosed with ASD are on the rise. Social Story™ is one of the proven methods of treatment in helping children with ASD to learn social skills. However, the current presentation format of Social Story™ has not been attractive and it requires intensive teacher-student interaction for the full benefit of social skills acquisition.

Numerous studies have proved that children with ASD are motivated and have a better understanding from reading or visual illustration learning rather than learning through spoken instructions. Results from studies have also discovered that the computer is attractive and engaging for children with ASD, as it offers much benefit to them.

It has been said that learning is most effectual when motivated, thus, the purpose of this study is to discover a learning tool that children with ASD will be motivated to use on their own, and it is achievable by combining elements that they are interested in.

This research focuses on the combination of Social Story™, 2D animation, and the computer as a medium of presentation to present an interactive pedagogical tool for children with ASD to learn social skills. This combination is anticipated to be an effective tool in teaching social skills to children with ASD, as they are naturally drawn to computers and visual cues, combined with the fact that Social Story™ has been effective in changing the social behavior of children with ASD.

The prototype titled ‘i-Learn Social Story’ has been developed and evaluated on thirty children with ASD in a special school located in Kuching, Sarawak. A preliminary study has been conducted on three children with ASD prior to this final evaluation to ensure that the final prototype functions are properly based on the children’s needs. The method used in the evaluation study is the quantitative method, specifically single subject design, which is one type of experimental design.

Results of the experimental study reveal that the prototype is effective in changing the participants’ social behavior and in improving their social skills. There are significant improvements in the appropriate social behavior, decrease in the inappropriate social behavior, and increase in the number of social interactions made by the participants.

Thus, this study has contributed to the emergent research of treatment for children with ASD in social skills learning. The result of this study is important as we have discovered a novel method of treatment that can be used effectively in assisting children with ASD to improve their main deficit, social skills.
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Declaration of originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university, and to the best of my knowledge contains no material previously published or written by another person, except where due reference is made in the text of the thesis. Work based on joint research or publications in this thesis fully acknowledges the relative contributions of the respective authors or workers.

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Chapter 1: Introduction

The first chapter of the thesis illustrates the scope of the research, the background of the research, the aim of the research achieved through several objectives, the targeted audience of the research, the timeline of the research process, and an overview of how this thesis is organized.

1.1 Scope of research

This research was performed at Swinburne University of Technology (Sarawak Campus) and the subjects of the study were students at Perkata Special School, a school for special children located in Kuching.

The study of this thesis is based on a quantitative research method that utilizes an experimental design of the single subject design in evaluating the usability and efficacy of the proposed prototype, entitled I-Learn Social Story in assisting children with ASD to learn social skills. This study attempts to introduce a new approach in helping children with ASD to learn social skills.

The prototype is titled I-Learn Social Story and throughout this thesis it will also be referred to as ‘2D Animated Social Story’, illustrating the main feature which is Social Story™ in 2D animation form.

This thesis covers the background of the study including the essential elements such as the research objectives and audience, intensive and detailed literature review on related topics, conceptual design and modeling of the prototype which will include the methodology of the study, the implementation process of the prototype, and the experimental design to evaluate the effectiveness of the I-Learn Social Story prototype.

1.2 Research background

Autism Spectrum Disorders (ASD) are conditions in children that causes them to have difficulties in their social lives because of the lack of social skills. Social skill is an important art in relating with others. Without social skills, an individual would find it difficult to live in society, since humans are required to relate with others in their daily lives. Social skills are essential for an individual to survive as a human being.
Chapter 1: Introduction

There has been evidence of growing rates in cases of ASD in the past decade (Stillman 2009; Bogdashina 2006; Fambonne 2003; Shattuck 2006; Kaufmann & Silverman 2010; Lewandowski, 2010; Williams & Williams 2011), yet there is still no exact knowledge of the cause and treatment for children with ASD; thus these children are trapped in their social problems with which they are born. Therefore it is important to help children with ASD to learn social skills in order for them to have an independent life. With this concern in mind, research and studies on the treatment and application to help children with ASD cope with their social skills, are increasing rapidly.

However, from the current treatment and application used for children with ASD to learn social skills, there are only a few that are proven to be effective, but with a high cost and a lengthy treatment (Shattuck & Grosse 2007; Ganz 2008). Thus, in between those current applications, there is a gap for improvement in the area of application for children with ASD to improve their social skills. This study presents a novel way of assisting children with ASD to learn social skills, by combining methods that have been evidently effective in teaching social skills to children with ASD, with a medium that they are attracted to.

Social Story™ is one of the interventions used to help children with ASD to learn social skills, created by Carol Gray in 1991. Social Story™ is a short story written from the child’s perspective to help them understand a particular social situation. Included in Social Story™ are the descriptions of the social situation, the people involved in the social situation and their perspectives, as well as the suggested appropriate response for the child to perform in that particular social situation. Social Story™ is thus one way of helping children with ASD to better understand social situations from the perspectives of others and of themselves.

Social Story™ has been widely used with children with ASD with promising results (Adams et al. 2004; Bledsoe et al. 2003; Crozier & Tincani 2005; Crozier & Tincani 2007; Delano & Snell 2006; Demiri 2004; Kuoch & Mirenda 2003; Ozdemir 2008; Sansosti & Powell-Smith 2006, Sansosti & Powell-Smith 2008; Scattone et al. 2002; Scattone et al. 2006, Schneider & Goldstein 2009). However, in spite of the apparent impact of Social Story™ to promote social behavioral changes, this technique has a few drawbacks. Several authors have reported that the social skills acquisition achieved from Social Story™ in children with ASD is minimal unless it is followed with intensive treatment. For Social Story™ to be significant and effective in changing the students’ behavior, it requires intensive one-to-one student-teacher interaction, where the teacher would read out the Social Story™ to the child and would then model the desired target behavior with the student consistently, for an extensive period of time.
Thus, the current usage of Social Story™ is resource and time consuming. It is crucial that there is a discovery of a new and dynamic approach in the Social Story™ treatment. These resource and time consuming problems can be overcome by a tool that can be used by the child independently with minimal supervision from the teacher. To achieve this, it is necessary for the tool to be appealing to the child so that he/she will be motivated to learn independently.

1.3 Research aim

The aim of this research study is to discover a supplementary treatment tool that can be used effectively in teaching social skills to children with ASD, using methods that will motivate their learning. This study examines whether the combination of the proposed model, Social Story™ and 2D animation on a computer, will have a significant role in changing the social behavior of children with ASD. Its effectiveness, efficiency and satisfaction are evaluated in the present study. Hence, this study has the following objectives:

- **To observe and understand the social behavior of children with ASD**

The study investigates the social behavior and the learning behavior of children with ASD. This will supply the crucial information needed in order to develop the learning tool that will fulfill their needs, based on their social behavior and learning style. This is important because children with ASD are different from normal children, therefore specific information on their behavior and learning styles is necessary. To achieve this objective, a field observation on children with ASD and a literature review is conducted.

- **To analyze the existing treatment tools for children with ASD**

The literature review was conducted in order to reassess the existing treatment tools that help children with ASD to learn social skills. This review highlights the benefits and the limitations of the treatment tools that have been developed and distributed by various organizations. It is important to find out the benefits and limitations of these available products, from which the benefits can be integrated into our model, and improvements that can be made based on the limitations of the current treatment tools.

- **To investigate and analyze the technology and hardware requirement for the prototype**

In developing the prototype, performing an investigation on the technology and hardware requirement is an essential step. This step ensures that the hardware and technology used are available to most general public users and are cost-effective and can be implemented in the user’s home.
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- To conduct a preliminary study for the initial prototype

A preliminary study ensures that the final model of the prototype is the refined model, based on the results gathered from the pilot study. The pilot study is conducted on a smaller number of participants to gather the necessary information on the prototype usability before proceeding to a larger number of participants.

- To design and develop the improved prototype

The final prototype is developed based on the previous analysis of the children’s needs, technology requirements and the results of the pilot testing/preliminary study.

- To evaluate the improved prototype to the targeted community

After the final prototype has been designed and implemented, an evaluation of its effectiveness is conducted. Experiments are conducted to test the usability and effectiveness of the prototype to children with ASD.

1.4 Research context and participants

This research targets children with ASD, especially those between the ages of 4 to 12 years. This is the age range when children start to have social interactions with other people independently. Also at this stage, children are more capable of coordinating and operating the computer or other mobile applications.

As the sample target audience for the study, thirty students with ASD are selected from a special school located in Kuching, Sarawak. Their participation in the study is completely voluntary. To achieve a pertinent result, certain inclusion criteria are imposed.

1.5 Research timeline

Table 1 briefly presents the timeline of the research. As illustrated, the research took about 96 weeks from the inception of ideas to the development, evaluation and documentation stages. The detailed research timeline is presented in Appendix G (Research Timeline).
Chapter 1: Introduction

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Proposed Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposal development</td>
<td>26 weeks</td>
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<tr>
<td>Preliminary study</td>
<td>14 weeks</td>
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<tr>
<td>Prototype implementation</td>
<td>10 weeks</td>
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<tr>
<td>Testing and evaluation</td>
<td>24 weeks</td>
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<tr>
<td>Result analysis</td>
<td>16 weeks</td>
</tr>
<tr>
<td>Dissertation writing</td>
<td>12 weeks</td>
</tr>
</tbody>
</table>

Table 1 Research timeline

1.6 Overview of the thesis

This thesis contains 6 chapters:

Chapter 1 (Introduction): the first chapter of the thesis begins with the introduction of the research, which includes the background of the study, the purposes of the research, the community of the targeted audience, schedule of the whole research, as well as the chapters in the outline.

Chapter 2 (Literature Review): consists of the review of the literature on the subjects that are related to the research, including a detailed review on ASD and their nature, the current treatments and their limitations, Social Story™ and its application for children with ASD, animation in computer with its benefits for children with ASD.

Chapter 3 (Conceptual Design and Modeling): presents the conceptual design and model of the study. Included here are the research problems and our proposed solutions, the methodology used in this study which covers the research design and the approach used in the study. The preliminary study is presented as the basis of the final design and evaluation. The conceptual design of the final prototype which is derived based on the preliminary study’s result refinement and it includes the requirements and specifications of the final prototype such as operation flow, requirements, as well as the conceptual design of the user interface.

Chapter 4 (Prototype Implementation): discusses the implementation of the prototype based on the conceptual design. This chapter captures the screenshot of the developed prototype, the development of social stories that have been integrated into the prototype, and tools used in developing the prototype.
Chapter 5 (Prototype Testing and Evaluation): contains the systematic experimental study of the prototype that was evaluated on thirty students with ASD in a local school. The chapter covers subjects that are related to the study, including methods of the experimental study, such as procedures, participants, setting, and materials. The findings from the experimental study are also discussed in this chapter.

Chapter 6 (Conclusion): gives the conclusion to the study by providing the thesis summary and the specific contribution to the field of the study. The directions for future work are also discussed in this chapter. And lastly, there is a final conclusion that summarizes the discussion of the research project.
Chapter 2: Literature Review

2.1 Introduction

This chapter reviews the related publications for this research. The discussions include a detailed explanation on the two major areas that are related to the research. The first is *Autism Spectrum Disorders*, its spectrum, characteristics and its social skill deficits. The second is social skill acquisition in children with ASD, which includes various teaching and learning applications available for children with ASD. And finally, a critical review is included as the final part of the chapter.

2.2 Autism Spectrum Disorders (ASD)

The term *Autism* was introduced by Paul Bleuler in 1921; it is derived from the Greek word to describe a condition of *self-state* where individuals are engrossed in their own world (Dixon et al. 2009). The formal discovery of ASD started when Leo Kanner in 1943 discovered eleven cases of children who lacked the ability to relate to people and social situations (Kanner 1943). Kanner used the term *early infantile autism* to describe children who exhibited poor social skills, engaged in self-abuse and showed repetitive patterns of behavior (Veague et al. 2009).

In 1944, Hans Asperger who was unaware of Kanner’s work, used the same term of *autistic or autism*, derived from the Greek word autos (self), and coined by Swiss psychiatrist Eugen Bleuler to describe his casework of four cases of children who found it difficult to fit in socially (Frith 1991; Townsend & Westerfield 2010). Lorna Wing in 1981 introduced the term *Asperger Syndrome* to refer to children who had a milder form of *Autism* as described by Asperger (LeBlanc & Volkers 2007).

Since Kanner’s and Asperger’s discoveries, there have been many different views of the disorders which are unique to each other (Feinstein 2010; Foster 2007). Therefore, the term of *Autism Spectrum Disorders* is widely used to cover all autism related disorders (Autism Society Canada 2005; Bregman 2005).

ASD is often referred to as *Pervasive Developmental Disorders* (PDD), as the disorder is characterized by pervasive and usually severe impairment of reciprocal social interaction skills, verbal and non-verbal communication deviance, and restricted repetitive stereotypical behavior or interest patterns (Videbeck 2010; Volkmar et al. 2005; LeBlanc & Volkers 2007; Jelicic 2005; Wood et al. 2006). The term ‘pervasive’ means that delays in certain areas of
development will impact, along with the line of growth, upon other areas of development, compounding the deficits of function. Because ASD is a developmental disorder, its symptoms inherited in particular personalities will appear different at different ages, some aspects fading away with growth stages while others begin (Berger 2002).

There is no medical test that can be used to diagnose a child as having ASD. Any diagnosis of ASD is based on observation of the characteristics of the children’s behavior (Sicile-Kira 2004).

As said earlier, ASD is a wide spectrum disorder; therefore, there will be no children with ASD that have exactly the same characteristics or symptoms and level of functioning. Different children with ASD will experience different combinations of symptoms, where some children will have mild symptoms while other children may have the severe combination of symptoms (Siegel 1997).

Due to the characteristics of the disorder that is somehow seen by normal people as anti-social, children with ASD are often being excluded from social opportunities for various reasons. They may be victimized by teasing or bullying, or even being considered as troublemakers, where well-meaning adults may isolate them in order to protect them from social rejection (Loomis 2008; Attwood 2006). For children with ASD, this social isolation often increases the loneliness and feelings of being different (Joan & Rich 1999; Bogdashina 2006).

Children with ASD have difficulties in dealing with their peers, therefore, they tend to spend time interacting with objects, which has resulted in their brain’s visual portion becoming highly developed (Kalb 2009; National Autistic Society 2008). This makes children with ASD have a better understanding of what they see compared to what they hear, thus, visual strategies are widely used to help children with ASD in communication learning.

Today, ASD is a neurodevelopmental disorder with high prevalence rates of 90 to 110 per 10000 children (Matson & Kozlowski 2011), affecting children all through the world (Stillman 2009; Bogdashina 2006; Fambonne 2003; Shattuck 2006; Kaufmann & Silverman 2010; Lewandowski 2010; Williams & Williams 2011), regardless of their race, ethnic group, creed, social and economic status (Veague et al. 2009).

2.2.1 The causes and treatment of Autism Spectrum Disorders

It is generally accepted that ASD is caused by atypical brain structure or function in the brain regions that are primarily responsible for social, communicative and executive functions (Sparks et al. 2002; Kaufmann & Silverman 2010; Muhle et al. 2004; Rutter & Bartak 1971;
Chapter 2: Literature Review

Bregman 2005; Boucher 2009), as brain scans show differences in the shapes and structures of the brain in children with ASD compared to neuro-typical children (Autism Society 2008). Boucher (2009), Lathe (2006), Weiss et al. (2009) and Boria et al. (2009) in their studies explained the relationship of the brain structure with the brain function that controls the social areas of children with ASD in enormous detail.

There have been many controversies in identifying the causes of the brain abnormalities in children with ASD, among which are environmental contributions (Landrigan 2010; Muhle et al. 2004; Roullet & Crawley 2011; Lewandowski 2010; Bernier & Gerdts 2010), genetics (Kaufmann & Silverman 2010; Muhle et al. 2004; Roullet & Crawley 2011; Bernier & Gerdts 2010), drug therapy/vaccine (Jick & Kaye 2003; Muhle et al. 2004; Lewandowski 2010; Bernier & Gerdts 2010), onset in infancy (Szatmari 2003), onset in prenatal period (Lewandowski 2010) or complications in pregnancy (Burstyn & al. 2011).

However, despite many literature reviews on the potential causes of ASD, as to date, there is still no definite answer for the specific cause of atypical brain structure in autism (Bogdashina 2006; Crawley 2007; Bernier & Gerdts 2010; Glicken 2009; Magyar 2010; Williams & Williams 2011), as it is very clear that genes are not the only explanation for all types of autism, maybe for the most distinctive types, as brain growth depends on more than just genes. ASD is suspected to be caused by a combination of genes and other factors, such as the environment, acting together that leads to the pattern of behavior in children with ASD (Lewandowski 2010; Bernier & Gerdts 2010; LeBlanc & Volkers 2007).

As the case with the cause, there have been controversies in the search for an effective treatment for children with ASD, which has branched into a wide variety of treatment approaches (Bernier & Gerdts 2010; Williams & Williams 2011; Turkington & Anan 2007).

Scott & Baldwin (2005), Dodd (2005) and Robledo & Ham-Kucharski (2005) compiled a partial list of the possible treatment approaches that have been promoted to offer benefits to children with ASD. Some of those approaches are: allergy therapies, anti-yeast therapy, applied behavioral analysis, auditory integration training, gluten free diet, cognitive approaches, discrete trial training, dolphin therapy, drug therapy, Epsom salt baths, folic acid, higashi, holding therapy, irlen lenses, lovaas method, magnet therapy, melatonin, music therapy, natural language paradigm, occupational therapy, picture exchange communication system, pivotal response training, play therapy, precision teaching, prism lenses, psychology psychotherapy, psychodynamic therapy, reiki massage, secretin infusion, sensory integration
therapy, social skills training, social stories, son-rise program, speech-language therapy, the squeeze machine, TEACCH, tomatis method, therapy dogs, verbal behavior, vision integration therapy, multiple subpial transections surgery, and martial arts therapy. From those approaches available, Schreibman (2008) stated that most of them, such as higashi, irlen lenses, melatonin, reiki massage or the squeeze machine, had not been rigorously evaluated, which could lead to a false hope for the well-being of the children with ASD.

Lack of knowledge in the specific causative factors of ASD is the reason behind the controversies that surround the treatment for children with ASD (Bernier & Gerdts 2010; Williams & Williams 2011). There are many treatments claimed to be effective for children with ASD, but each child has his/her own unique profile. Therefore, a treatment that is suitable for one child might not be suitable for another child (Ball 2008).

Research on the cause and treatment for children with ASD is expanding fast. It aims to understand the underlying brain abnormalities of ASD and to improve the systems for prevention, detection, diagnosis and treatment approaches for children with ASD (Fambonne 2003; Baird et al. 2000; Fillipek et al. 2000; Robins et al. 2001; Stone et al. 2000). With improvements in these systems, and particularly in detection and diagnosis, treatment can be effected as early as possible, which will eventually allow many children with ASD to be appropriately identified and treated (Loomis 2008; Scott & Baldwin 2005).

Many researchers agree that children with ASD can experience a great improvement when the treatment is carried out at the earliest possible time (Cipani 2008; Scott & Baldwin 2005; Corsello 2005; Dawson et al. 2010). With the early treatment, children with ASD can gain improved communication and social skills (Dawson et al. 2010; Holmes 2009). This suggestion for early treatment has also been supported by experiments at the Mind Institute of the University of California (Holmes 2009).

### 2.2.2 The spectrum of the Autism Disorders

As discussed above, there are many forms of Autism that are unique from each other. The three main types of ASD that are most studied are: (1) Asperger Syndrome, (2) Pervasive Developmental Disorders – Not Otherwise Specified, and (3) Autistic Disorder, and two rare, severe autistic-like conditions, are (4) Rett’s Syndrome and (5) Childhood Disintegrative Disorders (Hirsch 2009; American Psychiatric Association 2000; Matson & Neal 2009; Bregman 2005; Dixon et al. 2009).
2.2.2.1 Asperger Syndrome (AS)

Asperger syndrome was named after Hans Asperger by Lorna Wing, a psychiatrist and physician in 1981 for Asperger’s discovery of the disorder many years earlier (Wing 1998; Wing 1981; Lyons & Fitzgerald 2005).

Asperger referred to the children with this syndrome as “little professors”, as they showed a highly developed intellectual functioning despite their delay in social interaction, unusual behavior and difficulties in non-verbal communication and pragmatics of language (LeBlanc & Volkers 2007; Lyons & Fitzgerald 2005). Since children with ASD perceive and think about the world in a different way from other people, Attwood (2006) considered it as a personality disorder rather than a mental illness such as Schizophrenia.

Contrary to children with classic forms of ASD, children with AS generally perform better in the verbal and linguistic skills rather than in the visual and motor skills (LeBlanc & Volkers 2007; Jelicic 2005). Often their grammar and vocabulary are relatively advanced (Stoddart 2005; Patrick 2008). Also in contrast to children with the other types of disorders in the spectrum, children with AS do not have any clinically significant general delay in cognitive development, age-appropriate self-help skill, and adaptive behavior other than social interaction (Jelicic 2005).

Despite having normal speech development, there is a number of impairments in verbal and non-verbal communication in children with AS, especially in the conversational aspect of language (LeBlanc & Volkers 2007; Matson & Neal 2009; Attwood 2006). This causes them to have many difficulties in using language in an appropriate way, such as difficulty in conversational exchanges, not knowing when and how to terminate a conversation appropriately (Sigafoos et al. 2009). Apart from that, they have difficulties in using language to convey meaning in a communicative context, which is important for initiating and sustaining reciprocal social interaction (Tartaro & Cassell 2008), interpreting speeches of others concretely (LeBlanc & Volkers 2007), conducting one sided communication and having clumsy motor skills (Matson & Neal 2009; Attwood 2006), having difficulty in interpreting figurative language (Patrick 2008), and having a lack of imagination as a result of difficulty in abstract thinking (LeBlanc & Volkers 2007). According to Matson and Neal (2009) and Attwood (2006), the language used by children with AS is pedantic; however, they are deeply absorbed with extreme knowledge in the specific topic of their interest.
Chapter 2: Literature Review

Children with AS have delayed social reasoning and some aspects of their social abilities are quite unusual at any stage of development. Therefore, it severely disables their capacity for socialization despite their desire to establish social relationships (Jelicic 2005). They also do not possess the social intuition or do not understand social cues such as, not knowing when and how to terminate a conversation appropriately (Sigafoos et al. 2009). They have advanced grammar and vocabulary, however, their conversation reveals their inability to conduct a normal conversation.

Children with AS often have obsessive behavior such as in the area of their interest (LeBlanc & Volkers 2007). They find changes in their routine upsetting which can lead them to be anxious or distressed (LeBlanc & Volkers 2007). There are some AS children who have disorders like depression (LeBlanc & Volkers 2007). Personal relationships and social situations are challenging areas for them (Evans 2009). They are intellectually normal but have such an unusual behavior that people often label them as odd or eccentric (LeBlanc & Volkers 2007).

In order to maintain an independent life, Bauminger (2002) suggests that children with AS need help in understanding social norms/rules and in processing social information. Treatment should focus on facilitating their capabilities in social understanding and social cues in different social situations and improving their skills in making accurate social interpretations.

Mann & Myles (2008) incorporate the stories, writing and artwork from numerous children with AS, to assist the communities to understand the complex exceptionality of children with Asperger Syndrome. Temple Grandin, an American academic and world famous animal scientist who authored various books about ASD was one of the children with AS who managed to achieve a high academic performance and to live an independent life (Grandin 2006; Parsons et al. 2000).

2.2.2.2 Autistic Disorder

Autistic Disorder, also referred to as Classic Autism, is the most common condition in the spectrum (Pierangelo & Giuliani 2008) which is more prevalent in boys than in girls (Videbeck 2010). Autistic Disorder is a developmental disorder; symptoms usually appear during the first three years of childhood and continue throughout life (Turkington & Anan 2007). Jelicic (2005) states that symptoms in Autistic Disorder are usually measurable by 18 months of age, however, a formal diagnosis is usually made between the age of 2 to 3 years when there are delays in language development.
Jelicic (2005) and Turkington & Anan (2007) describe *Autistic Disorder* as a severe developmental disorder that affects children’s ability to communicate, to form relationships with others and to respond appropriately to the environment. Symptoms and characteristics that appear in children with *Autistic Disorder* emerge in a wide variety of combinations, from mild to severe. If children are left untreated, they may not learn to communicate or behave properly (Turkington & Anan 2007).

Filipek et al. (1999) highlight the absolute indications that require an immediate further evaluation for autistic disorder as (1) no babbling by 12 months, (2) no gesturing by 12 months, (3) no single word by 16 months, (4) no two word spontaneous phrases by 24 months, and (5) any loss of any language or social skill at any age. Some indications for *Autistic Disorder* can be observed through communication (does not respond to name, language is delayed, does not point or wave good-bye), social interaction (does not smile socially, prefers to play alone, very independent, poor eye contact, not interested in other children) and behavioral patterns (tantrums, does not know how to play with toys, toe walks, unusual attachment to toys, lines up things, odd movement patterns, oversensitive to certain texture or sound).

Children with *Autistic Disorder* may also have *echolalia* of words or phrases of others. Their communications are mainly for instruments such as in requesting something rather than for social communication or conversation (Sigafoos et al. 2009).

### 2.2.2.3 Pervasive Developmental Disorders – Not Otherwise Specified (PDD-NOS)

PDD-NOS has also been referred to as *Atypical Autism*, and although it is a relatively common diagnosis in ASD, research in this specific area is still highly limited (LeBlanc & Volkers 2007).

PDD-NOS diagnosis falls in the umbrella of *Pervasive Developmental Disorder* (PDD). The designation of NOS in PDD as a diagnosis is applied when the disorder appears to fall within the larger category of PDD, but does not meet the full criteria of any specific disorder within the category in ASD (LeBlanc & Volkers 2007; Matson & Neal 2009).

PDD-NOS is given as a diagnosis when there is a significant autistic symptom (such as deficits in reciprocal social interaction, verbal and non-verbal communication, stereotyped behavior, interests and activities), but the full criteria are not met for a specific diagnosis in any other ASD. This diagnosis is usually given to children whose symptoms are atypical or not as severe as *Autistic Disorder* (Jelicic 2005).
Children with PDD-NOS are characterized by a significant impairment in social interaction, communication, and/or stereotyped behavior pattern, but without all of the features defined in other specific types of ASD (Turkington & Anan 2007; Yale School of Medicine 2008; Matson & Neal 2009). Therefore, Turkington & Anan (2007) and Sigafuos et al. (2009) argue that children with PDD-NOS tend to function at a higher level of communication compared to children with other types of ASD, including Asperger Syndrome. However, as described by Sigafuos et al. (2009), communication in children with PDD-NOS often focuses on a limited range of idiosyncratic topics. They may appear to be anxious and awkward when they are engaged in any social communication.

2.2.2.4   Rett’s Syndrome

Rett’s Syndrome was first identified by Andreas Rett in 1954 when he noticed two girls engaged in the same repetitive hand-writhing behavior (Matson & Neal 2009). The name of Rett’s Syndrome was given by Berigt Hagberg in 1983, who observed the similar symptoms in his young female patient (Turkington & Anan 2007).

Based on the Encyclopaedia of Autism Spectrum Disorders, Rett’s Syndrome is a rare progressive disorder that occurs almost exclusively in girls, that is every 1 out of 10,000 to 15,000 girls (LeBlanc & Volkers 2007; Turkington & Anan 2007). However, recent studies discovered that boys can also have Rett’s Syndrome (Turkington & Anan 2007; Kerr 2002, Jelicic 2005).

Children with Rett’s Syndrome produce autistic like behavior, learning disabilities, poor muscle tone, aimless hand wringing movements, difficulty in expressing feelings, poor eye contact, seizures, slow brain and skull growth, shortened life expectancy and walking abnormalities; therefore, it is easily confused with Cerebral Palsy (LeBlanc & Volkers 2007).

Children with Rett’s Syndrome appear to develop normally until the age of 6 to 18 months. After that, autism-like symptoms start to manifest in the child’s development. Their mental and social development starts to regress followed by deceleration of head growth, loss of purposeful hand movements, and appearance of stereotypical hand movements. In addition, there is a loss of social engagement and severely impaired receptive and expressive language development and cognitive skills (Jelicic 2005). They are no longer responding to parents and they pull away from any social contact. They begin to stop verbal communication, to lose control of their feet and to start wringing their hands (LeBlanc & Volkers 2007). There are also psychomotor retardation and impairment of language development.
2.2.2.5  Childhood Disintegrative Disorders (CDD)

CDD was first described by Heller in 1930 (Rapoport & Ismond 1996). Therefore, it is also known as Heller’s Syndrome (LeBlanc & Volkers 2007). CDD is a well-described disorder (Jelicic 2005). CDD occurs with a prevalence of less than 2 children per 100,000 children with ASD (LeBlanc & Volkers 2007).

The differences of CDD from typical ASD are in the later onset of symptoms (usually between 26 to 48 months) in CDD (Turkington & Anan 2007). CDD is associated with seizures and is more common in boys. Children with CDD cannot be specifically treated or cured and usually require lifelong care (Turkington & Anan 2007). The cause of CDD is still unknown, but several lines of evidence suggest that CDD is linked to neurological problems (Turkington & Anan 2007), generally in some form of the central nervous system pathology (LeBlanc & Volkers 2007).

Children with CDD appear to develop appropriate skills in communication and social relationships for their age until the ages of three and four, where the symptoms typically appear. After this normal development, a child with CDD rapidly loses multiple areas of function, typically after serious illnesses such as the infection of the brain and/or nervous system (Turkington & Anan 2007). Somewhere in the first five years of age, children with CDD begin to “disintegrate” until their behavioral difficulties are basically the same as a child diagnosed with autism or PDD-NOS, or even more severe than in Classic Autism (LeBlanc & Volkers 2007).

The disintegration typically includes a loss of previously learned language; a loss of desire for significant amounts of social contact; a loss of desire to play; a loss in bowel and bladder control; increasingly poor eye contact; occurrences of seizures and possessing a very low IQ; impaired social interaction and communication associated with the onset of restrictive, repetitive and stereotyped behavior that are typical of autism (LeBlanc & Volkers 2007; Jelicic 2005; Siegel 1997); and a loss in other forms of nonverbal communication such as pointing (Siegel 1997). A more severe symptom includes mental retardation due to a profound loss of cognitive skills (Jelicic 2005).

2.2.3  Deficits in Autism Spectrum Disorders

Social skill deficits in children with ASD lay the concepts of Theory of Mind and Triad of Impairment, which both entered the literature around the same time (Doherty 2009). This elicited Baron-Cohen et al. (1985) to hypothesize that the two concepts might be related.
2.2.3.1  Deficits in Theory of Mind

Theory of Mind (ToM) could be referred to as empathy in general. However, this term has been popularly used to define the concept that is lacking in children with ASD and it explains the social challenges they are having (Bogdashina 2006; Doherty 2009; Baron-Cohen et al. 1985). ToM, or empathy, is crucial for social awareness in a complex social environment.

ToM is defined as the ability to take and surmise perspectives such as belief, desire, emotion, perception and intention of self and others to interpret behavior. This ability involves making a distinction between the real world and the mental representation of the world. ToM can be explained as the ability to understand other people as mindful beings who have their own mental states that are different from self (Lantz 2002; Elzouki et al. 2007).

Normal children are said to have ToM because of their ability to explain and predict others’ behavior by attributing them to independent mental states (Gallagher & Frith 2003). In contrast, children with ASD often rely on a backup system like intellectual reasoning and experiences for their daily decision making and social interaction, which could lead a simple social interaction into a complex social calculation for them (Hickson & Khemka 1999).

The development of ToM begins within the first year of life, such as by gaze following, joint attention, drawing attention of others with pointing, ability to understand if an object is animate or inanimate, and an awareness of others as intentional agents (Weiss et al. 2009).

The inability to impute mental states of self and others that underpins the essential human ability to communicate and interact in a meaningful way (Parsons & Mitchell 2002) has caused children with ASD to have a difficult time in understanding and interacting with other people. They find it difficult to understand that other people have their own point of view of things that is different from their own point of view. They also cannot understand that a comment could embarrass or offend other people and that an apology would help to make a person feel better (Sicile-Kira & Grandin 2006).

These abilities cause children with ASD to have problems in communication and social relation as they may not be able to anticipate what other people will say or do in various situations (Chen 2008). In addition, based on his personal experience as an individual with ASD, Chen (2008) also states that people with ASD have no instinct to share their world and are unconscious of the world around them.
From a study of a first birthday party at home, children with ASD paid less attention to other people, and to the faces of others, failed to respond when their names were called and did not see the gaze of others to guide their actions (Osterling & Dawson 1994; Dawson et al. 1998). This is an evidence that children with ASD often fail to develop the essential prerequisite of ToM.

2.2.3.2 Triad of Impairment

The original concept of *Triad of Impairment* as defined by Wing & Gould (1979) is impairment in the areas of (1) social interaction (impaired relationship); (2) social communication/language (verbal and non-verbal); and (3) imagination/rigidity of thought (Wing 1988; Wing & Wing 1976; Bowen & Plimley 2008; Macintyre 2009). However, imagination is now replaced in the triad by behavior inflexibility that is characterized by restricted, repetitive, stereotyped and narrow range of interests/behaviors and activities/actions (rigidity of thought/lack of imagination) (Doherty 2009; Boucher 2009; Slater & Bremner 2003; Bregman 2005; Eyal 2010).

*Triad of impairment* translates the difficulty that children with ASD have in understanding/conveying meaning, expressing/reading emotion, using non-verbal behavior and participating in interpersonal imaginative play (Tartaro & Casell 2008; Tartaro 2007; Cheng et al. 2005). Social interaction and communication are the critical features in children with ASD, as stated by many authors (Howlin 2003; Schreibman 2005; Tager-Flusberg 1989; Schopler & Mesibov 1985 & 1986; Kanner 1943). Language and communication pattern in children with ASD reflect their failure to understand the nature of another person. Another deficit includes restricted interest as identified by Howlin (2003) and Schreibman (2005).

The symptoms included in the *Triad of Impairment* differ among children with ASD; some children with ASD would have a mild combination of symptoms while symptoms in other children with ASD are more obvious (Sicile-Kira 2004). Schreibman (2005) states that there are heterogeneous nature and complexity in ASD; therefore, it is frustrating to identify the core and primary deficit in ASD, as it is unlikely that a single core deficit would explain all features of ASD. However, he identifies that the behavior problems featured in children with ASD are in the areas related to social skills, communication and restrictive, repetitive and stereotype behavior and interests.
a. Social interaction impairment

As identified by Kanner (1943), the natural inability to form a normal social relationship is the outstanding characteristic of children with ASD. Their inability to interact normally with other individuals includes: no desire to make friends, lack of eye contact, showing the trait of gullibility (LeBlanc & Volker 2007), less likely to develop peer relationships or personal friendships, and lack of the urge to share interests or achievements. Added to that, they hardly point out objects of interest, are lacking in cooperative play, they spend an unusual amount of time unoccupied or in ritualistic activities, have lack of empathy, and lack of coordination of social behavior to signify social intention (Schopler & Mesibov 1986).

They also possess abnormality in voice and speech intonation, impairment in non-verbal behavior such as eye gaze, facial expressions and gestures (Weiss et al. 2009). The lack in social/emotional reciprocity (such as discrimination between parents and other adults or repeating behavior that are laughed at) and their difficulty in initiating, maintaining and terminating social interactions in an appropriate manner or failure to respond properly in social situations are among the symptoms as well (Brassard & Boehm 2007).

Children with ASD are insensitive in responding to social stimuli such as name calling or play group participation. They have circumscribed and obsessive interests in the physical aspect of the social situation rather than in being engaged in the social experiences. For instance, in a setting where two or more children are playing with toys, children with ASD will not be drawn to join but will rather have a fixation on other physical elements such as on the toy itself.

Howlin (2003) refers to people with ASD as having social dyslexia, as they show direct avoidance of social situations and do not actively seek out social interaction, often failing in perceiving and appreciating others’ thoughts and feelings, failing in perceiving the impact of someone’s behavior on others, and having difficulty in reading facial and body expressions of other people.

Regardless of their inability to form normal social relationships, Bogdashina (2006) argues that many children with ASD have a strong desire to be with others. They interact and form relationships with others, but of a different nature. Thus, isolation from social situations will increase their feelings of loneliness and of being different (Joan & Rich 1999).
b. Social communication impairment

Social situations can be very confusing for children with ASD as they tend to pre dominantly interpret language literally without interpreting the accompanied body language (Myles et al. 2004). This makes them very vulnerable and dysfunctional in certain situations (Bogdashina 2006).

Symptoms of social communication inability in children with ASD are: inability to sense people who are not sincere, or when someone is lying (Bogdashina 2006), inability to grasp different idiosyncrasies of language/signs, monotonous speech in intonation and volume, overly formal speeches, taking phrases literally, and delayed responses to questions (LeBlanc & Volker 2007). They face difficulties in understanding and using forms of communication (such as speech, sign language, body language, tone of voice and vocalization), and difficulties with the form/content/use of verbal language (Dodd 2005).

Some children with ASD, especially those with AS, may be extremely verbal with vast vocabularies, however, their usage of words is not appropriate for social communication. They speak in monotonous or pedantic style, lacking in melody and intonation. Other children with ASD who are verbally delayed may have some typical language problems which are consistent with a language disorder (Howlin 2003), such as delayed or lack of functional language, impairment in initiating or sustaining conversations, repetitive use of language, lack of varied and spontaneous make-believe play, using idiosyncratic language, and a tendency to echo the last few words heard (Brassard & Boehm 2007). Children at the lower functioning level may throw tantrums, make noises or physical activities as the way infants do when they feel discomfort, have a fixation on an object, or as an initiation of interaction (Schopler & Mesibov 1985), may listen selectively to familiar words, and may point and use gestures to get something that they want (Brassard & Boehm 2007).

Social communication difficulties can trigger challenging behavior in children with ASD, such as self-injury, aggression and tantrums. There is evidence shown that when children with ASD are taught functional communication skills, there is a reduction in these challenging behaviors (Schreibman 2005).

Deficit in social communication results in a difficulty to learn through peer social interaction, which normally provides many benefits of learning. They will not only miss the valuable learning opportunities, but these deficits will affect their future especially in personal relationships, education and employment opportunities (Tartaro & Cassell 2008).
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c. Behavioral inflexibility

Rigidity of thought and an impoverished imagination causes children with ASD to have narrow and repetitive patterns of activities/behavior (Rosenberg 2000; Feinstein 2010; Macintyre 2009). This results from a lack of social imagination and creativity or a lack of novel, imaginative behavior (Boucher 2009).

Behavioral inflexibility in children with ASD is also indicated by their inability to pretend and hence they have a hard time trying to play games with peers. This shows their difficulties in relating with others and in forming friendships (Rosenberg 2000). They find it hard to transfer/generalize skills learnt from one situation to another similar situation (Bowen & Plimley 2008).

Other typical behaviors of children with ASD include stereotype (known as self-stimulatory behavior, referring to repetitive movement of body or object); hypersensitivity to environment; tunnel vision, which is strictly following rules and routines in highly specific orders everyday as repetitive behavior; and finding it difficult to cope with a sudden change in daily routine (Rosenberg 2000; Bowen & Plimley 2008). They seldom play spontaneously, instead, they simply manipulate toys and do not engage with them in any meaningful way (Slater & Bremmer 2003).

They are also preoccupied with a restricted pattern of interest, adhere to non-functional routines, engage in repetitive gestures and have a persistent preoccupation with parts of objects. They also show stereotyped behavior such as body rocking, hand flapping, finger flicking and object spinning and twirling with a lack of obvious purpose (Slater & Bremmer 2003). According to Schreibman (2005), this occurs up to 100% in children and adults with ASD.

Children with ASD are often fascinated with regular patterns of objects and may collect and arrange objects they find in a systematic and repetitive way for no apparent reason and they may be distressed when these arrangements are disturbed (Slater & Bremmer 2003). Their interest is restricted and narrow, and most of them show affinity to one special interest that can be all-absorbing and dominating. This causes problems in social interaction especially when they are with people who do not share the same interest (Howlin 2003; Bowen & Plimley 2008).
2.3 Social skills acquisition

Compared to normal children, children with ASD have diminishing to low social intelligence due to their impairment in ToM which is linked to social intelligence, causing social skills or the lack of them as the main issue in children with ASD.

Social skills, as defined by Westwood (2007), are “the specific behavior an individual uses to maintain effective interpersonal communication and interaction”, therefore, it is any learned behavior that allow a child to elicit social reinforcement and to avoid social punishment (Marton 2008). Social skills are needed in everyday life to interact with other people and when they are used correctly and at the right time, they will help people get along with others and make appropriate decisions in social situations (Burke et al. 2006).

According to Dautenhahn (1999), social skills are the individual’s capability to develop and manage relationship between individuals, to build up shared social interactions which help to integrate and manage the individual basic interest in relationship to the interest of the social system at the next higher level.

Basic social skills are following instructions, accepting critics, accepting ‘no’ for an answer, staying calm, disagreeing with others, asking for help, asking permission, getting along with others, apologizing, having a conversation, giving and accepting compliments, listening to others, being honest, showing sensitivity to others and introducing self (Burke et al. 2006).

As identified, social skills involve initiating social interaction, listening, taking turns in conversation, giving and receiving compliments, expressing emotional upsets appropriately, sharing and cooperating, following rules, resolving conflicts, assisting others and asking for assistance appropriately (Gresham & Elliott 1990; Marton 2008). Basic components of social initiation are greeting others, asking questions, commenting on others, negotiating needs and asking to join on-going activities. Social responses are responding to social overtures of others such as in greetings, questions and in offering to join activities (Weiss et al. 2009; Bauminger 2002).

One research suggests that social skill training is one of the most effective treatments to help children with ASD to learn skills to help them succeed in their personal and academic lives, as the lack of social skills can lead a person to a lonely life and depression (Loomis 2008). Active techniques in social skill training in structured home and classroom environment that focus on the children’s strength and compensate on their deficits can produce a higher gain in the development of children with ASD (Fambonne 2003).
Children with ASD usually find it easier to practice social skills with adults or younger children rather than with the same age peers, since peers often place a greater demand on verbal and non-verbal communication skills, and are less tolerant of poor social skills (Loomis 2008).

Generalization of learned social skills in children with ASD is difficult; their learning can be very context-based such that they only demonstrate the learned skills with the person who has taught them or in the setting where they have learnt them (Loomis 2008; Bowen & Plimley 2008). Eventually, if they do not use these skills outside the learning context, the skills will be forgotten and lost (Loomis 2008).

More than academic skills, development in peer social interaction skills and social competencies will support the success and well-being of these children with ASD and will determine how independent the children with ASD will be as adults (Loomis 2008; Tartaro & Cassell 2008).

There are many ways of intervention for children with ASD to learn social skills. According to Sicile-Kira (2004) the considerations involved when choosing an intervention are age, what the child is like in terms of functionality, the child’s behavior, whether the child is a visual or an auditory learner, what the child’s strengths and weaknesses are and what goal the child has. The types of treatment that have been widely used for children with ASD are behavioral modification treatment, augmentative and alternative communication, robot therapy, music therapy, computer assisted, animation, video modeling, interactive computer software, virtual reality and Social Story™.

2.3.1 Behavioral Modification Treatments

In the broadest sense, behavior modification treatment includes any system that is controlling behavior by means of reward and punishment (Waltz 2003). Effective strategies for a perfect behavioral modification program as identified by Ball (2008) are: repetition, shaping, reinforcement, play, extinction, and rapport building/behavioral momentum.

There are various behavioral modification treatments available, and with the three most popular treatments specifically designed for children with ASD are Applied Behavioral Analysis, Developmental Individual-Difference Relationship-based/Floortime, and The Treatment and Education of Autistic and related Communication-handicapped Children.
2.3.1.1 **Applied Behavior Analysis (ABA)**

ABA is a systematic process that examines behavior by observation, reproduction, testing and objectivity to select change and evaluate human behavior (Ball 2008; Ringdahl et al. 2009). It grew in popularity as a model to be used for children with ASD by the works of O. Ivar Lovaas, who succeeded in changing behavior in a small group of children with ASD, using a highly structured, intensive behavior modification program based on discrete trial teaching (Ball 2008).

ABA is the most widely researched treatment method for developmental disabilities, communication disorders, special education and rehabilitation psychology (Ball 2008; Matson & Neal 2009; Heilbroner & Castaneda 2006). ABA is taught through a number of discrete trials in which correct responses are reinforced, and the new skills are shaped through prompting (Dodd 2005). Children with ASD who use the ABA program are constantly re-directed to engage in appropriate behavior. In addition, the children’s responses in every ABA teaching session are recorded. The recorded data is used to determine the effectiveness of the activities and whether the program needs to be modified (Dodd 2005).

There are a variety of program models that are ABA based, ranging from the very intensive and structured to the less intensive and more naturalistic programs (Ball 2008), with the most popular ones as Discrete Trial Teaching, Pivotal Response Training and Lovaas Model (Sherman 2007).

**a. Discrete Trial Teaching (DTT)**

DTT also known as *Discrete Trial Instruction, Discrete Trial Therapy or Discrete Trial Training* (Ernsperger 2003), is a form of ABA. It is a systematic instructional training for children with ASD that breaks down specific target activity/skill into three distinct components (Sherman 2007; Ball 2008; Gerlach 2003). The specific target activity/skill has basic functional units, and each of these functional units is taught in a systematic way (Ball 2008; Gerlach 2003). The three components are: a cue (an instruction by teacher/therapist), a response/behavior (by the student) and a reinforcer/consequence (Ball 2008; Sherman 2007). As part of its methodology, DTT also uses prompts, consequences and measurement (Ball 2008).

The key principles of DTT are: (1) a high level of teacher-student interaction, (2) active student engagement, (3) employment of sequenced and structured materials and activities, (4) breaking down of task or skill into small measurable steps by completing a task analysis, (5) utilizing powerful motivation or reinforcement, (6) providing corrective and informational...
feedback, (7) giving the student many chances to learn a new skill through increased repetition, (8) strong emphasis on data collection, (9) providing clear and concrete instructions, and (10) maximizing student participation and learning outcomes (Ernsperger 2003).

DTT rely heavily on a direction or command from the teacher/therapist as a signal to begin the discrete trial. The beginning lesson in DTT focuses around basic functions, such as children learn to contain or control maladaptive behavior. At the same time, they are being taught positive behavior. If the children respond appropriately after the instruction, they may be given a simple reinforcer/reward such as a candy. As the program progresses, the reward can be changed to a social reinforcer such as a hug or praise (Sherman 2007). In the DTT approach, the targeted skill is repeated several times until the children reach a level of mastery (Ball 2008; Gerlach 2003), and as the program progresses, simple lessons are combined to teach more complex tasks or skills (Sherman 2007).

b. Lovaas/UCLA Model

Lovaas was first developed at the University College of Los Angeles (UCLA) by Dr. Ivor Lovaas in 1987 (Lovaas 1987; Richer & Coates 2001). Many have considered the Lovaas method as DTT such as Golden et al. (2010) and Siegel & Ficcaglia (2006), whereas there are others who consider it as a separate method from DTT, such as Sherman (2007), Gerstein & Gerstein (2004), Prelock et al. (2010). They consider the Lovaas model as only relying primarily on the DTT model.

Lovaas is an intensive, home-based intervention program for children with ASD that is run by parents, family, friends and students who are trained in the method (Deiner 2009). The intensive teaching is provided through a discrete trial format (Ringdahl et al. 2009; Gupta 2004). Lovaas uses a model of introduction, prompting and reinforcement of behavior, with a curriculum that focuses on increasing language skills, social behavior (Ringdahl et al. 2009; Deiner 2009), academic skills (Deiner 2009), imitation, play and self-care skills and decreasing disruptive behavior (Ringdahl et al. 2009). Generalization of skills learned is an important component of the Lovaas’s treatment plan (Deider 2009).

c. Applied Verbal Behavior (AVB)

AVB is the function assessment of a language program that has an emphasis on verbal behavior or language development (Ball 2008; Shore et al. 2006). In AVB, language is treated
as a behavior that can be shaped and reinforced, while careful attention is paid not only to what a child is saying but why he/she is using that language (Barbera & Rasmussen 2007).

AVB is an approach that emerges from the basic teaching of ABA (Boutot & Tincani 2009; Barbera & Rasmussen 2007). However AVB differs from ABA, as it is less formal and structured. The process of AVB occurs in a natural environment, where errors are minimized through systematic prompting and fading (Shore et al. 2006). The rationale in ABA is that language is the foundation for many other skills; it is easier to acquire other behavior or skills when a language is mastered (Shore et al. 2006).

According to Ball (2008), AVB is viewed as a bridge builder that is used in conjunction with the behavior modification technique to increase motivation and to provide a better understanding of words and their meanings. AVB teaches children to imitate, follow instructions, match and make requests not only through speech/spoken language, but also through all sorts of non-vocal forms of communication such as finger pointing, singing, writing, gesturing, signs, or even tantrums (Barbera & Rasmussen 2007). AVB also supports the use of the augmentative system for communication (Gupta 2004; Shore et al. 2006; Boutot & Tincani 2009).

AVB utilizes principles (such as reinforcement and extinction) and techniques (such as shaping, prompting/motivation and generalization) to increase on-task behavior, where the teacher/therapist continually attempts to offset the value of escape during instructional time, while every opportunity is viewed as a learning opportunity to maximize responding (Kates-McElrath & Axelrod 2006). In teaching children with ASD by using AVB, there is an initial emphasis on establishing the teacher as a conditional reinforcement, which is accomplished through pairing the teacher with a reinforcement (Kates-McElrath & Axelrod 2006).

d. Pivotal Response Training (PRT)

PRT was developed by Pierce & Schreibman (1995) as a naturalistic intervention model that combines ABA procedures and development approaches. It provides opportunities for children with ASD to learn within a natural environment setting and includes components such as the child’s choice and turn taking (Ringdahl et al. 2009; Sherman 2007; Ball 2008).

Rather than targeting on the individual behavior one at a time, PRT focuses on behaviors that are pivotal in the acquisition of other behavior/pivotal areas of the child’s development such as motivation (reinforcement), ability to respond to multiple cues (Ball 2008; Sherman 2007), self-management and social initiations (Sherman 2007). By targeting these pivotal areas, as
argued by Sherman (2007), PRT can result in widespread collateral improvements in other social, communicative and behavioral areas that are not specifically targeted.

PRT has been used to target the language skills, play skills and social behavior in children with ASD (Ball 2008), to decrease disruptive or self-stimulatory behavior, and to increase social communication and academic skills (Sherman 2007).

Motivational strategies of PRT are incorporated into the intervention as often as possible. These include: following the child’s lead/choice, using a child’s preferred items and activities, teaching the child within the natural context, providing clear instructions, providing choices, reinforcement/reward of attempts, varying and interspersing tasks, and using direct/natural reinforcers (Ringdahl et al. 2009; Sherman 2007).

In PRT, children play a crucial role in determining activities and objects that will be used as the exchange. Children’s intentful attempts at target behavior are rewarded with a natural reinforcer, such as, if a child attempts to request a stuffed animal they will receive the animal, not a piece of candy or other unrelated reinforcer (Sherman 2007).

**2.3.1.2 DIR/Floortime**

DIR (Developmental, Individual-Difference, Relationship-based) was developed by two child psychiatrists, Dr. Stanley Greenspan and Serena Wieder in 1980. DIR is an interactive, intensive, relationship based intervention program (Ball 2008; Sherman 2007) that emphasizes improving the child’s ability to form relationships (Hendrickson 2009).

DIR focuses on the importance of emotion and relationship in learning development and it systematically addresses the core issues in ASD through an array of family focused intervention. It is designed to build the child’s capacity to relate, communicate, think symbolically and process sensory information (Sherman 2007). To use the DIR approach, each child’s unique strength, developmental capabilities and challenges must be identified (Metz et al. 2005).

The goal of DIR is to connect the child’s emotion to the family and peers, to enable the child to read and respond to social signals with empathy and self-awareness, and to be involved in creative and reflective thinking and complex problem solving (Sherman 2007). It places parents as the central organizer of the child’s world and routine, who will eventually help the child to develop a greater functional and emotional independence and capacity (Metz et al. 2005).
Through systematic observation in the child’s natural environment and their interactions with family members, DIR identifies the children’s emotional development levels and intellectual functioning, determines their individual ways of reacting to movement, sound, sight and other sensations. Through it, methods are formulated for learning through relationships and interactions at home, schools and in different settings (Sherman 2007).

The centrepiece of DIR is Floortime, where the child and family members get down on the floor in a 20-30 minute session, to engage the child in establishing a bond between the child and family members (Ball 2008; Sherman 2007). Through Floortime, family members learn how to draw the child into emotionally satisfying and meaningful interactions by appealing to his/her natural interest/behavior. Floortime helps the child to be capable of establishing a warm reciprocal relationship, spontaneous self-expression, curiosity, flexibility and abstract thinking (Sherman 2007). The environment in Floortime that is based on play and social interactions make it a very natural way of teaching (Ball 2008).

However, there are also critics of the DIR/Floortime program. Hendrickson (2009) states that the DIR/Floortime intervention does not contain any skill training. The effectiveness of DIR/Floortime is also considered as unproven as it has not been researched or studied for its effectiveness (Ball 2008; Hendrickson 2009). According to Metz et al. (2005), there is only one study supporting the effectiveness of Floortime, which was done by Greenspan and Wieder (1997) who presented a retrospective, 200-casechart review of outcomes of children with ASD.

### 2.3.1.3 TEACCH

The Treatment and Education of Autistic and related Communication-handicapped Children (TEACCH) program was established in the early 1970s at the University of North Carolina by Dr. Eric Schopler. The long term-goal of the TEACCH program is for students with Autism to fit into society as adults through respecting the differences that Autism creates within them, and working within their cultures to teach the skills needed to function in society (Feinstein 2010; Ball 2008).

TEACCH is a broad and lifelong approach that addresses not just work skills and communication skills, but also covers other skills such as social and leisure skills (Ball 2008). It improves the welfare of children with ASD by understanding the nature of ASD and the individuals, then developing an appropriate structured individualized program that capitalizes on their skills and interests, promotes independent work skills, emphasizes strength/interest, fosters communication, social, leisure interest and opportunities (Metz et al. 2005).
TEACCH involves parents as co-therapists. It uses behavioral strategies to enhance communication and social interactions (Deiner 2009). TEACCH supports the use of visual organizers and cues such as picture squares combined with words or symbols (Deiner 2009; Sherman 2007).

The TEACCH program is very structured with separated areas for each different activity. Materials used such as visual strategies, independent scheduling, individual work station and labeled work boxes are modified to make them clearer and more meaningful (Sherman 2007). This is the foundation of the everyday routine for children with ASD to promote maximum independent life at home or in school (Ball 2008). The critic of TEACCH, Ball (2008) states that it is not exactly clear how the TEACCH individual program strategies are taught.

2.3.1.4 Limitation of Behavioral Modification Treatments

ABA’s approaches rely on teacher’s directions, prompted responses and contrived forms of reinforcement. ABA approaches have inherent weaknesses, they often lead to a passive style of communication, in which children respond to prompts to communicate but do not initiate communication or transfer the acquired behavior to situations outside the teaching context (Paul & Sutherland 2005; Stokes & Baer 1977; Prelock et al. 2010).

In order to optimize the benefits of the behavioral modification treatment program, intervention is very time intensive; it utilizes up to 40 hours per week for approximately 2 years (Dodd 2005). This approach has slow progress; it could take months or years to see noticeable results in children with ASD (Bernier & Gerdts 2010).

Behavioral modification treatment is also an expensive approach, which has to be carried out by a team of trained people including supervisors, therapists, parents and peers (Dodd 2005). This limits the feasibility of behavioral modification intervention for many families (Bernier & Gerdts 2010; Heilbroner & Castaneda 2006).

As identified by Heilbroner and Castaneda (2006), behavioral modification treatment does not appear to help all children with ASD. There are also claims that ABA does not allow children to establish relationship with others, skills are not generalized and these children appear to be very robotic in their responses to others (Ball 2008).
2.3.2 **Augmentative and Alternative Communication (AAC)**

AAC is another line of approach that was originally developed to help individuals with significant motor-speech problems (Volkmar & Wiesner 2009). AAC is widely used in enhancing the social, communicational, behavioral, academic and vocational lives of children with ASD (Mirenda 2003; Audet 2007; Charman & Stone 2006). In the AAC approach, children are helped to communicate in various ways, such as using *sign language*, Picture Exchange Communication System and *Facilitated Communication*. The AAC approach can also be combined with other approaches in helping children with ASD to communicate (Volkmar & Wiesner 2009).

2.3.2.1 **Sign Language**

There are two major forms of *sign language*, the American Sign Language (ASL) and the Exact English, with the primary difference in the use of conceptual thinking. The motion and gestures of ASL are created to say as much as possible quickly and economically where an entire phrase is often represented with one single sign. On the other hand, Exact English uses one sign for each word, which can be helpful for children with ASD as they learn about conceptual ideas (Tilton 2004).

*Sign language* is the preferred language for people who have a lack of verbal communication ability (Tilton 2004). In *sign language*, the child performs hand signs to request preferred items or to perform other language functions (Boutot & Tincani 2009). It was first developed as a means of communication for people with hearing impairment or developmental disabilities (LeBlanc & Volkers 2007).

However, children with different levels of ASD can also be taught to use *sign language* in communication (Turkington & Anan 2007). It has been useful in decreasing problem behavior in children with ASD such as aggression, tantrums, self-injury, anxiety and depression that are often caused by frustration over their inability to communicate (Kurtz 2008; Turkington & Anan 2007). Despite its effectiveness, the use of *sign language* is not as common as in previous years, due to an increase in the use of the computerized communication system (LeBlanc & Volkers 2007) and experts have suggested that it is better to use a picture system or a computerized device to enable communication for those who do not understand the signs (Turkington & Anan 2007).
2.3.2.2  Picture Exchange Communication System (PECS)

PECS is an augmentative communication system designed to assist non-verbal and verbal children with ASD to communicate in a functional and effective way (Ball, 2008). It has been recognized around the world for its focus on the initiation component of communication (Turkington & Anan 2007). PECS was developed in 1985 by Andrews Bondy and Lori Frost, as a training package to teach children with ASD to initiate communication (Ball 2008; Bondy 2001; Kurtz 2008), as they observed many children with ASD having difficulty in acquiring spontaneous communication skill via speech or sign language (Bondy 2001).

PECS teaches words by using a picture as an exchange for the desired object. Once the child has the idea, the picture can be used as the basis for building more complex language, including a full sentence. It is useful in both verbal and non-verbal children, as a way of producing spontaneous communication (Turkington & Anan 2007). The logic in PECS is that most children with ASD prefer to learn through the visual media. Therefore the use of pictures encourages their learning, where a picture of a reward is one of the fundamental tools that allow the child to let a person whom he is trying to talk to, know what he wants (Robledo & Ham-Kucharski 2005; Kurtz 2008).

The objective of PECS is to enable children with ASD, whose speech is unintelligible or non-existent, to spontaneously initiate communication with others, to understand the function of communication and to help them develop communicative competency (Lin & Biggs 2006; Cornwallis & Peacock 1998; Turkington & Anan 2007).

PECS emphasizes the differences between talking and communicating (Boushey 2004). Several authors such as Robledo & Ham-Kucharski (2005), Kurtz (2008) and Turkington & Anan (2007) consider PECS as a part of ABA because the teacher/trainer must first identify the learning motivation of a child, and then use that motivational object to reward the child.

PECS has many advantages for children with ASD; it is easy to understand and implement, it is child-initiated, it requests social contact, materials are readily available or it can be created by the teacher to tailor to the child’s needs, it has universal appeal and can be implemented and used everywhere because it is non-verbal (Ball 2008). There are many ranges of the PECS system, from cutting of magazines (Richman 2001) to the computerized system such as Boardmaker (Ben-Arie & Miller 2009; Richman 2001; Lin & Biggs 2006). PECS is easy to be incorporated into any existing program (Sicile-Kira 2004). It does not require expensive
materials (Sicile-Kira 2004; Richman 2001). It has also been argued that PECS can help to get language started (Turkington & Anan 2007; Sicile-Kira 2004; Mirenda & Erickson 2000).

There are controversies that say the use of PECS inhibits the development of speech in children with ASD (Glennen & DeCoste 1997; Volkmar & Wiesner 2009; Sicile-Kira 2004). There is an issue of when a child seeks to communicate something that is not yet in the picture system (Mirenda & Erickson 2000). In addition, minimal training for PECS’s therapists could lead to PECS being used inconsistently within the classroom (Boushey 2004).

2.3.2.3 Facilitated Communication (FC)

FC is a form of the AAC system that allows children with none or limited verbal ability to communicate with a facilitator assisting them (Biklen 2007; Schreibman 2005; Bernier & Gerdts 2010). It was initially developed for children with Cerebral Palsy by Rosemary Crossley. It has then subsequently been widely used with children with ASD after Douglas Biklen observed that children with ASD who used FC could engage in communication that was conceptually sophisticated (Schreibman 2005; Bernier & Gerdts 2010).

In the FC program, a child with ASD will work with one or more trained ‘facilitators’, who provide emotional and physical assistance as the child attempts to communicate by typing, pointing to pictures or accessing to computer controls (Kurtz 2008).

There was much controversy in FC (Gilpin 1993), as there was no convincing evidence that FC worked to help people with ASD (Weathington et al. 2010). When FC was put to scientific testing, it failed miserably, as the studies found that it was not the student who was communicating; it was in fact the facilitator who assisted the student (Schreibman 2005; Bernier & Gerdts 2010), therefore FC could be considered to be harmful (Bernier & Gerdts 2010).

2.3.2.4 Limitations of Augmentative and Alternative Communication

Regardless of the advantages and its wide range of applications, AAC has limitations as a means for children with ASD to learn social skills as identified by various authors.

Smith (2005) and Fossett & Mirenda (2009) suggest that more empirical studies are needed in order to evaluate the effectiveness of AAC application to support the learning of children with ASD. Professionals who wish to provide AAC services must be competent in the specified skills of the AAC system (Glennen & DeCoste 1997). Therefore, it limits the service availability of
AAC to public users. The AAC device is being abandoned by the users due to the mismatches between skills, expectations and device’s capabilities (Glennen & DeCoste 1997; Spitko 2008). Salminen & Petrie (1999) show that computerized AAC for disabled children is demanding, slow, and highly context-independent. In the same study, it is also found that users often lose interest in the device after six months of application.

2.3.3 Robot therapy

The robot therapy has been researched as an aid for children with ASD to learn social skills, as children with ASD tend to behave more pro-socially when interacting with robots than with humans (Ricks 2010; Khatib et al. 2009; Kozima et al. 2007; Dautenhahn 2008; Besio et al. 2007; Siciliano & Khatib 2008; Fujimoto et al. 2010; and Tsui 2008).

A robot has the potential to adapt to behavior and allow children to develop at their own rates (Werry et al. 2001a, 2001b). The use of robot as a therapy partner for children with ASD can lead to a stronger learning environment. The robot is able to function and communicate in the designated ways, allowing children with ASD to focus on a few communication channels without missing any details. The robot can also present the children with a safe and comfortable environment and allow them to explore and learn about the interaction space involved in social situations, where interaction can be controlled (Werry et al. 2001a, 2001b; Besio et al. 2007).

Three robot applications are included in the review. The first and second ones are simple toy-based robots for children with ASD to learn emotions that are necessary for social skills. They are the Affective Tigger and Keepon and the third robot is an advanced robot application, named Aurora Project, which is specifically developed for children with ASD.

2.3.3.1 Keepon

Keepon is a simple yellow snowman-like looking robot made of soft silicone rubber. Keepon was created by Professor Hideki Kozima to help in the research of the development of children with ASD, specifically to study their social development, by communicating with them. Keepon’s behavior were designed with intention to help children with ASD to understand its attentive and emotive actions (Kozima & Nakagawa 2007; Nakamoto 2011; Kozima et al. 2005; Fujimoto et al. 2010).

Keepon is a minimally social robot that has four degrees of freedom (Tsui 2008). Keepon’s minimal expressiveness helps children with ASD to understand socially meaningful
information, which then activates their motivation to share interests and feelings with others (Kozima et al. 2007). The purpose of Keepon is to study the social interaction of children with ASD (Tsui 2008) through non-verbal interactions.

2.3.3.2 The Affective Tigger

The objective of Affective Tigger is a toy that can serve as an affective mirror for the child’s expression, showing a reflection of the affective qualities when the child is playing with it (Picard 2000; MIT Media Lab 2009). A study conducted by MIT Media Lab shows that Affective Tigger has successfully communicated some aspects of emotion and is able to prompt positive behavior (MIT Media Lab 2009).

Tigger exhibits the expressive emotional behavior as responses to how a child plays with it, as it has sensors that are capable of discriminating potentially abusive actions like poking of the eyes to potentially playful actions like bouncing or light pulling in the tail (Picard 1999). When Tigger’s emotional state is happy, such as when the child has postured Tigger upright and bouncing it along the floor, the ears of Tigger will be moving upwards and it will be emitting a happy facial expression.

2.3.3.3 Aurora Project

The Aurora Project was developed in 1998 by Dautenhahn et al. as the result of a study in the possibility of using a robotic platform as a therapy aid for children with ASD (Dautenhahn 1999; Werry et al. 2001). The study covers the development of a mobile, autonomous, non-humanoid and social robot that can be used as a therapeutic tool for children with ASD, in an environment in which children can explore and discover their interaction skills, instead of being simply taught to them (Dautenhahn et al. 2002a, 2002b; Eliasz 2009).

The study was intended to discover how a mobile robot (Aurora Project) could become a toy and a remedial tool for getting children with ASD into coordinated and synchronized interactions with the environment (Dautenhahn 1999). Therefore, the aim of the Aurora Project is to serve as both mediator and teaching aid for children with ASD in giving them an opportunity to practice and explore their behavior in social situations, as well as to provide a focus of interest and attention for them, in order to stimulate interpersonal relations and interactions (Werry et al. 2001).

The long term goal of the Aurora Project is to develop a robotic platform that can be used in schools by teachers to allow children with ASD to practice their social skills, learned in other
classes (Werry et al. 2001), and eventually helping children with ASD make a bond with the social world (Dautenhahn 1999).

The main limitation of the *Aurora Project* as identified by Dautenhahn & Billard (2002) is that the robot used in the project can only offer a very small number of interactions with children with ASD, i.e. the type of interaction that occurs is limited to the spatial approach/avoidance turn-taking games.

### 2.3.3.4 Limitation of robot therapy

Using robots in education and as an aid to the therapy for children with ASD poses many challenges (Dautenhahn 2008). Issues in using a robot as a treatment aid for children with ASD are: (1) the high cost of developing and building the humanoid robots (Eliasz 2009); (2) design issues on the interactive environment for children with ASD, such as in the *Aurora Project* (Dautenhahn 2000); (3) the nature of ASD poses particular requirements and constraints on the robot and its behavioral capabilities, such as in safety and ethical issues, where it is vital to provide a safe, enjoyable and relaxed environment for the child, as well as for any aspect of the robot that might upset or scare the child (Dautenhahn & Billard 2002).

The use of robots can also inhibit children with ASD in building relationship with others if it is not used with caution, as they might seek to have the exclusive relationship/interaction with the robot and ignore other peers or adults who are present. Thus, there is a need to emphasize that robot should become a social mediator that will encourage interaction with other people, instead of reinforcing existing behavior of a social isolator (Besio et al. 2007).

### 2.3.4 Music therapy

Most children enjoy and respond positively to music, including children with ASD. Alvin (1978) was the first to explore the use of music therapy as a treatment to children with ASD. Subsequently, there have been many literature reports music to be used as one of the interventions in helping children with ASD cope with social skills (Brunk 2004; Gerlach 2003; Saville 2007; Howat 1995; Oldfield 2006).

Music therapy is the process of using music as a therapeutic tool or agent to address physical, emotional and social needs of an individual. It focuses on achieving non-musical goals such as body and environmental awareness, motor control, social interaction and communication (Shore et al. 2006). As suggested by Gerlach (2003), music therapy may include many activities such as singing, body movement to music and playing musical instruments.
The goal in music therapy is tailored to the needs of each individual, which may be to increase nonverbal interactions (such as turn taking and eye contact), to explore and express feelings, or to be creative and spontaneous (Sicile-Kira 2004).

Recently, music therapy has been combined with other therapeutic approaches for specific reasons. Social stories are musically adapted in Brownell’s research (2002) to help ASD children to understand social situations or events, whilst Berger (2002) describes a collaborative approach between music therapy and sensory integration theory with autism (Saville 2007).

However, as stated by Gerlach (2003), there are varying degrees of success in music therapy in children with ASD. In line with Gerlach (2003), Brunk (2004) states that there are no studies that have identified a particular music as being beneficial to all children with ASD. Berger (2002) also highlights that music therapy requires an extensive amount of time to be effective as a treatment for children with ASD.

### 2.3.5 Computer assisted learning

Direct face to face learning can be so overwhelmingly uncomfortable that children with ASD resist or switch off their attention (Moor 2008). While avoiding social interactions, the interest and attention of children with ASD are very much drawn to the computer, as proven in the studies of Elzouki et al. (2007), Strickland (1997), Tartaro & Cassell (2008), who find that children with ASD enjoy using the computer and are responding well to it. They find technology attractive and are drawn to computers (Moor 2008).

Studies were conducted in comparing the traditional book learning (Williams et al. 2002) and personal instruction (Chen & Bernard-Opitz 1993) with computer assisted learning in children with ASD. The first study found that children spent more time on task and reading materials in computer assisted learning compared to book learning (Williams et al. 2002), whereas the second study found that children showed better motivation and fewer behavioral problems in computer learning conditions (Chen & Bernard-Opitz 1993).

Stromer et al. (2006) suggest that integrating multimedia computers with an activity schedule can be an effective way to teach children with ASD to manage their work, play and skill-building activities independently. The review illustrates how the activity schedule presented in computers enforces new learning via videos, sounds, dialogues, images and words that are employed as instructional stimuli.
Due to this interest of children with ASD in computers that present visual cues (such as pictures and animation), application of computer assisted and multimedia learning as learning agents for children with ASD has been suggested and widely studied by various researchers, such as Hardy et al. (2002), LeBlanc & Volkers (2007), Eliasz (2009), Hall (2010), Moore & Calvert (2000). All of these studies found that the computer is beneficial as a treatment for children with ASD, as these children find a special appeal and enthusiasm for computers, therefore giving this method of using the computer a positive response (Hardy et al. 2002; Bernard-Opitz et al. 2001).

Children with ASD interact naturally with computer technology and they can use it creatively (Eliasz 2009). The computer can also become a catalyst for social interaction, such as, while using the computer, a child with ASD will converse naturally with the child next to him, such as telling him which button to press and what to do (Hardy et al. 2002). Another reason that supports computers to be used to help children with ASD to develop their interaction skills is the fact that when using the computer, the child is actually in direct control of the computer, meaning that the interaction may not be as intimidating as a face-to-face interaction with others (LeBlanc & Volkers 2007).

Advantages of the computer assisted learning method for children with ASD, as identified by Hall (2010) are: (1) it does not require interaction with other people; (2) it offers autonomy and a safe environment; (3) it is non-judgmental; (4) it provides a focal point to hold concentration; (5) it is consistent and predictable; (6) it enables errors to be easily corrected; (7) it provides instant feedback; (8) it creates an awareness of self; and (9) its simple computer-presented games promote communication with others.

2.3.6 Animation

Another method of presenting information to children with ASD is through animation. In traditional terms, animation is the process of caricaturing life which could serve as a medium to project a story, such as a film, comic or book used to illustrate a story, to its viewer. In modern terms, animation refers to the rapid displays of still images in a sequence to create an illusion of live motion. It can also be explained as the simulation of movements through the sequence of still images that have objects with slightly different positions shown one after the other very quickly so that the human eye and brain blend the image to produce the effect of live motion (Itl Esl 2009). Animation is a powerful tool in communicating complex ideas (Itl Esl
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2009), as it is often much easier to show a person how things work than to try to explain how things work.

Animation/cartoon is one type of visual support that children with ASD are attracted to, and this technique has already been implemented for many years in helping children with ASD to enhance their understanding of language (Myles et al. 2004). Animation figures can play an integral role in a number of intervention techniques, such as pragmatism (Arwood & Brown 1999), mind reading (Howlin et al. 1999), and comic strip conversation (Gray 1995). Each of these techniques promotes social understanding by using simple figures and other symbols.

The use of animation as a treatment approach for children with ASD has been widely supported by various authors, such as Wells (1998), Bernard-Opitz et al. (2001), Howlin et al. (1999), Herskowitz (2009) and Baron-Cohen et al. (2009). Children with ASD are capable of learning a new language within a program that is centered on a computer-animated agent, multimedia, to encourage active participation. Compared to video modeling, the use of this method shows that there is a transfer and use of language learned in a natural and untrained environment, as suggested by Bosselar & Massaro (2003).

Visual cues enhance the ability of children with ASD to understand their environment (Gray 1995; Rogers & Myles 2001; Myles et al. 2004). Visual symbols found in animation/cartoon often enhance the social understanding of children with ASD by turning an abstract and elusive event into something tangible and static that a person can reflect upon (Dunn et al. 2002; Hagiwara & Myles 1999; Kuttler et al. 1998; as noted by Myles et al. 2004).

A research by Bosselar & Massaro (2003) showed that children with ASD are capable of learning vocabulary with the help of a computer-animated agent. Positive results using animation to teach children with ASD have also been shown by Baron-Cohen et al. (2009), whose research shows that an animated movie has improved the understanding and emotion recognition in children with ASD. Using computerized animation, children with ASD are able to learn problem solving techniques (Herskowitz 2009); animation has also been proven effective in helping children with ASD to recognize human emotions (Golan et al. 2009; Baron-Cohen et al. 2009; Baron-Cohen et al. 2007).

As noted by Herskowitz (2009), animation can be used for several purposes: Firstly, animation can be used as a reinforcer, for example when a child performs a task correctly in the computer program, an animated character will display and congratulate the child for the job well done. The second function of the character animation is that it can be used as a prompt
device. And thirdly, the use of animation as the actual characters in the program can increase the child’s attention and focus on the task. There are two types of computerized animation, which are the 2D animation and 3D animation.

a. 2D animation

In the traditional technique, 2D animation is created in two flat planes or dimensions by making several sets of slightly different complete pictures and arranging them in a sequence to create an illusion of movement as perceived by the human brain. This is normally done manually by flipping a stack of notes or hand drawing pictures. In the modern technique, 2D animation is developed in digital format through the use of a computer program.

2D animation is a very common type of animation; it is widely used in the media industry, ranging from simple advertisements to movies, with great success (Itl Esl 2009).

Despite the fact that 2D animation has been widely used in many areas, there has not been much scientific research conducted on the effects of 2D animation, particularly on children with ASD, except for a few like Boraston et al. (2007) who studied the effect of 2D abstract animation on children with ASD, in identifying simple emotions. However, there has been much feedback from real-life experiences from the families of children with ASD who claimed that 2D animation was enjoyed by most of the children with ASD. Therefore, one of the study aims is to conduct a scientific research on how children with ASD respond to a 2D animation that is combined with a Social Story™.

b. 3D animation

3D animation is also one of the popular techniques in animation. According to Morrison (2003), the 3D model is the mathematical representation of a physical object, thus this makes 3D graphics, especially animation, to be extremely complicated because it often requires the heavy-duty mathematical processing.

The difference of 3D animation and 2D animation is that in the 2D animation, the object cannot be rotated to obtain views from different angles. This, however, can be achieved in the object of 3D animation. However, according to Morrison (2003), 2D animation is a more straightforward and efficient technique in animation compared to 3D animation. Therefore, while 3D technology is more advanced than the 2D animation, the use of digital 2D animation is more popular, where mostly cartoons on the televisions and movies are based. The 3D
animation is mostly used in computer-aided designs, such as in architectural building (Itl Esl 2009).

2.3.7 Video modeling (VM)

VM is the process of an individual, referred to as the model, being recorded in a video, demonstrating a behavior that can be imitated by another person (Dood 2005). The process of VM as a treatment for children with ASD often involves the child with ASD repeatedly watching videotapes of positive examples of competent confederates (could be adults, peers, or themselves) performing/engaging in a targeted behavior for improvement (Reichow & Volkmar 2010; Delano 2007; McCallister 2010; Baker et al. 2009). In this case, the child is also given an opportunity to perform the task in a real life setting (Reichow & Volkmar 2010; Ferraioli & Harris 2010). VM has been an important tool for teaching imitation and socially reciprocal behavior (Williams & Williams 2011); therefore, it is fit for social skill training in children with ASD (Hollander & Anagnostou 2007; Nikopoulos & Keenan 2003).

There are two types of VM which differ in the use of the model in the video. The first type uses competent confederates like peers, and the second type uses self-model in performing the targeted behavior, often referred to as video self-modeling (VSM) (Shipley-Benamou et al. 2002). Both types have proven effective as treatments for children with ASD in addressing social-communication skills, behavioral functioning, and functional skills (Bellini 2006).

VM has numerous benefits, including the demonstration of targeted skills in a relevant context, the use of multiple stimulus and response exemplars, and the standardization of the presentation of training, allowing for consistency (McCallister 2010). It is effective in promoting skill acquisition and maintenance in post-intervention (Shipley-Benamou et al. 2002; Nikopoulos & Keenan 2004).

The first study on VSM, conducted by Buggay et al. (1999) suggests that VSM is effective in increasing participants’ responses to questions during play situations. Therefore, it may constitute a positive behavior change. A review of nineteen empirical studies from 1985-2005 by Delano (2007) on the use of VM on children with ASD suggests that VM is effective in teaching a variety of skills to those children. Study by Taylor et al. (1999) show that the use of VM in teaching children with ASD to make play comments towards their siblings is effective.

MySchool Day is one of the commercial packages designed for use in VM activities (Prelock 2006). It is designed to facilitate learning by providing an option to pause and to discuss
information, reply scenarios for greater recall and understanding, and to engage in exercises that may help the learner to carry out the learned skills in everyday life. It is an interactive computer program that incorporates real-life video as a media of learning, to teach social skills to children and adolescents. The video clips illustrate a typical school day to allow the user to view the appropriate interactions and social behavior within the school environment. The user will be asked to identify, explain and produce several social situations in response to the video clips.

Setting up VM as an intervention for children with ASD requires a long process and needs at least two people involved in the video production (Moor 2008). The effectiveness of VM is subjective, depending on the child; VM can be more or less useful as an intervention (McCallister 2010). A study by Charlop-Christy & Daneshvar (2003) has found out that children with ASD can perform a generalization of the skills learnt from the VM; however, unlike their result, a study by LeBlanc et al. (2003) indicates that there is only a limited generalization in the skills learnt from VM. Therefore, strategies need to be developed for enhancing the generalization of the new skills learnt from VM.

2.3.8 Interactive computer software

The traditional method of teaching children with ASD is often monotonous, laborious and not effective (Sharmin et al. 2011). Therefore, for this reason and concerning the natural interest in computer of children with ASD, many developers have been led to produce interactive software to assist their play and learning activities.

In learning vocabulary, the use of the educational interactive computer software is more effective, where children are more attentive, motivated and can learn more vocabulary compared to learning through the behavioral program (Moore & Calvert 2000). The interactive computer software is also effective in increasing intelligibility in children with ASD (Sharmin et al. 2011).

The result of a study by Hetzroni & Tannous (2004) in the use of interactive computer software for enhancing communication functions of children with ASD indicates that after exposure to the software simulations, children produce fewer sentences with delayed and irrelevant speech, engage in fewer sentences involving echolalia and increase the number of communication intentions and the amount of relevant speech. Children are also able to transfer their skills learned from the software setting to the natural classroom environment.
a. **Mouse Trial**

*Mouse Trial* is one of the software packages based on the method of discrete trial therapy which is a major component of ABA and the related treatment programs.

There have not been many literature reviews on the *Mouse Trial*, however, Moor (2008) and Hall (2010) have suggested for *Mouse Trial* to be used as one of the software packages for children with ASD. *Mouse Trial* is utilized to develop vocabulary that can be used in communication for children with ASD. This software is available at a very low cost and is easy to be used by children with ASD, as long as the children are able to interact with computers. However, the features in *Mouse Trial* are limited to object recognition.

b. **MyYard**

*MyYard* features an expressive animated dog called *Buddy* and a series of circus characters in order to teach children to stay in their own yard while playing outside, to reinforce the importance of staying in their yard. The software comes with five main features which are: Stay in the yard; guard the yard; sing-a-long; color & get-2-free; and printables.

The learning of *MyYard* starts with a child making a connection with *Buddy* who will show him how to do things. According to Nelson (2008), 80 percent of participants in a multiple study groups using *MyYard*, had been able to transfer their new skills to the real world after 20-30 minutes of using the software.

c. **Gaining Face**

*Gaining Face* is an interactive computer software which helps people with AS learn to recognize facial expressions. It was developed in 1999 by Team Asperger, and has been studied by professionals in order to help people with AS learn to recognize facial expressions and associate them with moods and emotions (Hall 2010).

The software has four main features. The first feature *Faces of Moods*, allows the user to pick a mood by name, and it will illustrate and explain the expression that accompanies it. The second feature is *Moods of Faces*, where the user can select an expression from a pictorial menu of thumbnail images. The software then illustrates the chosen expression and provides a text narrative explaining the distinguishing features of the expression. The third feature is *Compare Expression* where the user can choose pairs of facial expressions, one from each of two side-by-side lists. The software then illustrates both expressions, side-by-side with a descriptive text to help the user discern their differences and similarities. The last feature is
Quiz, which consists of twenty questions, testing on the user’s skill at recognizing and distinguishing various facial expressions.

d. Mind Reading

Mind Reading is a memorization software for children with ASD in learning to recognize the expressions and emotions of others (Bryant 2004). The user can learn human emotion and the meaning of facial expressions including the tone of voice, by providing a live-action video library of all human emotions from six actors that portray 412 video expressions of emotion. These expressions are in the context of short stories that will provide appropriate information about the emotion (Bryant 2004).

There are three main features in Mind Reading. First is the visual dictionary of emotion titled Emotion Library, the second feature is the Learning Center, consisting of a variety of lessons and quizzes to present emotion in a systematic way and a recognition test, the difficulty of which can be adjusted to suit the ability of the user. Learning Center also features rich sets of rewards to motivate the user. The last feature is the Games Zone, where a user can play games to guess the feelings of others. It encourages informal learning of emotions in a fun and less structured setting to reinforce learning.

e. Affective Social Quest (ASQ)

ASQ was developed by Blocher and Picard (2005) at MIT for children with ASD. ASQ aims to help children with ASD learn to associate emotions with expressions and situations (Bryant 2004). The system plays videos of both the natural and animated situations giving rise to emotions, and the child interacts with the system by picking up one or more stuffed dwarfs that represent or are related to the set of emotions under study (video clips), and it is wirelessly connected to the computer via infrared (Bryant 2004).

ASQ was built on the strength of the visual system of children with ASD through the use of the video. This system has been tested and it has shown positive results, as a three-year-old participant has an increased ability to identify a wider range of emotions after each session of training with ASQ (Poon 2006).
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f. Emotion Expressor

*Emotion Expressor* is a project by Poon (2006), done with the aim of developing a prototype system that allows children with AS to explore their feelings and to express their opinions on a selected topic, and to enable them to express their feelings about the topic as easily as possible.

The interface of the system was developed and refined, using a user-centered design approach. A picture set was used since children with ASD are visual learners. *Emotion Expressor* focuses on the picture symbols that are the basis of communication, as these can be easily selected and understood by children.

g. Emotional Social Intelligence Prothesis (ESP)

*ESP/Self Cam* was created in the MIT Affective Computing Group Media Lab in 2006 (Teeters et al. 2006; MIT Media Lab 2009; Frames MIT Lab 2006) as a tool for children with ASD, and it consists of a wearable camera aimed at the wearer’s face for facial expressions. The data of the facial expression could be read and analyzed in real time by the system, i.e. the belt-mounted computer and real-time mental-state interface software that gives personal feedback to the wearer. The information gathered would be communicated back to the wearer immediately, allowing for dynamic reading of the effect in interpersonal situations with assistance from technology.

*ESP* analyses the wearer’s facial expressions and head gestures in real time. It infers six underlying affective cognitive-state of mind: agreeing, disagreeing, interested, confused, concentrating and thinking. The wearer of *ESP* can explore who they appear to be from other people’s point of view. *ESP* could help children with ASD improve their empathy by observing non-verbal cues and behavior of others; they would attribute mental states to these and respond accordingly (Teeters et al. 2006; MIT Media Lab 2009; Frames MIT Lab 2006).

h. Limitation of interactive computer software

According to Hall (2010), there is not much interactive software available for children with ASD, except for the few focused on specific aspects. Therefore, the computer is only to be used as an occasional support and not a dominant part of their learning activities. More research is also required to establish whether skills learned from computer instructions will be generalized into non-trained problem situations in the real life context (Bernard-Opitz et al. 2001).
2.3.9 Virtual reality (VR)

The potential for using VR in educational context for children with ASD has been recognized by authors such as McComas et al. (1998), Vera et al. (2005), Parsons et al. (2005), Herrera et al. (2006), Parsons et al. (2004), and Cobb & Sharkey (2007). There are two types of VR available, Immersive Virtual Reality (IVR) and Non-Immersive Virtual Reality (NVR).

In IVR, the user is required to wear a head-mounted display (HMD) stereo to provide a full visual immersion and special gloves that allow six-degree-of-freedom input for directly manipulating the environment (Robertson et al. 1993). The HMD devices are expensive and heavy to use, and can cause symptoms of cyber-sickness. Therefore, IVR may not be an appropriate technology to use with children with ASD (Parsons et al. 2004).

NVR is also referred to as Desktop VR, and it represents an alternative approach to the IVR. There are non-internet-based NVR and internet-based NVR, which, according to Wadley & Ducheneaut (2009) have become a popular form of 3D environment and are proposed for a variety of workplace scenarios. In Desktop VR, the user experiences a 3D environment that can be directly manipulated by a conventional graphic workstation using monitor, keyboard, and mouse. The scene is displayed with the same 3D depth cues used in IVR: perspective view, hidden-surface elimination, color, texture, lighting, shading, and shadows (Robertson et al. 1993). Desktop VR is more affordable and accessible for educational use, and tends to be much less susceptible to the symptoms of cyber-sickness (Parsons et al. 2004).

a. Second Life/Brigadoon City

One example of a successful VR application is Second Life (SL), a computer generated 3D online virtual world established in 2003. In this virtual world, objects such as houses and activities are created by the residents, i.e. players of the SL.

An individual with ASD has difficulty in social interaction and is unable to feel a sense of belonging in the real world. Therefore, the virtual world could serve as a therapeutic tool, an ideal place for them to communicate and interact with people via their avatars (Lester 2005; Shore & Zhou 2009; Weiss & Klinger 2009; Klinger & Weiss 2009; Bury 2008). Based on this idea, John Lester in 2004 purchased a 16-acre Private Island in SL and named it as Brigadoon City (Ball & Pearce 2008; Lester 2005; Bury 2008; Shore & Zhou 2009).

Brigadoon brings individuals with AS together to relate and help each other in their similar struggles. Lester attempts through Brigadoon City to enhance the lives of individuals with AS in
developing their social intelligence and communicative skills (Lester 2005; Bignell 2007; Burke 2008). *Brigadoon* is a private enclave reserved specifically for a mixture of caregivers and individuals with ASD as a medium to allow them to form social bonds in the virtual world, while learning and growing through the support and experiences of others within a flexible and safe environment (Lester 2005; Willems 2009; Shore & Zhou 2009). The residents of *Brigadoon City*, who call themselves Dooner, have the same privileges as others in the more public sector of SL. They are able to create their own avatars, build houses, and make friends through socialization, which have been much harder in their real lives (Bury 2008).

Research shows that the *Brigadoon* environment has some beneficial features for individuals with ASD (Sheehy 2008; Biever 2007). The controlled simulation environment is less fearful because it does not involve local interactions (Weiss & Klinger 2009; Klinger & Weiss 2009). However, Hansen (2009) reports that the residents in SL have lost their interests in their virtual world (i.e. Second Life). Weiss & Klinger (2009) also state that the ability of the virtual world of *Brigadoon* to teach social skills that are effective in real world situations still needs to be evaluated.

b. *iSocial*

*iSocial* is a 3D virtual learning environment created by Laffey et al. (2009) to support social competence development for adolescents with ASD and it is a Virtual Environment (VE) with the same concept as SL, however, with a smaller scope enclave specifically for adolescents and children with ASD.

Users and online guide of *iSocial* from different physical places could gather together in the *iSocial* virtual place where their appearances are represented in 3D avatars that would allow them to move around virtually and interact with the virtual world with the sense of other presence in the VE. There are tasks in *iSocial* that would require the users to interact with each other. There is a local teacher-facilitator who is with the students physically during the orientation. The user is expected to work with minimal supervision from the teacher. Upon login to the *iSocial* system, the user is able to see other students who are online, and the student will be greeted by an online guide, who is the trained teacher. The user could go into his virtual room which holds trophies and awards from previous accomplishments in *iSocial*, where a review of what has been achieved so far is also been provided.
Field tests conducted on *iSocial* indicate that *iSocial* is easy to use and is enjoyable for most users. Users are able to operate the system within the VE with minimal difficulty, engage in instructions, follow directions and interact with others.

The challenge in *iSocial* lies in the coordination of activities by the online guide. The online guide often has trouble in managing the instructions due to a lack of non-verbal and paralinguistic prompts. Communication with the teacher-facilitator is limited as the teacher can hear and see what is happening in the virtual world, but cannot communicate with the online guide. The online guide also lacks effective tools to coordinate with the teacher-facilitator to ensure that the users focus their attention on the task physically and virtually without getting distracted.

c. Sam, the virtual playmate

*Sam* is a gender ambiguous virtual peer developed to teach safety and social skills to children with ASD by simulating behavior and conversations of the children (Tartaro 2007, Tartaro & Cassell 2006a, Tartaro & Cassell 2006b). In order to boost motivation and to facilitate teaching, the key feature of *Sam* is that the control of the interaction will be under the children as the users (Trepagnier et al. 2006).

The image of *Sam* is displayed on a large drop-down or plasma screen and is projected against a background that matches the actual room, creating the illusion of shared space. Social communication and interaction among children fall under the watchful eyes of *Sam* who can track eye movement and has computational intelligence that allows *Sam* to respond to the children’s behavior on its own.

*Sam* acts as a bridge between two worlds, the virtual world of *Sam* and the real world of the child, and a wooden castle is used to bridge the two worlds. That miniature wooden castle anchors the play session, with its front end in the real world and its back end appearing in *Sam*’s virtual world. *Sam* would guide the child who interacts with him through the process of toy sharing and storytelling.

In the system, the child can play with three figurines and *Sam* can track their eye movements. When a child puts a figurine in the wooden castle’s so called *magic attic*, the figurine would reappear virtually in *Sam*’s hand. This gives the impression that the real child and *Sam*, the virtual peer, are sharing toys.
A study was conducted on six children with ASD, aged 7 to 11 (McGlaun 2008). They were engaged in a half-hour play session with collaborative narratives with both a real human and Sam. The findings suggest that contingent discourse increases over the course of interaction with Sam and not with the human peer, thus children with ASD are significantly more likely to respond to Sam’s invitation than to the real child’s. Furthermore, topic management such as introducing a new topic or maintaining the current topic is more likely to occur between the children with Sam rather than with the human peer. The story narratives are more interactive in Sam’s company (Tartaro & Cassell 2008).

d. Virtual street

Virtual Street is a VR program in which the user is required to guide the avatar across the divided crosswalk to a virtual Toys R Us store. The purpose of Virtual Street is to improve the traffic safety skills of children with ASD. The pared-down urban street scene in the program has proven its worth in teaching moderately functioning children with ASD on how to safely cross the street and to gain more independence in the process.

A study which was conducted suggested that the children, when presented with the program, quickly and noticeably improved their scores. At the onset training, they scored 2.66/9 and improved to 8.91/9. Likewise, their cumulative accident tallies decreased from 22 to 0. Three of six children were able to transfer their skills learned from virtual street to park street crossing (Nelson 2008).

e. Limitation of virtual reality approach

Children with ASD often interpret a situation literally; therefore an overly literal interpretation of the environment in VR could limit its usefulness as a tool to learning social skills, as the users of VR need to understand that what happens in the VR is not a literal representation of what happens in real life.

VR is a simulation technology, so no matter how perfect the virtual world is designed, the user’s activities in the virtual world are limited, compared to the real world (Zhao & Wang, 2008). In addition, in order to get engaged with the virtual world and their avatar, the user needs to spend a lot of time in the VE (Zhao & Wang 2008).

According to Vera et al. (2005) and Brown (2009), due to the high cost and complexity in its development, VR-based educational software is extremely limited in the market, especially for special education, making it not widely available for the general public yet.
2.3.10 Social Story™

*Social Story™* (SS) was first developed by Carol Gray in 1991 (Gray & Garand 1993) as an intervention strategy that taught social skills to children with ASD. SS is a promising approach and the effectiveness has been proven by numerous studies that have reported improvement in children’s behavior after a systematic exposure to SS, such as Hagiwara & Myles (1999), Ivey & Alberto (2004), Scurlock (2008), Bledsoe et al. (2003), and Rogers & Myles (2001).

SS is a brief, written story that explains a social situation that is causing difficulty in a person’s life due to the lack of information or cognitive confusion (Scurlock 2008), and it is used to provide concrete information to help improve social skills and appropriate behavior. Therefore, the objective of SS is to describe rather than to direct, and it provides a child with information through text and visual images. In each story it provides concise and accurate information about what is happening in a specific social situation, what people do, why they do it, and what the common responses (expected behavior) are to help children with ASD to feel more relaxed and comfortable in social situations. The child’s improved understanding of events and expectations from the story could lead to a more effective response (The Gray Center 2010).

SS is a great tool for teaching skills through direct instructions, giving a better understanding of other people’s thoughts, feelings and views, the areas where children with ASD are unable to pick up naturally. Therefore, providing SS to children with ASD before an event could help them predict actions, behavior and assumptions of others (Gabbert 2010). This could lead to a decrease in a child’s anxiety, improve his/her behavior and help him/her understand an event from the perspective of others (Heward 2006).

SS attempts to address the Theory of Mind impairment by helping children with ASD to be able guess beliefs, thoughts, feelings, emotions and behaviors of others (Wallin 2009). This will help strengthen their intuitive skill and instill in them a sense of ethics (Gabbert 2010). Therefore, SS should inculcate concrete and clear information on the social situation, expected behavior from characters involved, in order to improve their reactions and responses in the situation. It should also explain simple steps for achieving certain goals or outcomes.

The main goal of SS is not to change behavior, rather to increase the understanding of social situations and expectations in these situations, by describing the social situation in detail and translating the goal of the social event into understandable steps including appropriate responses. This would help the child to be more comfortable in the situation and could
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facilitate the opportunity to learn more effective responses to the social situation (Ball 2008; Wallin 2009).

2.3.10.1 Guide for writing Social Story™

Gray & Garand (1993) describe four main types of sentences which can be used in writing SS: descriptive sentences, perspective sentences, directive sentences and control sentences (Attwood 2005; Batts 2004; Brownell 2002; Kuoch & Mirenda 2003; Lorimer et al. 2002). However, according to various authors, there are currently six types of recognized sentences including the original four that can be used in writing social stories (Matson 2009; Barry & Burlew 2004; Crozier & Tincani 2007; Reynhout & Carter 2006; Kokina & Kern 2010; Sansosti et al. 2004; Test et al. 2011). They are:

- **Descriptive sentence** is the type of sentence that objectively defines where a social situation occurs, who is involved, what they are doing, and why they are doing that. It could also be used to suggest to the learner the expected positive response to the situation or new concept, and to provide sequential steps for completing the activity.

- **Perspective sentence** is the type of sentence that provides an insight into another’s internal states by describing how others involved, feel in a social situation. This type of sentence is mainly used to reflect other people’s perspectives especially on behavior, desire, emotion, knowledge, thought, feeling, belief, opinion, motivation or physical condition in a social situation; so the learner can learn how different people perceive differently in various situations. This type of sentence attempts to address the Theory of Mind impairment in children with ASD.

- **Affirmative/control sentence** is the type of sentence that is used to re-assure the learner. The control sentence uses analogies to explain a situation. It identifies personal strategies that the learner will use to recall and to apply the information learned from the story, reassuring the learner’s responses. Often written by the learner after reviewing the story, this sentence may be eliminated from lower functioning or younger children with ASD.

- **Directive sentence** is the type of sentence that directly tells the learner what is the expected behavior in response to a social situation. It often begins with “I will try to...” or “I can...” and it answers the “wh” (who, what, when, where and why) questions.

- **Cooperative sentence** is the type of sentence that tells the learner who can assist him/her in different situations.
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- **Consequence sentence** is the type of sentence that tells what will happen as a result of certain actions.

Not every SS will contain all the six or even the four main types of sentences (Washburn 2006), such as in the studies by Adams et al. (2004), Bledsoe et al. (2003) and Lorimer et al. (2002). In contrast, it may also contain long and complicated sentences, like in Dodd et al. (2008). SS primarily consists of descriptive and perspective sentences, since the primary goal is to provide information rather than instructions (Brownell 2002). As cited by Brownell (2002) and Gray (1994, 1997, and 1998) the most frequent mistake in SS is the utilization of too many directive sentences that turn the story into a rigid set of rules for the children to follow; therefore, phrases like “I will try to...” is preferred to “I will...” (Brownell 2002; Bledsoe et al. 2003).

According to Doyle & Iland (2004), SS should contain components of: (1) descriptions of what will happen; when, where and who will be present in the event, (2) descriptions of positive emotion or feeling that the learner may experience, positive thoughts the learner may have, and descriptions of expected behavior of the learner, (3) descriptions of what others may be thinking or feeling, (4) list of action steps for the learner, and (5) descriptions of any reward that may follow.

### 2.3.10.2 Application of Social Story™

SS was first developed for children with the higher functioning form of ASD. However, in the development, researchers found that the SS approach has also been successful with children, adolescents, and adults with ASD and other social and communication delays and differences, as well as young children who are developing normally (Gray 1994). SS for adults and adolescents must be written in a more age-appropriate level and format.

SS works especially well for children with ASD because of their inability to see social situations from the perspective of others and their dislike of surprises. Bauminger (2002) suggests that intervention should focus on facilitating the child’s social understanding, teaching them the ability to read social cues in different social situations; enhancing the capacity for making accurate social interpretation, and expanding the child’s repertoire of behavioral alternatives for different social tasks.

In terms of skill teaching, SS was initially developed to teach social skills. However, in the development, it expands beyond the scope of teaching social skills. It has also been used to teach a number of social and behavioral concepts in any environment/setting that children...
with ASD are having difficulty in, including self-awareness, self-calming, and self-management skills. SS is also used to teach new routines, how to tolerate changes of routines, and to teach things that the child values or is interested in.

According to The National Autistic Society (UK) website, SS has a huge range of applications, including: (1) to develop self-care skills (such as how to wash hands or get dressed), social skills (such as sharing, asking for help, saying thank you) and academic abilities; (2) to assist the learner to cope with changes in routine, and unexpected or distressing events such as absence of teacher, moving house or a thunderstorm; (3) to provide positive feedback to the learner regarding his/her area of strength or achievement in order to develop self-esteem; (4) to develop behavioral strategy, such as what to do when angry or coping with obsessions.

SS has been found effective in increasing appropriate greetings and compliments (Swaggart et al. 1995; Dodd et al. 2008), and increasing verbal interaction (Crozier & Tincani 2007). It also decreases inappropriate social interaction (Norris & Datillo 1999), increases initiation of comments and requests with generalization and maintenance across social behaviors (Delano & Snell 2006; Scattone et al. 2006; Thienmann & Goldstein 2001), decreases echolalia and excessive voice volume (Brownell 2002), and decreases tantrums and ineffective communication (Lorimer et al. 2002). Apart from that, it increases appropriate use of words (Adams et al. 2004), capacity in labeling and explaining emotions (Bernad-Ripoll 2007), and increases conversational abilities (Sansosti & Powell-Smith 2006, 2008).

2.3.10.3 Presentation of Social Story™

The original SS format as introduced by Gray from 1991-1995 is a plain paper-based format, where the text was printed on paper without any use of pictures or visual cues. Since children with ASD are visual learners, researchers found that incorporating visual cues such as pictures/drawings, or even real objects to each page of the story could increase the child’s understanding, thus, adding to the effectiveness of SS for children with ASD (Wallin 2009; Heward 2006; Gabbert 2010).

Hagiwara & Myles (1999) were the first to conduct a study to use the multimedia approach combining SS, visual symbols and computer-based instructions. Roger & Myles (2001) combined SS with comic strip conversations; Thiemann & Goldstein (2001) combined SS with a multi-component intervention which included SS, cue cards, role-play and video feedback.
The use of SS in combination with other methods of presentation has been widely studied, not only in combination with visual cues in paper text, but also in combination with music, power-point or video modeling, as discussed in the following section.

a. Paper-text

There are a few variations of paper-text based SS that include plain paper text with cues and with partnership with a teacher.

*Paper-text*

Scurlock (2008) presented a study of SS to a 10 year old boy with AS in her thesis. The purpose was to examine the effect of individualized SS intervention on sportsmanship social behavior. To address the boy’s problematic behavior, SS was typed on white paper mounted on black construction paper and was compiled into a book-like format that was spiral bound at the top. One or two sentences were placed on each page. The story was not combined with other interventions, including illustrations.

The overall result suggested that the introduction of SS had a positive effect on the participant. However, this study was a single subject design with a single participant, therefore, generalization of the findings to other students or behaviors was not proven.

*Paper-text with visual cues*

Schneider & Goldstein (2009) investigated the effect of SS on three children with ASD. There were two phases of the study, the first phase used plain text SS but the result was only fair and therefore, in the second phase, visual schedules were added to SS replacing the reading of SS. The visual schedule used pictures and shorter phrases adapted from the SS at the first phase and it was placed on a 6 by 9 inch black foam board.

The results of the study indicated that SS is effective in improving appropriate behaviors of the participants, and the visual schedule in SS holds promise for children with ASD. After the intervention, participants were able to respond more appropriately and were able to manage their behaviors, indicating that SS could facilitate the development of self-management.
Paper-text with partnership

Agosta et al. (2004) collaborated with a classroom teacher and a team of university researchers to address the problem behavior of a child with ASD. The classroom teacher had tried several techniques to decrease these behaviors, however, none was successful. For the study, SS was developed to be used in two different approaches. The first approach was with tangible reinforcement of the reward system (candy), and the second approach was done with a minor variation that was the removal of the tangible reinforcement (candy). SS was presented in a 5-page booklet, with one sentence and accompanying pictorial icons from Boardmaker on each page.

The result collected from the study revealed that the SS presented by the classroom teacher successfully helped to solve challenging behavior of the participant in the classroom. However, this approach requires the classroom teacher to become a central member of the research team throughout the study, and to be exceptionally faithful in reading the story and providing positive reinforcement. This method is time and effort consuming, especially in a large classroom context where a teacher has to cater to quite a number of students and will not be able to focus on a single student.

b. Comic strip conversation (CSC)

CSC is a type of SS, adapted for younger children or those with limited verbal communication skills, that utilizes simple symbols, stick figures and colors to identify key elements of social interaction (Glaeser et al. 2003). It is used as a positive behavioral support strategy to improve the social skills of children with ASD (Pierson & Glaeser 2005). CSC is based on beliefs that visualization and visual support is useful in structuring the learning of children with ASD and to improve their understanding and comprehension of conversations (Gray 1994, cited by Fouse & Wheeler 1997). It provides additional support to individuals who struggle to understand the quick exchange of information which occurs in conversation, by providing visual representations of the conversation to enhance understanding and comprehension (Dood 2005; Gray 1994).

The illustration in CSC usually consists of stick figures and bubbles where the figures’ words and thoughts are written. It focuses on what people in a situation may be thinking and assists them in understanding the situation or another person’s perspective (Dodd 2005). This technique involves drawing an event on a story board with stick figures to represent each participant and using speech and thought bubbles to represent the participants’ words and
thoughts, allowing children with ASD to analyze and understand the range of the message and meaning that are a natural part of a conversation or play (Attwood 2004).

Fouse & Wheeler (1997) suggest CSC to be used with children with ASD who enjoy drawing. CSC is most useful in conveying information or in teaching social skills (Dood 2005). It helps children with ASD discover the thoughts, beliefs, knowledge and intentions of the participants in a social situation (Attwood 2004). According to Attwood (2000), CSC is particularly useful for clinicians in analyzing a child’s motives when a specific incident has caused considerable distress, as well as in illustrating alternative responses that a child could make.

There are few studies published on the use of CSC to present SS to children with ASD. A study by Rogers & Myles (2001) revealed that SS presented in CSC had successfully changed the behavior of a 14 year old child with AS, and the child enjoyed using the CSC and had requested to use it for other settings. A study by Pierson & Glaeser (2005) on four students with problems in social behavior showed that all of the four participants improved their perception of the social situation, exhibited appropriate social growth and began to generate their own solution to difficult social situations, and demonstrated decrease in target behavior. Glaeser et al. (2003) describe three steps to implementing CSC with illustrated examples for a child with mild ASD and an aggressive child. However, the CSC technique has not been examined by independent empirical research (Attwood 2000).

c. Music integrated into the SS

Brownell (2002) was the only author investigating the effect of musical presentation of SS on the behavior of children with ASD, in his Masters’ study. The participants of the study were four children with ASD. To address the behavioral goals, two versions of a unique SS were created. One version was the original SS with only text, and the subsequent version of original music was composed using the text of the SS as lyrics.

The independent variable was one of three treatment conditions: baseline (a); reading the story (b); and singing the story (c). The result from all four cases indicated that both the reading condition (b) and the singing condition (c) were significantly more effective in reducing the target behavior than the no-contact control condition (a). The singing condition was significantly more effective than the reading condition in case study 3. For the remaining case, the mean frequency of the target behavior was smaller during the singing condition but not significantly so. These results suggest that the use of musically adapted version of SS is an effective and viable treatment option for modifying behavior in children with ASD.
d. Computers and SS

As a majority of children with ASD show a great interest in computers, researchers have adapted the computer as a presentation format of SS, such as in Power-Point and VM. SS in computerized format was first implemented by Hagiwara and Myles in 1999, using PowerPoint instead of paper in presenting pages of the story. Following them, there were a few more computerized SS for children with ASD studies, such as by Sansosti & Powell-Smith in 2008. More (2008), suggests presenting SS by using a slideshow program. These studies show that the combination of SS and visual image on computer is effective in helping children with ASD learn social skills.

Benefits of the computer to children with ASD include: children enjoy and respond well to the computer’s structure, explicit, consistent expectations and challenges (Strickland 1997; Tartaro & Cassell 2008). The computer offers a conducive environment to children with ASD, as it provides a safer learning situation by individualized tutoring where instructions could be repeated without tedium and potentially counter-productive human intervention (Elzouki et al. 2007; Strickland 1997). The computer environment can also be made progressively complex until it becomes a realistic scenario, to help children function safely and comfortably in the real world (Elzouki et al. 2007; Strickland 1997; Vera et al. 2005). Computers are predictable and do not demand social skills required by humans, such as not having to look them in the eyes, not having to talk to them and read their emotions (Tartaro & Cassell 2008).

Mancil et al. (2009) conducted a study that compared two different formats of SS to three children with ASD. For this study, a SS that addressed all of the three children’s needs was developed. The story was seven sentences long, one written in paper format with pictures of peers performing the targeted behavior and another in a computerized format in the form of an interactive power-point presentation. The latter format was referred to as Computer Assisted Social Skills Training (CASST), which presented the story with a black background using the same pictures and text used in the paper format. Compared to the paper format, the text used in the power-point version was interactive; when a space bar was pressed, the text would slowly change colors to serve as a visual cue to read the text. The overall results showed that the CASST format was slightly better than the paper format, as all participants preferred the CASST format to the paper format and they could maintain the use of the CASST format without teacher prompting. Teachers also reported that they liked the CASST format better than the paper format because the students seemed to enjoy the CASST format more. Each teacher noted a change in the participants’ behavior by the end of the study. After the last
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intervention session, participants were asked to choose whether to continue using the SS. Each participant chose to continue using the CASST format and had been using it during the two week interval following the final phase, without assistance from adults.

Studies by Mancil et al. (2009), Sansosti & Powell-Smith (2008) and Hagiwara & Myles (1999) also find that computerized SS is as effective as SS in the original paper-text, or even slightly more effective.

e. Video

According to Scattone (2008), Video Modeling (VM) has been found effective in enhancing conversational skills for children with ASD; therefore, Scattone (2008) combined SS and VM in an effort to examine the impact on conversation skills of a 9 year old boy with AS who had poor eye contact and had often engaged in one sided conversations. Attempts by his mother and teacher to teach him appropriate social behavior had failed.

Three different SS for three different target skills (eye contact, smiling and initiation) were developed. Each story was compiled into a booklet of 6, 7 and 10 pages respectively. The wording on each page was shown in the video narrated by an adult. After the story had been narrated, the adults modeled the target skill during 5 minutes of video-taped conversations.

When the treatment was introduced, the participant immediately demonstrated an improvement in eye contact, however, smiling was difficult for him to master, and the results indicated that no appreciable improvement had occurred. As reported by his mother, it was difficult to maintain the participant’s interest in viewing the video towards the conclusion of the study, especially after he had mastered the skills. This study shows that SS combined with VM may be an effective intervention for some children with ASD in certain skills. However, the exact role VM plays in conjunction with SS is uncertain and needs further exploration; it is impossible to determine how individual components contribute to the effectiveness of SS.

Another study on SS and VM was conducted by Litras et al. (2010), who investigated the effectiveness of SS combined with VSM in teaching social skills to a 3 year old child with ASD. His study showed that this combined intervention was effective in improving targeted behaviors.

One drawback of video modeling is the process involved in the video production which requires extensive planning, is time consuming and is resource intensive, especially in video self-modeling where the video will only suit a specific child (Litras et al. 2010).
2.3.10.4 **Limitations of Social Story™**

There has not been much limitation of SS reported. However, Prelock (2006) states that the maintenance of skills learned from SS is somehow inconsistent, therefore more research is needed to demonstrate generalization and maintenance effect of the skills learned from SS across social context.

The paper-text based SS presented by teachers to use as a classroom lesson had received positive responses. However, to use it as a classroom lesson in a consistent manner is time consuming for the teacher especially when handling a large group of students with ASD (Crozier & Tincani 2007). The inconsistency in the SS deployment decreases its effectiveness as a tool in remedial behavior. Therefore, a more appropriate approach is needed, such as an approach where the children can read the SS on their own.

2.4 **Critical Review**

ASD is a wide disorder with causes that are still unknown. Available treatments cannot fit every child. There are many areas of deficit that children with ASD experience, as explained by the *Triad of Impairment*. The main deficits that all children with ASD have, is in the area of social skills, which is mainly caused by an impairment in the ToM, which medical researchers suspect to be caused by brain abnormalities affecting the areas that involve social behavior. Because of this impairment, children with ASD have difficulties in social interaction compared to normal children. Fortunately, children with ASD can improve their social communication and social skills with early detection and treatment.

As the cases of ASD are on the rise, there have been many applications that are mainly targeted at children with ASD in teaching, learning, communication and social skills, ranging from the simple PECS to the high-end system, such as *immersive virtual reality*.

SS is also one method of treatment for children with ASD to learn social skills. It has been used widely and effectively in teaching social skills to children with ASD, with many supports from various publications to use SS to improve the social skills of the affected children. The most common presentation type of SS is in the original paper-text based with or without the use of pictures as visual cues but there are also computerized SS in Power-Point presentation format.

For the SS approach to be effective, it requires an intensive teacher-student interaction with a long period of treatment. The presentation format of the current SS is also somehow dull and not interactive, even in the Power-Point format. The presentation of SS can still be improved
to catch the attention of children with ASD, thus they could learn on their own without intensive support from the teacher.

To achieve this goal, the presentation of SS needs to be something that a child with ASD is attracted to, thus they would be motivated to learn independently. Studies have also proved that children with ASD are naturally interested in computers and visual cues. Animation, which is a type of visual cue, has also been used effectively in teaching children with ASD, as illustrated in the review.

Thus, the intention of this study is to combine SS with the computer and 2D animation as a pedagogical tool for children with ASD to learn social skills. SS is presented as 2D animation with the computer as the medium. We can anticipate that this method of presenting SS should be effective in assisting children with ASD to learn social skills, as the review has highlighted that SS has been used effectively and 2D animation has engaged the attention of children with ASD.
Chapter 3: Conceptual Design and Modeling

3.1 Introduction

After grasping the idea of the nature of ASD, the current treatment tools and their limitations from the Literature Review, this chapter lays out the essential information to design the prototype to suit the needs of the targeted audience. It includes the research problems and proposed solutions, followed by the research methodology and procedures, the conceptual design and its rationale, the preliminary study conducted and finally the improved conceptual design based on the results of the preliminary study.

3.2 Research problem

The literature review highlighted crucial information that relates to the research. It started with the growing rates of diagnosis of ASD (Stillman 2009; Bogdashina 2006; Fambonne 2003; Shattuck 2006; Kaufmann & Silverman 2010; Lewandowski 2010; Williams & Williams 2011).

Children who have been diagnosed with ASD have problems in the area of social skills, which include verbal and non-verbal communications, behavioral inflexibility and impaired social interaction, as explained by the deficit in Theory of Mind and Triad of Impairment (Sicile-Kira 2004; Bogdashina 2006). These were explained as being caused by brain abnormalities, however, there is still no exact known cause for these brain abnormalities. Thus, treatment for them to cope with their social skill impairment is needed and crucial, to help them manage their social lives; this is a fundamental step to help them lead independent lives.

There are many ways to learn social skills. SS, computer and visual cues including 2D animation, play an important role as treatment tools for children with ASD. Each of these approaches has been used positively with children with ASD, whether used individually or in combination with others. It is also evident that SS is more effective when it is used in combination with visual schedules, as they enhance learning and understanding of children with ASD (Schneider & Goldstein 2009).

The use of visualization and visual support, such as pictures and animation has been found useful in structuring the learning of children with ASD, in improving their understanding and comprehension of conversations (Gray 1995; Odom & Watts 1991; Twachtman 1992; Quill 1995; Quill 1997), as well as in reducing teacher prompts (Odom & Watts 1991).
Chapter 3: Conceptual Design and Modelling

SS in combination with visual schedules has also been incorporated into computerized format, where the power-point presentation program is used to display SS together with the visual cues. Studies have suggested that these increase the propensity of children with ASD towards their learning, thus producing more positive results compared to the normal paper-test based SS (Hagiwara & Myles 1999; Mancil et al. 2009; Heimann et al. 1995; Sansosti & Powell-Smith 2008).

However, the use of static pictures as shown in the previous studies often fail to portray the non-literal components in communication, such as body language, facial expression and gestures. Another problem of the current SS method is that it requires intensive teacher-assistance or supervision. For the SS to be effective, it requires a teacher to be a part of the program during the student’s learning time, to read out the SS to the student intensively and personally for a period of time.

Children with ASD eventually need to learn social skills more effectively to help them cope with everyday life. The following specific research questions are raised to address the issues above.

1. How effective is the combination of SS and 2D animation in computer presented format as an intervention tool in assisting children with ASD learn social skills in the school setting?

2. How is the user’s (child with ASD) response to this new approach of intervention?

3.3 Proposed solution

Looking at the limitations of the current treatment, researchers are trying to discover new interactive and dynamic approaches in helping children with ASD to learn social skills effectively. The issue in the use of static pictures could be altered with the use of moving pictures, i.e. animation.

The matter concerning the intensive student-teacher time required by the current method could be overcome by a tool that can be used by the children independently. To develop such an independent learning tool, there is a need first to develop the children’s natural interest in the learning tool. To achieve this, the tool must be appealing to children with ASD so that they would be motivated to learn and their willingness to learn would be formed naturally; thus it will require less supervision time by the teacher and will lead to independent and effective learning.
Chapter 3: Conceptual Design and Modelling

As a solution to the research problems stated above, this study proposes to combine SS, 2D animation, and the computer as the medium of presentation, to develop an interactive and dynamic pedagogical tool for children with ASD to learn SS in order to improve their social skills. We anticipate that this combination of methods would have many advantages over the current available methods, as it would engage and motivate children with ASD to learn by providing an attractive and enjoyable learning environment, thus boosting the effectiveness of social skill inception in the children with ASD, with minimum supervision from the teacher. The proposed solution is also intended to break the monotony of a typical SS format and to capture and engage the children’s attention by using visual effects and vibrant colors.

Multimedia has also been said to offer children more control of the learning experience, which will then lead to increased motivation, engagement and positive attitude (Yildirim et al. 2001). The use of computer and 2D animation helps to increase the usability of SS through the application of currently available technology as a means to enhance and enrich the social skill learning process of children with ASD. This combination enhances the currently available presentation format of SS.

The animation of the SS is made as simple as possible, as it is noted by Brownell (2002), and stated by Gray (1994) that using illustrations with excessive details may cause more difficulties to some children with ASD who may interpret information literally, or they may be unable to generalize the situation beyond the environment or setting represented in the visual cues.

As part of the research problem and solution to verify that this method is effective, a scientific study was conducted to evaluate the effectiveness and usability of the proposed model in assisting children with ASD in their social skill learning.

3.4 Hypothesis

There are null hypothesis and alternative hypothesis formulated for the research problems, detailed as below:

**Null hypothesis (H0):** *The combination of SS and 2D animation in computer presented format is not effective as an intervention in assisting children with ASD to learn social skills in the school setting.*

**Alternative hypothesis (H1):** *The combination of SS and 2D animation in computer presented format is effective as an intervention in assisting children with ASD to learn social skills in the school setting.*
The effectiveness of the proposed model is determined by whether there is a change in the behavior of children with ASD after the intervention. If there is a positive change in their behavior, the intervention is said to be effective, if there is no change or negative change of the behavior of children with ASD after the intervention, then the intervention is said to be not effective. A statistical test was performed to prove these hypotheses, presented in Chapter 5.

3.5 Research methodology

A research method is conventionally divided into two categories: the qualitative research method and the quantitative research method. Each of these methods differs in approaches, tools and techniques, form, focus and emphasis of the study, thus they serve the research purpose and will produce different results (Lee 1992). The combination of qualitative and quantitative methods is known as the mixed-method research design.

For this research, the quantitative method is adopted. This method is well suited for quantitative descriptions and comparisons. It is used to determine the relationship between one thing (independent variable) and another thing (dependent/outcome variable) in a way that can be expressed numerically (Lakshman et al. 2000). The foundation of the quantitative research is that the objective truth can be measured and explained scientifically, valid and reliable (Cassell & Symon 1994; Matveev 2002).

Unlike the qualitative method, the quantitative method follows firmly the original set of goals and arrives at a more objective conclusion and determines the issues of causality. The focus in the quantitative method is the collection and analysis of numerical data and statistics that involve counting and measuring events, and performing statistical analysis of numerical data, rather than relying on interviews or case studies (Smith 1988).

When designed properly, the quantitative method can produce results that are highly reliable and can be seen as real and unbiased (Martyn 2008) due to the use of controlled experiments (Balsley 1970) and the elimination/minimizing of biases of researchers’ subjectivity (Kealey & Protheroe 1996; Ting-Toomey 1984). Therefore, it is arguable that this method can arrive at a more conclusive result, supported by statistical proof (Gergen 2010; Moutinho & Hutcheson 2011; White 2002), especially to provide evidence concerning whether a particular intervention is effective (Barlow et al. 2004).
a. Descriptive Study

Descriptive study is also called observational study or survey study, as this study only includes observation on subjects without intervening. In this approach, subjects are usually only measured once, thus it is said that researchers measure things as they are. The main purpose of the descriptive study is to only establish association between variables and the causality (Hopkins 2000). The techniques included in the descriptive study are: case, case study, cross-sectional, cohort/perspective/longitudinal, and case-control/retrospective. For an accurate estimation of relationship between variables, a descriptive study needs samples of hundreds to thousands of subjects.

b. Experimental Design

Experimental design is often referred to as true science as it has a standard format across scientific discipline with a minor-interdisciplinary difference in proving or disproving hypothesis by mathematical and statistical means (Martyn 2008). Experimental study is also referred to as intervention, as it involves more than just observation of the subjects (Hopkins 2000). The main purpose of the experimental design is to demonstrate how manipulating one set of variable (independent) can produce a systematic change in another set of variable (dependent/outcome).

In this method, the subject is measured before and after intervention to see what the effect of the intervention is. Compared to the descriptive study, this approach may only need ten subjects as study samples (Hopkins 2000). However, ideally the experiment should be constructed in a manner that allows others to repeat the same experiment and obtain similar results (Martyn 2008).

The simplest form of the experimental design is time series, where one or more measurement is taken on all the subjects before and after treatment, thus known as repeated-measure study. A special case of time series is called a single-subject design where measurement is taken repeatedly before and after intervention on one or a few subjects where the same participant serves as both the experiment and control sample (Hopkins 2000; Carolan 2000 as cited by Kapitan 2010).

i. Single subject design (SSD)

SSD is based on B. F. Skinner’s study of using treatment on the subject and measuring the outcome at various points in time, thus this design is often considered when performing
behavioral modification or measuring behavioral changes (Heffner 2004). The basis of SSD is to study behavioral changes that an individual exhibits as a result of some form of treatment (Gay & Airasian 2003; Wasson 2005). It looks at the cause effect or functional relationship by comparing each individual’s behavior on the pre- and post-intervention processes (Horner et al. 2005).

SSD is used extensively in experimental analysis of behavior as it is effective in measuring behavioral changes when performing behavioral modification to an individual. Thus, this design has been widely used by the SS researchers in measuring the effectiveness of SS in modifying social behavior of children with ASD. It is also approved by Horner et al. (2005) that this design is a rigorous scientific method to define behavior with features that are particularly appropriate in the field of special education research.

SSD may only involve one participant, but typically it involves multiple participants that are considered as one group. Each participant or group serves as their own control rather than using another participant or group as control. It relies on the comparison of their performances prior to treatment to during treatment and/or after the treatment. The performance is generated in a single score per measurement period (e.g. 20 minutes) (Heffner 2004; Wasson 2005).

It is argued by Seale & Barnard (1998) that SSD is better and should be used in preference to case study, which is essentially loose and limited in terms of empirical validity and difficult to generalize results from another individual to others, who may differ in a number of ways. Gill et al. (1992) state that SSD closes the gap between experimental research and practice, as they provide realistic representation of participant-treatment effects. The characteristics of SSD are: reliable and repeated measure of behavior, diligent description of all conditions of target behavior, consistency and stability of baseline/treatment, focus on changing one variable at a time, and clear specification of treatment goal (Wasson 2005; McMillan 2004; Vacc & Loesch 2000). There are several types of SSD, as discussed below.

In SSD, the basic order of behavior measurement is: determine behavior (A/Baseline), introduce treatment (B/C/Intervention) and remove treatment (A/Reversal Baseline). In the first A (Baseline), behavior are observed and recorded with no treatment in place, this is a crucial phase as it is impossible to determine if changes have occurred without this pre-test data (Heffner 2004). In B/C (Intervention), treatment is introduced and behavior is observed and recorded. In the second A (Reversal Baseline), treatment is removed and behavior is
observed and recorded (Seale & Barnard 1998). The duration of each phase should be long enough (usually 5-20 measurements, according to Seale & Barnard (1998)) to achieve stability and consistency in the behavior before moving to the next phase (Heffner 2004).

The combination of these phases differs in each design, thus producing several types of SSD. There are three common types of SSD: ABA withdrawal/reversal design, multiple baseline design and alternating treatment design (Wasson 2005; Gliner & Morgan 2009).

- **Withdrawal/reversal design**

  A common variant of withdrawal or reversal design includes AB, ABA, and ABAB design. AB design is the simplest and most common yet the least interpretable variant of SSD (Houser 2007); it is used to quickly access the effects of a treatment. If there is a change in the behavior after the treatment, then it is assumed that the changes are the direct results of the treatment. However, in AB design, it is difficult to be certain that this assumption is accurate or valid as there are only two phases in the design (Vacc & Loesch 2000). This weakness can be strengthened substantially by adding to the withdraw/reversal phase, designs such as ABA or ABAB (Monette et al. 2007; Bennett & Weissman 2004). The complexity of combinations depends on the original intention of the study and the feasibility. ABA design would be used to determine the effect of treatment and the degree of extinction only; complex ABABABAB would be used to determine if any additional treatment would change the ultimate results.

  ABA is also known as reversal/withdrawal design (Seale & Barnard 1998); this design is simply an extension of AB design where another control phase is added after the end of the treatment phase to allow for more reliable assessment of treatment effects. According to Kazdin (1982) and noted in Wikipedia (2011), this reversal design is the most powerful single subject design as it presents a strong reversal from baseline to treatment and back again to baseline.

  ABA design allows for strong interference if the target behavior returns to baseline after the treatment is terminated (Vacc & Loesch 2000). However, there are certain situations when condition is irreversible and the outcome is not expected to return to baseline, such as when a treatment targeting on social skills or reading is withdrawn; one cannot unlearn these skills and there are also ethical issues in the activities that involve self-injurious behavior (Sparrow 1992; Janosky et al. 2009), or terminating the study after baseline would deny the subject to the full benefit of treatment (Janosky et al. 2009; Vacc & Loesch 2000).
ABAB design could overcome the ethical problem in ABA design by ending the experiment with treatment; therefore ABAB design is basically the extension of ABA design where an additional treatment phase is added at the end of the ABA design. Concerns with ABAB design include training time and problems with internal validity.

- **Multiple baseline design**

  In multiple baseline design, a varying time schedule is used to determine if a treatment is truly influencing behavioral changes, thus there are two or three variables included in the experiment: behavior/participant/setting. A common variant of multiple baseline design includes the performance of several participants on the same behavior and the same setting, the performance of one participant on several behaviors in one setting, and the performance of one participant in one behavior in several settings. This design could strengthen the competing hypothesis in AB design.

  Multiple baseline design would require considerable time and resources and verification must be inferred from the lack of changes in other behavior, thus making it weaker than the reversal design at demonstrating experimental control.

- **Alternating treatment design**

  Alternating treatment design is useful for evaluating the effects of several types of treatments (B and C) on the same individual. After baseline (A) data is collected, the participant would be given one of the two treatments (B or C) which is randomly chosen. After the first treatment, the two other treatments are altered in rapid succession and the results from both treatments are compared to figure out the most effective treatment.

3.6  **Research procedures**

As indicated earlier, in investigating the effectiveness of *I-Learn Social Story*, this study employed a single subject experimental design, specifically the ABA withdrawal/reversal design, which is a research approach from the quantitative research method. According to Sidman (1960), the single subject design is the best design used in proving the effectiveness of an intervention and in measuring behavioral changes in an individual, and it is argued to be as much more statistically powerful (Gergen 2010; Moutinho & Hutcheson 2011; White 2002), especially to provide evidence concerning whether a particular intervention is effective (Barlow et al. 2004). Therefore it has been widely used in the SS research to determine
changes in behavior by researchers, such as Kuttler et al. (1998), Adams et al. (2004), Marr et al. (2007), Kuoch & Mirenda (2003), Swaggart et al. (1995), Norris & Datillo (1999), Haggerty et al. (2005), Bledsoe et al. (2002), Lorimer et al. (2002), Brownell (2002), Ivey & Alberto (2004) and many more.

For reasons described above, a single subject design, specifically the reversal design, was used in this study to solicit the information gathered from testing. This included the development of the intervention tool used to change the social behavior of children with ASD.

As illustrated in Figure 1, this study started by identifying the specific problem and solution by collecting information related to the topic of research and to come up with preliminary ideas to solve the research problem. After the literature of the related topic was collected, a thorough deep review was conducted to understand issues that were related to ASD, animation and SS, as well as to how the combination of animation and SS could be useful in assisting the teaching of social skills to children with ASD.

The observation on children with ASD was useful to understand their behavior and how they think and feel. The observation was essential to model a prototype that would be suitable for their needs. Apart from the observation, interviews were conducted on the children and their teachers to collect information in order to grasp a deeper understanding of the children’s
needs. From the information collected from the observation and interview, an analysis was carried out to determine the needs of children with ASD.

After the children’s needs and a potential solution were identified, the next step was prototype development. This included a survey and an investigation on the available software for children with ASD in the market, by examining the benefits and limitations of each product. This survey helped to build a prototype with improved features, compared to the existing products.

Hardware affordability and availability that supported the development of the model was also investigated. The system required hardware that was fast yet at reasonable cost to ensure that it was affordable for general public users.

Research on SS and animation was conducted to understand the effect of the current application of SS and animation on children with ASD; how they could be effective to help children with ASD in social skill acquisition. The review of the current applications and studies of SS and animation - to investigate their advantages and limitations - would be valuable for the design of the prototype.

After understanding the limitations of current applications, the developmental stage started by conceptually modeling the prototype; analysis from the literature review and field observation helped in identifying the requirements of the model. It also identified and anticipated any risks that might arise. Thus, the first model of the prototype was developed.

A pilot test was conducted as part of the conceptual model to ensure that the final model would satisfy the needs of the targeted community. The pilot test was conducted using the first developed model of the prototype. The purpose was to discover the usability and features that were necessary to be included before developing the final prototype. The result of the pilot testing refined the conceptual model design of the final prototype.

Based on the refined conceptual model, the final prototype was developed with Adobe Flash. By using Adobe Flash, the content was interactive and portable as it could be used on a PC, notebook PC or mobile phone.

Once the final prototype was developed, an evaluation of the prototype was performed to determine whether it was useful and appropriately suited to the children’s needs, and how it assisted them in social skill learning. The evaluation was done by collecting and comparing the behavior data of the participants before and after the intervention to identify the prototype’s
effectiveness and usability. Feedback on the prototype was collected as well, from the participants’ teachers.

As the final step of the study, the results of the evaluation, including the literature review, conceptual model, prototype implementation and the methodology used in the experimental study were compiled.

3.7 Conceptual design

This section illustrates the conceptual design of the prototype, which includes a discussion of the requirements and specifications and the design rationale.

3.7.1 Requirements and specifications

The main methods used in the requirement gathering for the conceptual model were field observation and prototyping (pilot study).

Children in a local school were observed during their daily school activities to understand their social behavior. They were observed while they were performing their learning and social activities in the natural setting of the school compound, mainly in the classroom. This was done to understand their learning style and social behavior, and to define the target behavior that they had to acquire. The data collected during the observation was essential before moving to any developmental stage.

Prototyping was done as part of the pilot study. Prototyping is one of the modern techniques in gathering requirements. Using this technique, preliminary requirements were gathered and used to build an initial version of the prototype, i.e. the functional prototype used in the preliminary testing for the pilot study. Based on the results generated from the pilot test, additional requirements for the final prototype were discovered.

3.7.1.1 User characteristics

Most of the participants in the school were novice computer users who had a small amount of knowledge about the computer system. In the school, they were currently using the computer at specific allocated times of the week and they were not familiar with the overall structure of the computer, thus, they would require an easy-to-use navigation menu.

a. End user/direct user: student with ASD
The end users of *I-Learn Social Story* were students with ASD. They would use the prototype to learn social skills from the animated social story. For children who were familiar with the computer, they would be able to operate 2D Animated Social Story (*I-Learn Social Story*) by themselves, where the others might need someone (such as other students or teacher) to assist them to use the prototype presented in the computer.

**b. Expert users: teacher, parent, caretaker**

Teachers, parents or caretakers would assist the children who were not able to operate the 2D Animated Social Story (*I-Learn Social Story*) by themselves. As the expert users, a short training would be provided for them. They would be required to assist and guide children in using the program. They would give support to the user, until the end user was fully competent in using *I-Learn Social Story* independently.

**3.7.1.2 Target behavior identifications**

To implement an effective behavioral change, identification of specific target behavior was essential before implementing the SS. This allowed the measurement of behavioral changes from baseline to intervention, from intervention to reversal baseline, or from baseline to the reversal baseline. It would also help to keep track of the specific behavior.

The initial data gathering for the identification of target behavior occurred after the first few visits to the school through direct observation of the participants in their natural setting, along with unstructured conversations with the school principal, teachers, class helpers and students themselves. From the visitation to the school, the important behavioral traits that the participants needed help in were observed and identified.

This process took place in the students’ classroom by observing their social behavior towards their classmates, teachers, class helpers, other peers, or others who were interacting with them. During the process, since teachers and class helpers were willing to discuss students’ behavior, they were verbally asked for their comments and input regarding the behavior of the participants that they would like to see changes in.

Once all of the participants’ target behavior were identified, they were cross-referenced with the help of teachers, to determine the desired target behavior that were shared by all of the participants, as in Buggey et al. (1999). Social stories were then created to address these selected target behavior shared by all of the participants, as presented in Chapter 4.
3.7.1.3 Quality requirements

Quality requirements are global constraints or quality attributes of the prototype to ensure the prototype is concrete and stable, included here are the following:

a. Performance requirement
*I-Learn Social Story* must respond to the user’s inputs with no perceptible delays.

b. Usability requirement
*I-Learn Social Story* must be easy to use/operate, easy to handle and easy to navigate in the most expected way.

c. Affordability requirement
*I-Learn Social Story* must be affordable and available at a reasonable cost to most of the users.

d. Controllability requirement
*I-Learn Social Story* must be easy to be controlled by the users.

e. Simplicity/understandability requirement
*I-Learn Social Story* must use a simple interface and easy operation to ensure understandability.

f. Reusability requirement
*I-Learn Social Story* must be able to be used effectively by different users.
3.7.2 Design rationale

The prototype was developed to ensure that it is easy to operate, with the use of simple sentences. Figure 2 illustrates the operation flow of the first prototype. Once started, the prototype showed a simple introduction animation for 8 seconds before the program displayed a list of stories to choose from. Once the selection of one of the stories had been made, the respective animation and video instructions of the SS content were displayed. To go to the next page of the story, the user was required to click on the ‘next’ button available on every page. There was also a ‘prev’ button, if the user needed to return to the previous page of the SS animation. Quizzes would appear at the end of each SS. The participant was required to answer one multiple-choice question that was related to the story by selecting only one of the choices given. Unlimited attempts were given in answering the question and if the participant had selected the correct answer, hand clapping animation would be shown and then it would lead back to the SS list.

![Figure 2 Operation flow of the first prototype](image)

Figure 3 illustrates the user interface of the first prototype design with listed features, which contained a learning screen, a teacher video narration, a user face display, ‘next’ and ‘prev’ buttons, and a quiz section. Other elements like font and colors, interaction style and interface graphic elements and duration were discussed as part of the design rationale.
The user interface design and rationale of each feature is discussed in the following subsections.

3.7.2.1 Learning screen

The learning screen was the main feature of the prototype. This screen presented the SS texts that had been implemented into 2D animation form.

3.7.2.2 Teacher video narration

Audio narration was incorporated into the model with the intention of helping the children with ASD to learn to read, thus this prototype could be used to gear the children towards self-learning with minor supervision. This was a shift from the “teacher-centered approach”, where a student was a passive learner by listening and reciting what had been taught to them by teachers to “learning through experience”, where children could relate what they saw in the learning content to the real life objects within their environment. The narration was presented through a pre-recorded video of an instructor reading out the story. It was displayed through a small window at the right corner of the screen. This was to manifest the presence of the instructor to extend personalized attention and verbal prompts while the participant was using the prototype.

3.7.2.3 Display of user’s face

The user face display feature was used to display the user’s face in real time. This feature allowed the user to look at his/her facial expressions during the learning. As suggested by Loveland et al. (1994), producing elicited affective expression is difficult for children with ASD, therefore, the user’s face was displayed in the expectation that children with ASD could imitate the expressions from the animation, as suggested by Field et al. (2001); imitation could
help children with ASD display more social and affective behavior. Study by Gena et al. (1996) showed that affective display could promote generalization and social interaction.

3.7.2.4 ‘Next’ and ‘Prev’ button

The ‘next’ and ‘prev’ buttons were used to navigate around the pages of the story. The ‘next’ button was used to go forward one page and the ‘prev’ button was used to go backward one page from the current page. These buttons allowed the children to learn at their own pace.

3.7.2.5 Quizzes

A one question quiz was presented at the end of the SS. The question would be related to the SS played. The purpose of the quiz was to examine if the child understood what had been taught in the SS.

3.7.2.6 Font and colors

Font type, the size of the font, spacing lines, contrast of print and paper (background) will influence legibility (Thiessen & Dyson 2009). Study by Hughes & Wilkins (2000) found that children benefited from a larger font size and spacing. Children materials were often Inappropriate in the print size and words used (King et al. 2003).

In the prototype, the font used would be large with a variation of colors on each story, as it was noted by Bernard-Opitz & Hauber (2011) and Stahmer et al. (2011) that a variation of colors helped in the learning of children with ASD.

The font type used was the sans-serif type, as it was easier for children to read (Sanchez et al. 2004; Satterfield 2009). Sans-serif font should be simple and big with clear messages and a good contrast with the background (Sanchez et al. 2004). Vivid colors and details were avoided, as it could confuse children with ASD (Moor 2008).

3.7.2.7 Interface and interaction style

The interface of the prototype was designed to display in full-screen mode once started, to avoid any distraction from the desktop background during learning, thus the user could focus on the SS screen alone.

The graphic element of the SS was in 2D animation with simple graphics, as excessive use of images with many details could confuse children with ASD in their understanding (Moor 2008). The interaction style used was made as simple as possible with one sentence on one page, as it
was noted by Herskowitz (2009) that too much animation on the screen might scare and
distract children with ASD, or they might become over-stimulated by the animation.

There were reasons for choosing 2D animation over 3D animation or real-human video, as
described below:

- Children with ASD have more interest in 2D animation compared to real-life video (Rosset
  et al. 2008; van der Geest et al. 2002; and Grelotti et al. 2005).
- 3D animation is complicated and costly.
- As stated earlier, animation should be made as simple as possible (Brownell 2002; Gray
  1994), which is achievable by 2D animation.

3.7.2.8 Duration

The duration of each SS depended on the number of sentences - about 5 to 8 in each SS. With
this number of sentences, the duration of the animation was less than 5 minutes on each
story.

3.8 Preliminary study

As described by Hopkins (2000), a pilot test or preliminary study is performed to develop,
adapt or check the feasibility of techniques to determine the reliability of measures. In this
study, a pilot test, as part of an experimental design, had been conducted to confirm that
components of the prototype, as being the critical characteristics of the final prototype, would
function pertinently on targeted users. The main purpose was to examine the features and
functions of the prototype, as well as to test the procedure. This ensured that the final
prototype would fulfill all the requirements needed by the users when running this program so
that it could be used effectively in their social skill learning.

For the preliminary testing, an initial prototype was designed and implemented. This prototype
was tested on three participants, and from the testing an evaluation was made. From the
observation of the effectiveness of the initial prototype, such as how the participants
interacted with it, the final model of the prototype would be refined, based on the results of
the pilot testing. The final prototype and testing would then be confirmed as an improved
version from the first version of the prototype developed for the preliminary study.
3.8.1 Methodology

This section discusses the setup of the pilot study in the aspects of participants, materials, settings and procedures followed. Prior to the pilot testing, consent forms were sent to the school, from which consent was obtained from parents through the school principal who informed participants’ parents and teachers.

3.8.1.1 Participants

Three children with ASD participated in the pilot study. The participants were invited through the principal of the school.

Participant 1 was a 10 year old boy. He had very decent drawing and coloring skills. He was the most advanced student among his classmates. He was good in mathematics and had shown some creativity in building Lego blocks. However, he had difficulties in expressing his emotions while communicating with his teachers or friends. He hardly initiated conversation and interaction with his peers. However, he showed an ability in following directions, taking turns and staying on the task.

Participant 2 was an 11 year old boy. He was experiencing difficulties in communicating with peers, but he could respond well to the teacher’s instructions. His teacher often asked him to help out in the class daily task, such as cleaning. He suffered from echolalia, an involuntary tendency to repeat words or sentences spoken by others. He had difficulties in taking turns. He demonstrated a higher social skill than the other two participants.

Participant 3 was a 10 year old boy. He had difficulties in following directions, transitioning, and staying on the task. During class, he often got bored and restless. He liked playing the computer. He hardly communicated with his teachers or with his friends. He did not have a sense of ownership with regards to people’s belongings. When he wanted something he would just get it without asking for permission, or would guide someone’s hand to reach for the things that were unreachable to him. Because the classroom teacher often scolded him for turning on the computer, he had the tendency to lead his classmate’s hands to press on the computer’s switch.

3.8.1.2 Materials

The material used in the study was a notebook PC with an integrated camera that presented 2D Animated Social Story. Observation notes were used to record the significant behavior of the participants and how they interacted with the prototype, including the features that they
liked and features that distracted them. The content of the SS was titled *Snack time*. English was the only language implemented in the first prototype.

*Snack time* was adapted from the paper of Crozier and Tincani published in 2007, “Effects of Social Stories on Pro-social Behavior of Preschool Children with Autism Spectrum Disorders”. They had tested this story on three children with ASD. This story was selected as it was applicable to the situation in the local school, where they had *Snack time* at their classroom daily. The interface for *Snack time* 2D Animated Social Story is illustrated in Figure 4.

**Figure 4 Screenshot of ‘Snack time’ (first prototype)**
3.8.1.3 **Setting**

The pilot testing was conducted in *Perkata Special School*, a school for mentally retarded children located in Kuching, Sarawak. There were two special classes for students with *Cerebral Palsy* and seven classes for children with other disabilities. The students in the mixed-class came from various intellectually disabled groups: *Downs Syndrome*, ASD and various types of brain damage related problems with additional problems such as physical handicaps, hearing or speech impairments and other behavioral problems. Each class had one teacher and one to two helpers with a maximum of 17 students.

The pilot test took place in the respective participant’s classroom at the same time and location each day. All of the three participants were in the classroom with about 10 to 15 students, depending on the class’s daily attendance. There were a teacher and a class helper in each class during testing.

3.8.1.4 **Procedure**

During the testing, the participants went through the first version of the prototype. The testing lasted for one week, with 2 to 3 sessions each day for each participant. Each session took about 10-15 minutes.

The participants were not videotaped during the intervention, and at all time, as this was the request from the parents and the school principal, to protect the children’s privacy. As a substitution for the video recording, observation notes were taken down during the intervention period to note essential information.

3.8.2 **Findings**

The preliminary study results are discussed in the following sections based on observations of the participants. The results were analyzed according to each participant’s response to the *I-Learn Social Story* prototype.

3.8.2.1 **Prototype’s Features/User Interface**

From the pilot test, it was found that there were features in the user interface design that had to be amended. ‘Teacher video narration’ and ‘user face display’ were found to distract the user’s attention from focusing on the learning screen. Participant 1 and 2 were distracted by the teacher video narration because they wanted to listen to the narration carefully, thus
switching their focuses between the main animation and the narrated video, and participant 3 was distracted by his own face display.

The quiz section would be removed as it was found that participant 2, and especially participant 3 were clicking the answers aimlessly, so it was found that the quiz section was not effective, especially for children with a lower cognitive skill.

There were features that were to be added, as will be explained in section 3.9.2

### 3.8.2.2 Testing Procedure

In the pilot study, the testing was conducted by presenting the prototype to the participants, together with the other students, in their main learning area. This was quite disturbing for the other students and the participants themselves. Thus, in the final testing, it was advisable to present the prototype to one student at a time in a corner of the classroom and with the use of earphones.

### 3.8.2.3 Overall participation

Although the purpose of the pilot study was not to capture the effectiveness of the SS, it was found that all of the participants were engaged in the SS intervention. They would immediately apply the story they had learnt right after the learning. Participant 1, right after the SS reading, could immediately apply or generalize what he had learnt from the prototype into the real life setting. He was playing with a matching pair puzzle, and once he finished with one pair, he would say “next”, imitating the prototype, and after he had completed all the pairs, he would say “well done” and clapped his hands. The teacher was amazed by this.

### 3.9 Improved conceptual design

This section discusses the conceptual design of the final prototype, which is the refined model from the first prototype that had been used in the pilot testing. **2D Animated Social Story (I-Learn Social Story)** is an independent and self-contained prototype that consists of a set of social stories for children with ASD. The main goal is to teach social skills to children with ASD in a medium that they are interested in, which is 2D animation in the computer presented form. Each SS has its targeted behavior to be achieved.

This design is thus an improved one from the first design used in the pilot study. It was implemented based on the requirements gathered from the observation and interviews, as
well as the additional requirements gathered from the preliminary testing, such as the addition of automated play and the Bahasa Malaysia option, as discussed in the following sections.

3.9.1 Final design

The operation flow of the final prototype is illustrated in Figure 5. To start the program, the user needs to double-click on the ‘I Learn Social Story’ icon, then the program will start and the user will be shown a 5-second introduction animation. The user will then go to the SS list that contains 5 social stories (5 in English and 5 in Bahasa Malaysia). The user is required to choose one of the social stories from the list. Once a SS is chosen, the target behavior of the SS will be shown for 5 seconds then the respective animation of the SS will be played. At the end of the SS animation there will be one button; if the user clicks it, the program will return to the SS list. To stop the program, the user needs to minimize the full-screen and use the default exit to close.

![Figure 5 Operation flow of the final prototype](image)

Figure 6 illustrates a screenshot of the final model of the prototype that was built based upon the pilot testing result; some features had been added and some features that were not beneficial to the users had been discarded, thus making it a simpler, yet an enhanced version.
3.9.2 Changes and rationale

The following are the amendments made from the first prototype design to the final prototype design.

a. Learning screen

The learning screen which contains the SS animation interface and was the main focus of the prototype remained in the final design with improved graphics and animation of the SS. The learning screen mainly contained SS in 2D animation form. The animations used were similar to the cartoonish look of Sam, which had been preferred to by children with ASD compared to a real peer, as discussed in 2.3.9 Virtual Reality.

b. Automated play to replace the ‘next’/’prev’ button

Automated play was added as the replacement for the ‘next’/’prev’ button. It was added for easier control and smoother story flow. This was useful for children who were not computer literate, thus the teacher needed to only play the SS and the story would run continuously as in a video, without using the mouse control to move to the next scene. From the pilot testing it was also found that the user did not use the go back to the previous page button and the buttons were only used mainly for moving to the next page of the story, so they had been replaced with an automated flow for easy navigation.

c. Add-on Bahasa Malaysia option

The mother tongue or first language is the language that an individual has learned from birth from their parents. There are different definitions of mother tongue as defined in Kecskes and Papp (2000). Edwards (2010) recorded that UNESCO (1953:11) dictum encourages the use of
the mother tongue as the best medium in teaching a child. Murphy (2011) also stated that the academic benefits of the mother tongue program are well documented.

In contrast with the dialect variation of the mother tongue, this suggestion may be for the standard form of mother tongue instead of the non-standard dialectic variant of the students in their heterogeneous setting, such as Mandarin for the Chinese instead of other dialects.

However, this suggestion is not unanimously accepted, especially in a multi-language setting. And in the students with ASD setting, a study by Kremer-Sadlik (2005) revealed that clinicians have recommended the use of English only for children with ASD and their families, even to parents whose native language is other than English. This is to ensure that the child is exposed to the same language inside and outside the home.

In the current study, there were three major mother tongues spoken by the participants, English for students with English educated parents, Bahasa Malaysia for most of the Bumiputra (native Malaysian), and Mandarin for the Chinese. In the school setting, instructions used were in both Bahasa Malaysia (official) and English. Thus, in the final prototype it was proposed to add Bahasa Malaysia as a language option. This option would enable the children to choose the language that they were more familiar with. Mandarin or other dialect options, such as the Sarawak dialects could be expanded in future work.

d. User face display discarded

The user’s face display was discarded in the final design as the finding from the pilot test discovered that some users often got distracted by this feature, thus they could not concentrate on the learning screen.

e. Audio narration to replace the teacher video narration

Audio narration was added as a replacement for the teacher video narration. Similar to the case with the user’s face display feature, the video narration was distracting the user from the social story (learning screen). Thus, the video narration was replaced with an audio narration instead.

f. Quiz section discarded

The quiz section was discarded due to the inability of many children to use the quiz feature. Some of the participants were just playing around with this feature instead of using it appropriately. Apart from that, children with ASD have different functional and intelligence
levels. Many children could not attempt the quiz. Therefore, the quiz feature did not serve its intended purpose.

3.10 Summary

This chapter has discussed the requirements in designing the conceptual model of the program, 2D Animated Social Story (I-Learn Social Story). This chapter covered the introduction to the available research design and the design that had been chosen to be used in the study, the discussion on the preliminary study and the results, and a detailed conceptual model of the final prototype. The next chapter discusses the implementation of the prototype based on the conceptual design that has been discussed in this chapter.
Chapter 4: I-Learn Social Story design and development

4.1 Introduction

As the title indicates, this chapter reviews the implementation of the final prototype based on the conceptual design that has been outlined in the previous chapter. The first section discusses the method used in developing the prototype, including the developed/selected SS and the user interface. The tools/software used in the development of the prototype is discussed in the section on developmental tools.

4.2 Method in developing I-Learn Social Story

Swaggart et al. (1995) outlined ten steps in producing, implementing and evaluating paper-based SS that are consistent with the recommendations made by Gray (1994). They are: (1) identifying the target behavior of the problem situation for SS intervention; (2) define the target behavior for data collection; (3) collect the baseline data on the target behavior; (4) write a short SS using descriptive, perspective and control sentences; (5) place one to three sentences on each page; (6) use photographs, hand-drawn pictures or pictorial icons; (7) read the story to the students and model the desired behavior; (8) collect intervention data; (9) review intervention data; and (10) review the findings and related SS procedures.
In this study, social stories were developed after target behaviors/skills were identified from literature review, observation and interview with classroom teachers and class helpers. Each SS was first drafted in paper before implemented into 2D animation. The SS was developed or taken from a previous study that adhered to Gray’s guidelines. When the SS script was ready, audio narration was recorded and edited based on the story script. The narration was to be used together with the animation that was implemented later. The next step was to construct the SS script into 2D animation using Adobe Flash CS3. These steps of I-Learn Social Story development are illustrated in Figure 7.

4.3 Social story development

This section describes the development of the SS as the main content of the prototype. The social stories were individualized in the sense that they were designed around specific situations that were causing difficulties. In order to develop a SS that would be effective for children with ASD, the guidelines and types of sentences from the SS author, Carol Gray, were followed (refer to 2.3.6.3 Guide/criteria in writing social story). Titles of the social stories, developed to suit the children’s common needs were: How to greet someone at school, Play and sing with friends, Snack time, Walking in the hallway, and Washing hands.

4.3.1 Targeted social skills

The SS was formed based on the targeted social skills/behaviors of the children that had been gathered from the earlier stage. Below is a list of the essential social skills/behaviors to be acquired by the participants in the local school, after the observation requirement gathering and information obtained from the teacher and class helpers.

1. Appropriate social behavior, such as how to relate and respond appropriately to others in a social situation,
2. Friendship building through socialization which included initiating and responding to conversation with friends,
3. Self-management and healthy lifestyle, and,
4. Patience and self-control

4.3.2 Social story selection/writing

The social stories to be adopted for 2D animation essentially have the targeted behaviors as listed in the section above. Apart from the original writing, the social stories were to be taken from websites or published papers, which where ever necessary, would be modified to suit the
setting of the children with ASD in Perkata Special School. All of the five SS scripts were created from the perspective of students, using familiar and simple vocabulary. The following section discusses the selected social stories incorporated into the final prototype.

4.3.2.1 How to greet someone at school

How to greet someone at school was taken from http://www.child-autism-parent-cafe.com/How-To-Greet-Someone-At-School.html and it was not modified as the story suited the school context. It taught the students skills like initiating or responding to greetings verbally or non-verbally. The general targeted social skills were types 1 and 2 (refer to 4.3.1 Targeted social skills). This SS aimed to help the students learn to respond verbally to greetings with “hello” and “good-bye”, and to help them learn how to acknowledge their teachers and classmates in non-verbal ways. Table 2 presents the storyline and sentence combination of How to greet someone at school.

Appropriate behavior included students could initiate and/or respond to greetings verbally, physically or through gesture. Inappropriate behavior included students who initiated and/or responded to greetings in inappropriate ways such as pushing and yelling. No Interaction included students had no response to social greetings.

<table>
<thead>
<tr>
<th>English version (How to greet someone at school)</th>
<th>Bahasa Malaysia version (Menyapa seseorang di sekolah)</th>
<th>Type of sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are many ways to greet someone at school</td>
<td>Ada banyak cara untuk menyapa seseorang di sekolah</td>
<td>Descriptive</td>
</tr>
<tr>
<td>When I see someone I know, I will try to smile and say ‘hi’ or ‘hello’</td>
<td>Apabila saya berjumpa seseorang yang saya kenal. Saya akan cuba senyum dan berkata ‘hi’ atau ‘helo’</td>
<td>Descriptive</td>
</tr>
<tr>
<td>They may say ‘hi’ or ‘hello’ back to me</td>
<td>Mereka juga pasti akan menjawab ‘hi’ atau ‘helo’</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I can ask someone ‘how are you today?’</td>
<td>Saya boleh bertanya kepada seseorang, ‘apa khabarmu hari ini?’ Mereka mungkin berhenti untuk bercakap dengan saya</td>
<td>Directive</td>
</tr>
<tr>
<td>they may stop to talk with me</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the morning, I will try to say ‘good morning’ to someone</td>
<td>Pada waktu pagi, saya akan cuba menyapa ‘selamat pagi’ kepada seseorang.</td>
<td>Directive</td>
</tr>
<tr>
<td>At dismissal time, I will try to say ‘good-bye’ or ‘see you tomorrow’</td>
<td>Selepas habis waktu, saya akan cuba mengucapkan ‘selamat tinggal’ atau ‘semoga berjumpa lagi’</td>
<td>Directive</td>
</tr>
</tbody>
</table>

Table 2 Storyline and sentence combination of ‘How to greet someone at school’
4.3.2.2  **Play and sing with friends**

The general targeted social skills for *Play and sing with friends* were type 2 (refer to 4.3.1 Targeted social skills). The *Appropriate* behaviors included students could play, sing or had other social interactions with their peers, such as sharing stationery and/or asking/responding to help in appropriate ways. *Inappropriate* behaviors included students refused to play or share their toy/stationery with their peers in an inappropriate way, students refused to sing together with peers, students refused to lend or help their peers in an inappropriate way. *No Interaction* included students had no response to social invitation by their peers.

This SS aimed to teach students in building friendship through class activities. Table 3 presents the storyline and sentence combination of *Play and sing with friends*.

<table>
<thead>
<tr>
<th>English version</th>
<th>Bahasa Malaysia version</th>
<th>Type of sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>At school, I can do a lot of things</td>
<td>Di sekolah, saya boleh melakukan banyak perkara</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I can work, I can play and I can sing too</td>
<td>Saya boleh bekerja, saya boleh bermain, dan saya boleh menyanyi</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I can play with my friends and we can sing together too</td>
<td>Saya juga boleh bermain dengan rakan-rakan saya dan bernyanyi bersama</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Playing and singing with friends is a fun thing to do</td>
<td>Bermain and bernyanyi bersama kawan sangatlah menyeronokkan</td>
<td>Descriptive</td>
</tr>
<tr>
<td>My friend and I will be happy when we are having fun playing or singing together</td>
<td>Kawan-kawan dan saya seronok apabila bermain atau bernyanyi bersama</td>
<td>Consequence</td>
</tr>
</tbody>
</table>

**Table 3** Storyline and sentence combination of ‘*Play and sing with friends*’

4.3.2.3  **Snack time**

*Snack time* was adapted from the paper of Crozier and Tincani published in 2007. They had tested this story on three children with ASD. This story was selected as it was applicable to the setting of the students in the local school, where they had their *Snack time* in their classroom daily. This SS aimed to encourage students to talk with their friends during snack time at school, and to encourage students to share their snacks with their friends during snack time. Table 4 presents the storyline and sentence combination of *Snack time*.

The targeted social skills for *Snack time* were types 1 and 2 (refer to 4.3.1 Targeted social skills). This story was used to encourage students to interact with others during snack time at school, or to hold a decent conversation by asking for more snacks or drinks. The *Appropriate*
behaviors included students could initiate or respond to others verbally, physically or gesturally during snack time, students could share their snacks with others, students could ask for snacks from others, students refused to share snacks in an appropriate way. Inappropriate behaviors included students taking other’s snacks without permission, students refused to share their snacks in an improper way, such as pushing. No Interaction behavior included students had no response when being offered snacks, students had no response on being invited to participate in social interaction during snack time.

<table>
<thead>
<tr>
<th>English version (Snack time)</th>
<th>Bahasa Malaysia version (Waktu rehat)</th>
<th>Type of sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have snack time at school</td>
<td>Kita ada waktu rehat di sekolah</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Friends talk and share at snack time</td>
<td>Rakan-rakan berbual dan berkongsi semasa waktu rehat</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Some friends greet ‘hi.’</td>
<td>Beberapa kawan yang menyapa’hi’</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Some friends ask for drink</td>
<td>Beberapa kawan ingin minum</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Some friends ask for more snacks</td>
<td>Beberapa kawan meminta makanan ringan lebih</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I can say ‘hi..’ to my friend</td>
<td>Saya boleh menyapa ‘hi’ kepada kawan saya</td>
<td>Directive</td>
</tr>
<tr>
<td>I can ask for more snacks</td>
<td>Saya boleh meminta makanan ringan lebih banyak lagi</td>
<td>Directive</td>
</tr>
<tr>
<td>Friends are happy when we talk at snack time</td>
<td>Rakan-rakan gembira apabila kami berbual-bual pada waktu rehat</td>
<td>Consequence</td>
</tr>
</tbody>
</table>

Table 4 Storyline and sentence combination of ‘Snack time’

4.3.2.4 Walking in the hallway

The targeted social skills of Walking in the hallway were types 1, 2 and 4 (refer to 4.3.1 Targeted social skills). Appropriate behaviors included students could initiate/respond to social interaction while walking in the hallway, such as holding hands or talking softly, students walked slowly and did not make noises while walking in the hallway. Inappropriate behavior included students initiated/responded to social interaction in an inappropriate manner, students ran or made noises while walking in the hallway. No Interaction included students had no response when being offered snacks, students had no response on being invited to participate in social interaction during their walk in the hallway.

This story aimed to teach students to walk appropriately in the hallway and to encourage students to socialize while walking in the hallway. Table 5 presents the storyline and sentence combination of Walking in the hallway.
4.3.2.5 Washing hands

The general targeted social skills for this SS were types 2 and 3 (refer to 4.3.1 Targeted social skills). This story aimed to encourage students to socialize while doing activities, i.e. washing hands, and to promote hygienic lifestyle by washing hands before meals. Table 6 presents the storyline and sentence combination of Washing hands.

Appropriate behaviors included students were able to ask their peers to go to wash their hands, brush their teeth or to the washroom together, students were able to accept/reject in an appropriate way at their peer’s request to go to wash their hands, brush their teeth, or to go to the washroom together, without promptings, students were able to go to wash their hands before meals or after activities. Inappropriate behaviors included students rejecting their friend’s request to wash their hands, brush their teeth or to go to the washroom together in an inappropriate way, such as pushing or shouting, students went to wash their hands only after a few promptings from the teacher/class helper. No Interaction was defined as students did not respond to the teacher, class helper or friend’s request to go to wash their hands, brush teeth or to go to the washroom together.
<table>
<thead>
<tr>
<th>English version (Washing hands)</th>
<th>Bahasa Malaysia version (Mencuci tangan)</th>
<th>Type of sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>My hands often get dirty when I do things such as coloring</td>
<td>Tangan saya senang kotor ketika mewarna</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Dirt and germs on dirty hands can make people sick</td>
<td>Habuk and kuman di tangan yang kotor boleh membuatkan orang sakit</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I will wash my hands when they are dirty</td>
<td>Saya pasti mencuci tangan apabila ianya kotor</td>
<td>Directive</td>
</tr>
<tr>
<td>I need to wash my hands before I eat to stay healthy</td>
<td>Sebelum makan saya perlu mencuci tangan supaya lebih sihat</td>
<td>Descriptive</td>
</tr>
<tr>
<td>Washing my hands keep them clean again</td>
<td>Untuk lebih bersih lagi, saya mencuci tangan saya</td>
<td>Descriptive</td>
</tr>
<tr>
<td>I can also ask my friend to go to wash hands together</td>
<td>Saya selalu bertanya kawan-kawan saya untuk pergi mencuci tangan bersama-sama</td>
<td>Directive</td>
</tr>
<tr>
<td>We will stay happy if we are healthy</td>
<td>Jika kita sihat, kita pasti gembira</td>
<td>Consequence</td>
</tr>
</tbody>
</table>

Table 6 Storyline and sentence combination of ‘Washing hands’

### 4.4 User interface development

This section presents screen captures of the user interface of the I-Learn Social Story that has been implemented into 2D animation forms, in English and Bahasa Malaysia. The rationale of font, colors, interaction style, interface and graphic element used has been discussed in Chapter 3.

The prototype was designed to display in full-screen to avoid any distraction from the background display while children were using the prototype. Figure 8 illustrates the introduction animation of I-Learn Social Story; it is a simple animation for 8 seconds before the program displays the list of the social stories to choose from in Figure 9, where the five social stories reside, with English and Bahasa Malaysia as options to choose from. Figure 10, Figure 14, Figure 17, Figure 22 and Figure 26 illustrate the social story list with each social story highlighted in turn.

Once the user has made the selection of a story, the respective target behavior will be displayed for 10-20 seconds; there is also a “skip” button, where the user can press to skip this target behavior scene (Figure 11, Figure 15, Figure 18, Figure 23 and Figure 27).

And finally, after the target behavior scene, the animation for the respective SS that has been chosen will be played. Figure 12, Figure 13, Figure 16, Figure 19, Figure 20, Figure 21, Figure 24, Figure 25, Figure 28 and Figure 29 show the screenshots of some social stories animation.
At the end of each story, there will be “Another story” button to bring the user back to the social story list as in Figure 9.

4.4.1 The introductory screen

![Figure 8 The introduction scene](image)

![Figure 9 The story list](image)
4.4.2 How to greet someone at school

Figure 10 presents the screenshot of the SS list with How to greet someone at school highlighted. The screenshot of the target behaviors is displayed in Figure 11. Figure 12 and Figure 13 present the animation screenshot of How to greet someone at school. All of the figures are presented with the original two versions; on the left is the English version and on the right is the Bahasa Malaysia version.

![Figure 10 Story list with 'How to greet someone at school' highlighted](image)

![Figure 11 The target behavior of 'How to greet someone at school'](image)

![Figure 12 Screenshoot of 'How to greet someone at school' animation (part 1 of 2)](image)
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Figure 13 Screenshot of ‘How to greet someone at school’ animation (part 2 of 2)
4.4.3 Play and sing with friends

Figure 14 presents the screenshot of the SS list with Play and sing with friends highlighted. The screenshot of the target behaviors is displayed in Figure 15. Figure 16 present the animation screenshot of Play and sing with friends. All of the figures are presented with the original two versions; on the left is the English version and on the right is the Bahasa Malaysia version.
Figure 16 Screenshoot of ‘Play and sing with friends’ 2D animation (part 1 of 1)
4.4.4 Snack time

Figure 17 presents the screenshot of the SS list with *Snack time* highlighted. The screenshot of the target behaviors is displayed in Figure 18. Figure 19, Figure 20 and Figure 21 present the animation screenshot of *Snack time*. All of the figures are presented with the original two versions; on the left is the English version and on the right is the Bahasa Malaysia version.

![Figure 17 Story list with 'Snack time' highlighted](image1.png)

![Figure 18 The target behavior of 'Snack time'](image2.png)

![Figure 19 Screenshots of 'Snack time' animation (part 1 of 3)](image3.png)
Figure 20 Screenshots of ‘Snack time’ animation (part 2 of 3)
4.4.5 Walking in the hallway

Figure 22 presents the screenshot of the SS list with Walking in the hallway highlighted. The screenshot of the target behaviors is displayed in Figure 23. Figure 24 and Figure 25 present the animation screenshot of Walking in the hallway. All of the figures are presented with the original two versions; on the left is the English version and on the right is the Bahasa Malaysia version.
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Figure 23 The target behavior of 'Walking in the hallway'

Figure 24 Screenshot of 'Walking in the hallway' animation (part 1 of 2)
4.4.6 Washing hands

Figure 26 presents the screenshot of the SS list with Washing hands highlighted. The screenshot of the target behaviors is displayed in Figure 27. Figure 28 and Figure 29 present the animation screenshot of Washing hands. All of the figures are presented with the original two versions; on the left is the English version and on the right is the Bahasa Malaysia version.
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Figure 26 Story list with ‘Washing hands’ highlighted

Figure 27 The target behavior of ‘Washing hands’

Figure 28 Screenshoot of ‘Washing hands’ animation (part 1 of 2)
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Figure 29 Screenshoot of 'Washing hands' animation (part 2 of 2)
4.5 Development tools

The tools that had been used in developing the prototype were: Adobe Flash CS3 with ActionScript 3.0 for developing animation, Microsoft Windows sound recorder and external microphone for the narration recording, and Audacity for narration editing.

4.5.1 Adobe Flash CS3 and ActionScript 3.0

In developing the prototypes, used in both the preliminary testing and the final evaluation, the main tools used were Adobe Flash CS3 together with its programming language, ActionScript 3.0. Flash and ActionScript have evolved together since Flash was originally released in 1996 (Florio et al. 2008). Flash CS3 is the first version of Flash to incorporate ActionScript 3.0 (Florio et al. 2008).

Adobe Flash was formerly known as Macromedia Flash; it is an authoring application that uses vector graphics, and it allows the designer to create an interactive content with the use of ActionScript and simple frame-based animation (Reimers & Stewart 2007). Adobe Flash has been used in research to deliver interactive content, such as Reimers & Stewart (2007), who used Adobe Flash to run complex psychological experiments over the web.

Without ActionScript, Flash is "just" a powerful animation tool. ActionScript is the tool that makes the Flash content interactive; it is a well-organized and mature language that shares much of its syntax and methodologies with other object oriented programming languages (Braunstein 2009). ActionScript is crucial for a content that is highly dynamic, responsive, reusable and customizable (Braunstein 2009). The combination of these two offers the most powerful, most versatile and most popular development environment available (Florio et al. 2008).

Flash is especially used for creating animations, games, splash screens or advertisements. There are millions of Flash-created contents as indexed by Google (Reimers & Stewart 2007).

4.5.2 Windows Sound Recorder and external microphone

All audio narration that had been incorporated into the prototype was recorded using Windows Sound Recorder with an external microphone attached to the computer. Windows Sound Recorder is a simple sound recorder program that has been included in Windows since its earliest days (Cowart & Knittel 2008).
In recording sound with Windows Sound Recorder, a microphone was plugged into the Mic port on the sound card (Wempen 2004). The recorded sound was saved as the waveform (WAV) format, which was then being edited using Audacity.

### 4.5.3 Audacity

Audacity is an open source software that is used in editing the recorded sound. It was developed by a team of students, software developers, musicians, recording engineers and others, freely in their spare time (http://web.audacityteam.org/sponsor.php).

In the prototype, Audacity was used to divide the recorded sound files into smaller sound files for each line of the SS narration.

### 4.6 Summary

*i-Learn Social Story*, the prototype used in the experimental design was developed by incorporating five selected social stories that were written following the guidelines from Carol Gray. The five stories were *Snack time*, *Walking in the hallway*, *Play and sing with friends*, *Washing hands*, and *How to greet someone at school*. The English and Bahasa Malaysia versions were implemented as presented in this chapter. The major tool that was used in developing the prototype was Adobe Flash CS3 together with its programming language, ActionScript3.0 to create animation and to add interactivity. Other tools that were used in developing the prototype were Windows Sound Recorder with an external microphone and Audacity, which had been used to handle the sound recording and editing. The next chapter discusses the testing of the prototype that had been implemented on thirty students with ASD in Perkata Special School.
Chapter 5: Prototype Testing and Evaluation

5.1 Introduction

As discussed in Chapter 3, out of the three research design methods (qualitative method, quantitative method and mixed-method), this study employed the quantitative research design as it is the most suitable design to be used in this type of study.

It has been said in Chapter 3 that the single subject design from the quantitative method is effective in measuring behavioral changes. According to Horner et al. (2005), the single subject design is a rigorous scientific methodology used to define behavior and it offers many features that are particularly appropriate for use in the field of special education research.

The objective of a single subject design is to establish the effects of an intervention on a single individual, thus the essence in this design is that the individual participants will be in control. Since the participants are in control, each will benefit from the intervention (Washburn 2006).

In this study, the reversal (ABA) design, which is a type of a single subject design, was used to measure the effectiveness of I-Learn Social Story to children with ASD.

5.2 Procedure/preparation

Figure 30 illustrates the procedure used in the experimental study. In selecting participants, inclusion criteria were set (refer to 5.2.1 Participant selection for details of inclusion criteria). In gathering participants, the author met with the school principal and consulted her concerning the potential participants who could satisfy the inclusion criteria set. The school principal then selected the students who met those criteria and sent the consent forms to their parents. Once consent was given, the principal then informed and passed the approved participants to the author. The school principal also informed the classroom teachers about the study and requested for their help and assistance in aiding the author to access the participants’ daily classroom activities.

Once the participants were confirmed, intervention started with observation for the collection of baseline data using the data collection sheet (Appendix C). It was done in the participants’ respective classrooms, during their daily school activities. After the baseline data had been collected for 2 weeks, the treatment took place in the participants’ respective classrooms during their free time, before the targeted activity.
The treatment was done by showing and assisting participants to use *I-Learn Social Story*. In the treatment session, student behaviors were recorded in the data collection sheet immediately after each treatment. After the treatment, which was conducted for a minimum of 16 sessions, the reversal phase began, where the participants were no longer using *I-Learn Social Story*. In the reversal phase, the data collection sheet was again used to gather information on the behavior of the participants, which was also done in the participants’ respective classrooms during their daily school activities.

The analysis of the data began by compiling all the data collected in all phases into the Excel spreadsheet and graphed for visual analysis. The analysis was done by comparing the baseline data with the data from intervention and reversal baseline. The conclusion was drawn on whether the intervention was effective on the participants based on the analysis of data collected.

![Figure 30 Steps in the experimental study](image_url)

The following subsections discuss the procedures on participant selection, participant profile, dependent measures in data collection, data collection in all phases, data processing and analysis, and ethical consideration.
5.2.1 Participant selection

The participants of the study were students from Perkata Special School, a special school for disabled children located in Kuching, Sarawak. In order to ensure the validity of the experimental study, there were a number of criteria imposed when selecting the participants, as listed below:

1. He/she had a diagnosis of Autism Spectrum Disorders, which includes Asperger Syndrome, Autistic Disorders, Pervasive Developmental Disorders – Not Otherwise Specified, Rett’s Syndrome or Childhood Disintegrative Disorders, whether identified by a psychological assessment or a psychiatric diagnosis. They were obtained from their medical records as documented in the school database,
2. His/her age had to be between 4 to 17 years old,
3. He/she was currently a student of the school,
4. He/she demonstrated behavioral problem and/or had impaired verbal/social communication on the targeted social skills (listed in section 4.3.1 Targeted social skills),
5. He/she was able to look at a computer screen, without the necessity of knowing how to operate the computer, and
6. He/she was willing to participate in the study.

The participants were recruited through the principal of the Perkata Special School by perusing the school record for students who met these inclusion criteria provided by the author.

Parents of selected participants were contacted directly by the principal for their consent for the child's participation in the study (see Appendix B). Once consent was given, the principal passed the students’ names to the author. The principal then informed the classroom teachers regarding the study and asked for their help and cooperation in assisting the author in the study with the selected participants. Prior to the study, permission was obtained from the participants and the Student Assent Forms (Appendix D) were distributed to them.
5.2.2 Participants’ profiles

There were thirty participants selected to participate in the study. Table 7 shows the summary of the participants’ profile, including their gender, age, diagnosis, basic communication skills, cognitive functioning, home-class, mother tongue and special notes if any.

It had been anticipated that the number of male participants would be significantly more than the female participants, as statistic has shown that the diagnosis of ASD is more prominent in males (Fambonne 2003). In this study, there were 4 female participants and 26 male participants. The average age of the participants was 9.8 years old. There was only one participant with a diagnosis of Rett’s Syndrome, three participants with Asperger Syndrome, eleven participants with Pervasive Developmental Disorders – Not Otherwise Specified, fifteen participants with Autistic Disorders and none with Childhood Disintegrative Disorders.

Basic communication skill was defined from the ability of the students to communicate in an appropriate way using verbal or non-verbal languages (such as gestures). Students without basic communication skills were the ones who often did not respond to others verbally or gesturally in an appropriate way.

Cognitive functioning was defined from the students’ competency to understand the materials taught by the teacher and be able to join in the teaching activities. Students afflicted with this problem would not also participate in the teaching activities, and were thus often excluded from the teaching sessions.
### Table 7 Summary of participants' profile

<table>
<thead>
<tr>
<th>ID</th>
<th>Gender</th>
<th>Age</th>
<th>Diagnosis</th>
<th>Basic communication skill</th>
<th>Cognitive functioning</th>
<th>Class</th>
<th>Mother tongue</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>4</td>
<td>Rett’s Syndrome</td>
<td>-</td>
<td>√</td>
<td>1</td>
<td>English</td>
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</tr>
<tr>
<td>2</td>
<td>F</td>
<td>5</td>
<td>Asperger Syndrome</td>
<td>-</td>
<td>√</td>
<td>1</td>
<td>Mandarin</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>5</td>
<td>PDD/NOS</td>
<td>-</td>
<td>√</td>
<td>2</td>
<td>Mandarin/English</td>
<td></td>
</tr>
<tr>
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<td>M</td>
<td>6</td>
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<td>1</td>
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<td>Interest in drawing and computer</td>
</tr>
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<td>√</td>
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<td>√</td>
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<td>2</td>
<td>Mandarin/English</td>
<td>Hyperactive</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>8</td>
<td>PDD/NOS</td>
<td>√</td>
<td>√</td>
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<td></td>
</tr>
<tr>
<td>11</td>
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<td>Autistic Disorder</td>
<td>-</td>
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<td>BM</td>
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</tr>
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<td>√</td>
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<td>English</td>
<td></td>
</tr>
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<td>√</td>
<td>4</td>
<td>BM/English</td>
<td>Interest in computer and math</td>
</tr>
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<td>16</td>
<td>M</td>
<td>10</td>
<td>PDD/NOS</td>
<td>√</td>
<td>√</td>
<td>4</td>
<td>Mandarin</td>
<td>Special interest in computer</td>
</tr>
<tr>
<td>17</td>
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<td>-</td>
<td>-</td>
<td>2</td>
<td>BM</td>
<td>Severe type</td>
</tr>
<tr>
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<td>PDD/NOS</td>
<td>-</td>
<td>√</td>
<td>3</td>
<td>Mandarin/ BM</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>M</td>
<td>10</td>
<td>Autistic Disorder</td>
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<td>BM</td>
<td>Hyperactive</td>
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<tr>
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<td>PDD/NOS</td>
<td>√</td>
<td>√</td>
<td>4</td>
<td>BM</td>
<td>Interest in phones and computer</td>
</tr>
<tr>
<td>23</td>
<td>M</td>
<td>11</td>
<td>Autistic Disorder</td>
<td>-</td>
<td>√</td>
<td>4</td>
<td>BM/English</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>M</td>
<td>11</td>
<td>Autistic Disorder</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>Mandarin</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>M</td>
<td>12</td>
<td>Autistic Disorder</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>BM</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>13</td>
<td>Autistic Disorder</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>BM</td>
<td>Severe type</td>
</tr>
<tr>
<td>27</td>
<td>F</td>
<td>15</td>
<td>PDD/NOS</td>
<td>√</td>
<td>√</td>
<td>5</td>
<td>Mandarin</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>M</td>
<td>16</td>
<td>Autistic Disorder</td>
<td>√</td>
<td>√</td>
<td>5</td>
<td>BM</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>M</td>
<td>17</td>
<td>Autistic Disorder</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>English</td>
<td>Severe type</td>
</tr>
<tr>
<td>30</td>
<td>M</td>
<td>17</td>
<td>Autistic Disorder</td>
<td>√</td>
<td>√</td>
<td>6</td>
<td>Mandarin/ BM</td>
<td></td>
</tr>
</tbody>
</table>
5.2.3 Dependent measures in data collection

The dependent measure in the data collection was set based on Thiemann & Goldstein (2001) that categorized social behavior as *Appropriate* and *Inappropriate*. The dependent measure had to be set to measure the behavioral changes of the participants.

In this study, apart from the *Appropriate* and *Inappropriate* responses to measure the behavior, *No Interaction* will also be used as one of the dependent measures. Table 8 illustrates the definition of *Appropriate*, *Inappropriate* and *No Interaction* social behavior measures, as adopted from Thiemann & Goldstein (2001).

<table>
<thead>
<tr>
<th>Social Skills</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appropriate</strong></td>
<td></td>
</tr>
<tr>
<td>Contingent response (CR)</td>
<td>Coded if the focus child’s utterance is contingent on a peer’s immediate prior utterance, within a 2-s interval following the peer’s utterance, through (a) acknowledging (e.g. “hmm”) or direct or partial repetition of the utterance, (b) agreeing (e.g. head nod, “yeah”), (c) answering peer’s question, (d) responding with a related comment about observable objects or events within the on-going activity, (e) confirming or clarifying a question or comment from the peer (e.g. “What did you say?”).</td>
</tr>
<tr>
<td>Securing attention (SA)</td>
<td>Coded if the focus child (a) request attention or acknowledgement from peers (e.g. “Hey” “See this?” or “Look”), (b) call the peer’s name to gain attention, or (c) uses gestures or vocalization to establish joint attention with the peer (e.g. taps on shoulder, holds an object up to show peers).</td>
</tr>
<tr>
<td>Initiating comments (IC)</td>
<td>Descriptive comments that are related to the on-going topic or event, but not contingent on a peer’s prior utterance and not used to request information, and the focus child (a) provides a comment following a 3-s interval after a peer’s last utterance, (b) initiates a new idea or topic that relates to the on-going joint activity or topic but is not a request, (c) compliment the peer (e.g. “You did it!”) or himself, (d) reinforces the peer for winning, (e) expresses enjoyment to the peer regarding their interaction together (e.g. “This is fun!”). The child’s utterance is coded as IC if met with the criteria of (b) to (e) within the 3-s interval.</td>
</tr>
<tr>
<td>Initiating requests (IR)</td>
<td>Coded if focus child’s utterance is related to the on-going topic or event, but not contingent on a peer’s prior utterance and not used to clarify something the peer said (would be CR), and the focus child requests information or actions following a 3-s interval after a peer’s last utterance.</td>
</tr>
<tr>
<td><strong>Inappropriate</strong></td>
<td></td>
</tr>
<tr>
<td>Topic change (TC)</td>
<td>Coded with or without a change in materials or games if the focus child (a) interrupts (definite overlap of words) a peer to introduce a new topic that has not been discussed previously or to reintroduce a previous topic, (b) changes the topic to something unrelated to and non-contingent on the peer’s prior utterance, (c) comments tangential to some aspect of the peer’s previous utterance but there is an ambiguous semantic referent not immediately recognizable. Verbal turns that follow a TC are coded as CR, IC, IR, or SA if the conversation follows the changes or shifted topic.</td>
</tr>
<tr>
<td>Unintelligible (UN)</td>
<td>Utterances that are not interpretable or are unintelligible to the coder after listening to the audiotape a minimum of three times.</td>
</tr>
<tr>
<td>Other (OT)</td>
<td>Any (a) animal noises or other vocalizations, (b) stereotypic or perseverative utterance (considered perseverative on the third utterance; if another child speaks or the child continues the perseveration at a later time, start over and code the first two utterance as they are defined), (c) delayed echolalia that is non-interactive.</td>
</tr>
<tr>
<td>No response (NR)</td>
<td>Child does not respond verbally or non-verbally within 3-s to (a) a peer’s request for information, requests for actions, or protests; (b) if the child is performing an action requested by the peer that takes longer than 3-s, wait to see if he completes the task and give him credit if he does, or (c) if the peer asks the same question again within the 3-s interval, the utterance is not coded, and the time frame starts at 0 after the peer’s second question. If the child does not respond after the peer repeats himself two or more times, code as NR.</td>
</tr>
</tbody>
</table>

Table 8 Social behavior definition as adopted from Thiemann & Goldstein (2001)
5.2.4 Data collection

There were three phases in the data collection: baseline, intervention and reversal baseline. To conceal the children’s privacy, the data collection process was not recorded, instead, a Data Collection Sheet that was prepared specifically for the data collection was used (Appendix C)

The Data Collection Sheet (Appendix C) was prepared by the author following Norris & Datillo (1999) with the response definition of Appropriate, Inappropriate and No Interaction (see Table 8 for definition).

Data for each category was collected during the session as soon as it occurred, using the traditional tally method by marking with “I” in the appropriate column of the Data Collection Sheet for each occurrence. The duration of each session of data collection was set to 10 minutes. In a regular one day class, there would be 2 to 8 sessions of data collection.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-condition</td>
<td>Consent letter approved by parents</td>
</tr>
<tr>
<td></td>
<td>Participants had behavioral problems as listed in the targeted social skills (Section 4.3.1).</td>
</tr>
<tr>
<td>Setting/Environment</td>
<td>Participants’ respective classrooms/kitchen/multi-purpose hall/outdoor, including the participants, teacher, classroom helper, other students of the class and the author, as the observer.</td>
</tr>
<tr>
<td>Duration/No of sessions</td>
<td>10 days. 1 day = 2 sessions, total 12-20 sessions</td>
</tr>
<tr>
<td>Materials</td>
<td>Data Collection Sheet</td>
</tr>
<tr>
<td>Data collection procedures</td>
<td>Author informs the classroom teacher about the observation</td>
</tr>
<tr>
<td></td>
<td>Participants were observed in their daily class activities, they were not informed about the observation so that they could behave naturally, if any of the targeted behaviors occurred, notes would be taken on the Data Collection Sheet by marking with ‘I’ for each behavior.</td>
</tr>
</tbody>
</table>

Table 9 Baseline data collection procedure

In the baseline phase, the initial conditions of the participants were observed. They were observed while engaging in their daily school activities from a close distance or through direct interaction. There was no intervention, inappropriate behaviors were not corrected and correct behaviors were not cued in this phase. Each participant engaged in 10-mins of social activities per session. The social activities were based on the current classroom curricular topic, familiar routines and the child’s preference whenever possible.
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Each participant in total was observed for 12 to 20 sessions in the baseline, depending on their attendance and the stability of the baseline data. An *Appropriate, Inappropriate* and *No Interaction* behaviors were noted in the Data Collection Sheet when they occurred. The data was then processed, and was graphed for visual analysis within twenty-four hours of the occurrence. Once the data collected was consistent, or twenty sessions had been completed, the intervention phase began. Table 9 describes the baseline data collection procedure.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-condition</td>
<td>Participants’ baseline data had been collected for at least 10 sessions and the data was stable</td>
</tr>
<tr>
<td>Setting/Environment</td>
<td>A corner in the classroom, provided with table and chairs. Other students of the class, teacher, and class helper were presents as well.</td>
</tr>
<tr>
<td>Duration/No of sessions</td>
<td>5 days. 1 day = 4 sessions, total 12-20 sessions.</td>
</tr>
<tr>
<td>Materials</td>
<td>I-Learn Social Story presented in a notebook</td>
</tr>
<tr>
<td></td>
<td>Data Collection Sheet</td>
</tr>
<tr>
<td>Data collection procedures</td>
<td>Classroom teacher informed the author if the participants were available for the testing</td>
</tr>
<tr>
<td></td>
<td>The author brought participants to a corner of the classroom that was provided with table and chairs</td>
</tr>
<tr>
<td></td>
<td>Author briefed the participants on the testing</td>
</tr>
<tr>
<td></td>
<td>Author started up I-Learn Social Story from a notebook</td>
</tr>
<tr>
<td></td>
<td>Participants who were able to operate the prototype were allowed to operate the program on their own; otherwise the author would assist the participants in operating the program</td>
</tr>
<tr>
<td></td>
<td>At the end of each social story, the author would ask if the participants understood or wanted to repeat the story before moving on to the next story</td>
</tr>
<tr>
<td></td>
<td>At the end of the testing session, the author brought the participants back to their seats and the observation sessions began (procedure as in the baseline/reversal baseline)</td>
</tr>
</tbody>
</table>

Table 10 Intervention data collection procedure

In the intervention phase, the author showed *I-Learn Social Story* to the participants during their free time prior to the activity of interest, and that was after the classroom teacher told the author when the participant was available for testing. The intervention phase continued daily for a week. During the first session of the intervention, the author explained to the participant that the purpose of the SS intervention was for them to learn social skills.
During testing, the participant and the author sat side by side at a table with chairs and the author assisted the participant in using the *I-Learn Social Story* for 10-20 minutes. Immediately after the testing was done, the participant was brought back to his/her regular school activities and the observation for the intervention phase began. There were 10 to 16 sessions of data collection in the intervention phase, depending on the participant’s attendance.

In order to ensure that the SS was understood by the participant, the author would ask some comprehension questions to ascertain that the participant understood the SS and behavior recommended, such as what the SS was referring to, what other people expected you to do, and what you need to do in the situation. Then the SS was repeated to them for additional one or two times. Table 10 describes the intervention data collection procedure.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Reversal Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-condition</td>
<td>Participants completed the intervention phase</td>
</tr>
<tr>
<td>Setting/Environment</td>
<td>Participants’ respective classrooms/kitchen/multi-purpose hall/outdoor, including the participants, teacher, classroom helper, other students of the class and the author, as the observer.</td>
</tr>
<tr>
<td>Duration/No of sessions</td>
<td>5 days. 1 day = 7 sessions, total 32 sessions.</td>
</tr>
<tr>
<td>Materials</td>
<td>Data Collection Sheet</td>
</tr>
<tr>
<td>Data collection procedures</td>
<td>Participants were observed in their daily class activities, they were not informed about the observation so that they could behave naturally, if any of the targeted behaviors occurred, notes would be taken on the Data Collection Sheet.</td>
</tr>
</tbody>
</table>

Table 11 Reversal baseline data collection procedure

Once intervention data had become stable or 16 sessions of intervention had been completed, *I-Learn Social Story* intervention was completely withdrawn from the participants, and reversal baseline phase began for 16 to 32 sessions (depending on the participants’ attendance and the stability of the data), right after the intervention phase ended.

The procedure used in the reversal baseline was the same procedure used in the baseline. The purpose of the reversal baseline phase was to access the short-term skill maintenance of the participants after they had learnt the SS. This phase could also be called as the post-intervention phase. Table 11 describes the reversal baseline data collection procedure.
Phase | Follow-up
--- | ---
Pre-condition | Participants had completed the study for one month
Setting/Environment | Participants’ respective classrooms/kitchen/multi-purpose hall/outdoor, including the participants, teacher, classroom helper, other students of the class and the author, as the observer.
Duration/No of sessions | 1-2 visits, each visit = 30 minutes
Materials | Data Collection Sheet or notepad
Data collection procedures | Participants were observed in their daily class activities, they were not informed about the observation so that they could behave naturally, if any of the targeted behaviors occurred, notes would be taken on the Data Collection Sheet.

Table 12 Follow-up data collection procedure

The purpose of the follow up session was to assess the long-term skill maintenance, conducted three to five weeks after the completion of the study, in one or two visits, with each visit lasting for 30 minutes. Table 12 describes the follow-up data collection procedure.

The procedure used in the follow-up session was the same as the procedure used in the baseline/reversal baseline session, where the Data Collection Sheet was used to record the participant’s behaviors. *I-Learn Social Story* was not shown to the participant prior to the follow-up visit. Teacher and class helpers were asked for their comments on the participant’s post study behaviors, whether he had maintained the social skills learned. These data collected during the follow-up was not presented in the data analysis, instead it is discussed in section 5.4 under Findings and Discussions.

5.2.5 Data processing and analysis

Data collected from the Data Collection Sheet (Appendix C) were recorded manually, and data processing analyses were done in Microsoft Excel 2010. Microsoft Excel has been widely used in data analysis for single subject design study, ever since Carr & Burkholder (1998). Data collected from the sheet was converted within 24 hours of the data collection from shorthand/keywords into sentences or descriptive narratives.

In Microsoft Excel, data collected during all of the phases in the study was combined and tabulated to generate the average value of behavioral change of *Appropriate, Inappropriate* and *No Interactions* for each participant. This yielded the number of interaction in average per
session (10 minutes). The results/rates of the behavioral changes were then graphed, using Microsoft Excel 2010 for visual analysis. The overall data of behavioral changes were also tabulated and graphed by combining all the data generated from all of the participants.

In the best studies in experimental design, the blind analysis technique was performed on the data, to prevent conscious or unconscious fudging or prejudiced interpretation (Hopkins 2000). Thus, in this study, the data was analyzed without using the name of the participant, instead, a number ID was given to each participant, and their collected data were analyzed using the ID without revealing the real name.

Along with the preliminary data collected from the Data Collection Sheet during intervention, secondary data from published papers, literature, and interview with teachers were analyzed in order to support the intervention results and to generate social validity and teacher satisfaction on the prototype, as discussed in section 5.4 under Findings and Discussions.

5.2.6 Ethical considerations

As this study required human participation, particularly children with ASD, certain ethical issues of sensitivity needed to be addressed. The consideration of these ethical issues was for the purpose of ensuring the privacy and safety of all the participants.

Among the significant ethical issues that were to be considered in the study process were the consent from parents and teachers, as well as ensuring the confidentiality of the information obtained in the study. In order to secure the consent of the selected participants, all important details of the study, including its aim and purpose were relayed. The participants were also advised that they could withdraw from the study if they wished to, even during the process, without any penalty. With this, the participants were not made to feel forced to participate in the research study.

The confidentiality of the participants was ensured by not disclosing their real names or any other personal information in any presentation or publications related to the research, as well as not being photographed or recorded throughout the study in order to conceal their privacy. The data collected from the observation and interviews for the analysis was locked and destroyed after the analysis of the data was done.
5.3 Settings

The experimental study was held in Perkata Special School in a few specific locations of the school area, such as the different classrooms, school kitchen, multi-purpose meeting hall, and the open area of the school.

5.3.1 Classrooms

There were 6 classrooms used as the setting for the study. Each classroom held a maximum of 17 students of mixed mental disabilities. Each class was managed by one classroom teacher and one or two teacher’s assistants. Table 13 describes the classrooms and a short description of the classes’ main activities.

<table>
<thead>
<tr>
<th>Class</th>
<th>No of participant from the class</th>
<th>Short description</th>
<th>Class main activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>5 (Participant 1, 2, 4, 6, 7)</td>
<td>First range class; class for the youngest students</td>
<td>Playing with toys, Learning alphabet, Watching kids’ movies, Coloring, Singing, Introduction to numbers, Learning simple vocabulary</td>
</tr>
<tr>
<td>Class 2</td>
<td>6 (Participant 3, 5, 8, 9, 11, 17)</td>
<td>Second range class</td>
<td>Playing with toys, Learning alphabets, Watching kids’ movies, Drawing/coloring, Singing, Introduction to numbers, Matching object pictures</td>
</tr>
<tr>
<td>Class 3</td>
<td>6 (Participant 10, 12, 13, 14, 18, 19)</td>
<td>Third range class</td>
<td>Singing, Drawing/coloring, Matching object pictures, Simple math, Cooking, Spelling, Exercise, Puzzle solving</td>
</tr>
<tr>
<td>Class 4</td>
<td>7 (Participant 15, 16, 20, 21, 22, 23, 24)</td>
<td>Fourth range class</td>
<td>Singing, Math, Matching object pictures, Spelling, Cooking, Puzzle solving/logic learning, Exercise, Reading/writing, Computer, Art/craft, Drawing/coloring</td>
</tr>
<tr>
<td>Class 5</td>
<td>5 (Participant 25, 26, 27, 28, 29)</td>
<td>Fifth range class</td>
<td>Singing, Puzzle solving/logic learning, Cooking, Reading/writing, Exercise, Art/craft, Computer, Gardening, Drawing/coloring, Life skills (cleaning, planting), Math</td>
</tr>
<tr>
<td>Class 6</td>
<td>1 (Participant 30)</td>
<td>Seventh range class; the last year students</td>
<td>Singing, Puzzle solving/logic learning, Cooking, Reading/writing, Exercise, Art/craft, Computer, Gardening, Drawing/coloring, Life skills (cleaning, planting), Math</td>
</tr>
</tbody>
</table>

Table 13 Classrooms profile summary
5.3.2 School multi-purpose hall

In Perkata Special School, there is one multi-purpose hall which is normally used for singing sessions, where there will be two classes combined for the session; teachers and class helpers from both classrooms will lead the students in the singing. Other than that, it is also used to hold special activities, such as visit from outside, class competition or any other purposes.

5.3.3 Kitchen

There is a kitchen in the school where cooking activities are held daily by different classes. While the teacher and class helper are cooking, the students will be sitting down at the kitchen table. Some of the more capable students will be asked to help the teacher out in various activities, like washing the plates and spoons, distributing the utensils to their classmates, or helping in peeling the vegetables.

5.3.4 Outdoor field

In Perkata Special School, there is an outdoor field where outdoor activities are carried out, such as exercising or gardening. Thus, the outdoor field was one of the settings where the observation was taking place.

5.4 Material and equipment

5.4.1 Data collection sheet

Data collection sheet (Appendix C) was mainly used for the data collection in all of the phases. This sheet was prepared specifically for the data collection, as in Norris & Datillo (1999) with columns for the response definition of Appropriate, Inappropriate and No Interaction as defined in Table 8.

5.4.2 I-Learn Social Story presented in a set of notebook

A notebook PC was used to present the I-Learn Social Story to the participants. In the study, the notebook used was Lenovo IdeaPad 10.1”. However, I-Learn Social Story can be presented in any computer and mobile phone that supports Adobe Flash Player.
5.5 Result and analysis

The effectiveness of I-Learn Social Story in changing the social behavior of the participants was identified by comparing the average (mean) number of occurrences for the social behavior (Appropriate, Inappropriate and No Interaction) on each of the phases (baseline, intervention and reversal baseline) for each participant.

The average (mean) number of social behavior occurrences was obtained by summing-up the number of occurrences for the phase and dividing it by the number of sessions in the phase, as each participant had a different number of sessions on each phase.

The unit used to measure the behavioral change in the results was by the number of behavioral change within 10 minutes. Figure 28 to Figure 57 illustrate the graph for behavioral changes for individual participants, Table 18 to Table 22 illustrate the changes based on each SS. And after the result of the entire SS was tabled, the overall behavioral change results were compiled into the overall results (Table 23), which revealed that the intervention of I-Learn Social Story was effective in changing the behavior of children with ASD.

5.5.1 Individual results

This section discusses the results of each individual participant following Figure 31 to Figure 60. Each figure displays the graphs of the individual participant’s result on each SS that the participant went through. Included in each graph is the number of social interactions made on each phase of the intervention. There were three phases of data collection (Baseline, Intervention and Reversal Baseline, as discussed in section 5.2.1.4 Data collection). The average value of each phase was calculated by adding the numbers of social behavior and dividing it with the number of sessions in the phase. The value for overall behavioral changes of each phase was obtained from the average behavioral changes value of all social stories in each phase divided by the number of social stories that the participant went through. All values were stated in number of times (occurrences) per 10 minutes session.
I. Participant 1

Figure 31 illustrates the comparison graphs of Participant 1’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

**Figure 31 Participant 1’s behavioral changes**
a. Result of How to greet someone at school

During the baseline phase, Participant 1 achieved an average of 0.1 occurrence of Appropriate behavior; 1.6 occurrences of Inappropriate behavior; and 2.4 occurrences of No Interaction in the observation. During the intervention phase, Participant 1 achieved 0.6 occurrence of Appropriate behavior; 0.6 occurrence of Inappropriate behavior; and 0.8 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.5 occurrence, Inappropriate behavior was 0.5 occurrence and No Interaction was 0.8 occurrence. From the findings of the observation in the three phases, Participant 1 had improved in Appropriate behavior by 0.45 occurrence. Inappropriate behavior was reduced by 1.05 occurrences and the number of interactions increased by 1.6 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 1 achieved an average of 0.3 occurrence of Appropriate behavior; 1.3 occurrences of Inappropriate behavior; and 3.8 occurrences of No Interaction in the observation. During the intervention phase, Participant 1 achieved 2.3 occurrences of Appropriate behavior; 0.4 occurrence of Inappropriate behavior; and 1.2 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.1 occurrences, Inappropriate behavior was 0.5 occurrence and No Interaction was 0.9 occurrence. From the findings of the observation in these three phases, Participant 1 had improved in Appropriate behavior by 1.9 occurrences. Inappropriate behavior was reduced by 0.85 occurrence and the number of interactions increased by 2.75 occurrences.

c. Result of Snack time

During the baseline phase, Participant 1 achieved an average of 0.7 occurrence of Appropriate behavior; 2.7 occurrences of Inappropriate behavior; and 3.0 occurrences of No Interaction in the observation. During the intervention phase, Participant 1 achieved 1.9 occurrences of Appropriate behavior; 0.9 occurrence of Inappropriate behavior; and 1.0 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.8 occurrences, Inappropriate behavior was 0.9 occurrence and No Interaction was 1.2 occurrences. From the findings of the observation in the three phases, Participant 1 had improved in Appropriate behavior by 1.15 occurrences. Inappropriate behavior was reduced by 1.80 occurrences and the number of interactions increased by 1.9 occurrences.
d. Result of Washing hands

During the baseline phase, Participant 1 achieved an average of 0.2 occurrence of Appropriate behavior; 1.9 occurrences of Inappropriate behavior; and 3.7 occurrences of No Interaction in the observation. During the intervention phase, Participant 1 achieved 1.5 occurrences of Appropriate behavior; 0.9 occurrence of Inappropriate behavior; and 1.3 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.8 occurrences, Inappropriate behavior was 0.8 occurrence and No Interaction was 0.7 occurrence. From the findings of the observation in these three phases, Participant 1 had improved in Appropriate behavior by 1.45 occurrences. Inappropriate behavior was reduced by 1.05 occurrences and the number of interactions increased by 2.7 occurrences.

Overall, the results suggested that introduction of SS presented in I-Learn Social Story had a considerable and beneficial effect on Participant 1 in increasing the number of Appropriate behaviors, decreasing the number of Inappropriate behaviors as well as increasing the number of social interactions made.
II. Participant 2

Figure 32 illustrates the comparison graphs of Participant 2’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 32 Participant 2’s behavioral changes
Chapter 5: Prototype Testing and Evaluation

a. Result of How to greet someone at school

During the baseline phase, Participant 2 achieved an average of 0.8 occurrence of Appropriate behavior; 2.3 occurrences of Inappropriate behavior; and 2.6 occurrences of No Interaction in the observation. During the intervention phase, Participant 2 achieved 2.2 occurrences of Appropriate behavior; 0.8 occurrence of Inappropriate behavior; and 0.6 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.6 occurrences, Inappropriate behavior was 0.8 occurrence and No Interaction was 0.7 occurrence. From the findings of the observation in the three phases, Participant 2 had improved in Appropriate behavior by 1.1 occurrences. Inappropriate behavior was reduced by 1.5 occurrences and the number of interactions increased by 1.95 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 2 achieved an average of 0.8 occurrence of Appropriate behavior; 2.5 occurrences of Inappropriate behavior; and 2.1 occurrences of No Interaction in the observation. During the intervention phase, Participant 2 achieved 2.7 occurrences of Appropriate behavior; 0.7 occurrence of Inappropriate behavior; and 0.7 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.3 occurrences, Inappropriate behavior was 0.8 occurrence and No Interaction was 0.9 occurrence. From the findings of the observation in these three phases, Participant 2 had improved in Appropriate behavior by 1.7 occurrences. Inappropriate behavior was reduced by 1.75 occurrences and the number of interactions increased by 1.3 occurrences.

c. Result of Snack time

During the baseline phase, Participant 2 achieved an average of 0.8 occurrence of Appropriate behavior; 1.9 occurrences of Inappropriate behavior; and 2.4 occurrences of No Interaction in the observation. During the intervention phase, Participant 2 achieved 2.3 occurrences of Appropriate behavior; 0.8 occurrence of Inappropriate behavior; and 1.0 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.0 occurrences, Inappropriate behavior was 0.9 occurrence and No Interaction was 1.0 occurrence. From the findings of the observation in these three phases, Participant 2 had improved in Appropriate behavior by 1.35 occurrences. Inappropriate behavior was reduced by 1.05 occurrences and the number of interactions increased by 1.4 occurrences.
d. Result of Washing hands

During the baseline phase, Participant 2 achieved an average of 0.1 occurrence of *Appropriate* behavior; 2.0 occurrences of *Inappropriate* behavior; and 2.3 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 2 achieved 1.2 occurrences of *Appropriate* behavior; 0.4 occurrence of *Inappropriate* behavior; and 0.7 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.2 occurrences, *Inappropriate* behavior was 0.5 occurrence and *No Interaction* was 0.6 occurrence. From the findings of the observation in the three phases, Participant 2 had improved in *Appropriate* behavior by 1.1 occurrences. *Inappropriate* behavior was reduced by 1.55 occurrences and the number of interactions increased by 1.65 occurrences.

Overall, the results for Participant 2 suggested that the introduction of SS presented in *I-Learn Social Story* had a sizeable role in increasing the number of *Appropriate* behaviors and decreasing the number of *Inappropriate* behaviors, as well as increasing the number of social interactions made.
III. Participant 3

Figure 33 illustrates the comparison graphs of Participant 3’s *Appropriate, Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

**Participant 3 (How to greet someone at school)**

**Participant 3 (Play and sing with friends)**

**Participant 3 (Snack time)**

**Participant 3 (Washing hands)**

*Figure 33 Participant 3’s behavioral changes*
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a. **Result of How to greet someone at school**

During the baseline phase, Participant 3 achieved an average of 0.7 occurrence of *Appropriate* behavior; 1.3 occurrences of *Inappropriate* behavior; and 2.9 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 3 achieved 2.1 occurrences of *Appropriate* behavior; 1.2 occurrences of *Inappropriate* behavior; and 1.1 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.6 occurrences, *Inappropriate* behavior was 1.2 occurrences and *No Interaction* was 1.5 occurrences. From the findings of the observation in three phases, Participant 3 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior reduced by 0.1 occurrence and the number of interactions increased by 1.6 occurrences.

b. **Result of Play and sing with friends**

During the baseline phase, Participant 3 achieved an average of 0.5 occurrence of *Appropriate* behavior; 1.6 occurrences of *Inappropriate* behavior; and 3.4 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 3 achieved 2.0 occurrences of *Appropriate* behavior; 0.9 occurrences of *Inappropriate* behavior; and 1.5 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.0 occurrences, *Inappropriate* behavior was 0.8 occurrence and *No Interaction* was 1.3 occurrences. From the findings of the observation in the three phases, Participant 3 had improved in *Appropriate* behavior by 1.5 occurrences. *Inappropriate* behavior was reduced by 0.75 occurrence and the number of interactions increased by 2.00 occurrences.

c. **Result of Snack time**

During the baseline phase, Participant 3 achieved an average of 0.7 occurrence of *Appropriate* behavior; 1.8 occurrences of *Inappropriate* behavior; and 3.8 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 3 achieved 2.4 occurrences of *Appropriate* behavior; 1.6 occurrences of *Inappropriate* behavior; and 1.8 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.2 occurrences, *Inappropriate* behavior was 1.5 occurrences and *No Interaction* was 2.0 occurrences. From the findings of the observation in the three phases, Participant 3 had improved in *Appropriate* behavior by 1.60 occurrences. *Inappropriate* behavior was reduced by 0.25 occurrence and number of interactions increased by 1.90 occurrences.
d. Result of Washing hands

During the baseline phase, Participant 3 achieved an average of 0.4 occurrence of Appropriate behavior; 2.2 occurrences of Inappropriate behavior; and 2.3 occurrences of No Interaction in the observation. During the intervention phase, Participant 3 achieved 1.2 occurrences of Appropriate behavior; 0.9 occurrence of Inappropriate behavior; and 0.9 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.8 occurrence, Inappropriate behavior was 1.0 occurrence and No Interaction was 0.9 occurrence. From the findings of the observation in the three phases, Participant 3 had improved in Appropriate behavior by 0.60 occurrence. Inappropriate behavior was reduced by 1.25 occurrences and the number of interactions increased by 1.40 occurrences.

Overall, the result for Participant 3 suggested that the introduction of SS presented in I-Learn Social Story had a substantial effect in increasing the Appropriate behaviors and the number of social interactions made, as well as having little effect in decreasing Inappropriate behaviors.
IV. Participant 4

Figure 34 illustrates the comparison graphs of Participant 4’s *Appropriate*, *Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

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**Figure 34** Participant 4’s behavioral changes
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**a. Result of How to greet someone at school**

During the baseline phase, Participant 4 achieved an average of 0.6 occurrence of *Appropriate* behavior; 2.4 occurrences of *Inappropriate* behavior; and 1.4 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 4 achieved 2.6 occurrences of *Appropriate* behavior; 0.6 occurrence of *Inappropriate* behavior; and 0.3 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.3 occurrences, *Inappropriate* behavior was 0.4 occurrence and *No Interaction* was 0.3 occurrence. From the findings of the observation in the three phases, Participant 4 had improved in *Appropriate* behavior by 1.85 occurrences. *Inappropriate* behavior was reduced by 1.90 occurrences and the number of interactions increased by 1.10 occurrences.

**b. Result of Play and sing with friends**

During the baseline phase, Participant 4 achieved an average of 0.4 occurrence of *Appropriate* behavior; 2.5 occurrences of *Inappropriate* behavior; and 1.6 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 4 achieved 2.6 occurrences of *Appropriate* behavior; 0.8 occurrence of *Inappropriate* behavior; and 0.4 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.2 occurrences, *Inappropriate* behavior was 1.0 occurrence and *No Interaction* was 0.5 occurrence. From the findings of the observation in the three phases, Participant 4 had improved in *Appropriate* behavior by 2.0 occurrences. *Inappropriate* behavior was reduced by 1.6 occurrences and the number of interactions increased by 1.15 occurrences.

**c. Result of Snack time**

During the baseline phase, Participant 4 achieved an average of 0.8 occurrence of *Appropriate* behavior; 1.6 occurrences of *Inappropriate* behavior; and 2.7 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 4 achieved 2.8 occurrences of *Appropriate* behavior; 0.6 occurrence of *Inappropriate* behavior; and 0.4 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.5 occurrences, *Inappropriate* behavior was 0.7 occurrence and *No Interaction* was 0.5 occurrence. From the findings of the observation in the three phases, Participant 4 had improved in *Appropriate* behavior by 1.85 occurrences. *Inappropriate* behavior was reduced by 0.95 occurrence and the number of interactions increased by 2.25 occurrences.
d. Result of Washing hands

During the baseline phase, Participant 4 achieved an average of 0.9 occurrence of Appropriate behavior; 2.4 occurrences of Inappropriate behavior; and 1.8 occurrences of No Interaction in the observation. During the intervention phase, Participant 4 achieved 2.8 occurrences of Appropriate behavior; 0.9 occurrence of Inappropriate behavior; and 0.3 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.3 occurrences, Inappropriate behavior was 0.7 occurrence and No Interaction was 0.4 occurrence. From the findings of the observation in the three phases, Participant 4 had improved in Appropriate behavior by 1.65 occurrences. Inappropriate behavior was reduced by 1.60 occurrences and the number of interactions increased by 1.45 occurrences.

Overall, the results for Participant 4 suggested that the introduction of SS presented in I-Learn Social Story had a great positive effect in changing the social behaviors of the participant.
Figure 35 illustrates the comparison graphs of Participant 5’s *Appropriate, Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 35 Participant 5’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 5 achieved an average of 0.4 occurrence of Appropriate behavior; 2.4 occurrences of Inappropriate behavior; and 2.9 occurrences of No Interaction in the observation. During the intervention phase, Participant 5 achieved 2.2 occurrences of Appropriate behavior; 1.1 occurrences of Inappropriate behavior; and 0.8 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.1 occurrences, Inappropriate behavior was 1.0 occurrence and No Interaction was 0.8 occurrence.

From the findings of the observation in the three phases, Participant 5 had improved in Appropriate behavior by 1.75 occurrences. Inappropriate behavior was reduced by 1.35 occurrences and the number of interactions increased by 2.10 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 5 achieved an average of 0.8 occurrence of Appropriate behavior; 2.1 occurrences of Inappropriate behavior; and 3.4 occurrences of No Interaction in the observation. During the intervention phase, Participant 5 achieved 2.9 occurrences of Appropriate behavior; 0.7 occurrence of Inappropriate behavior; and 1.2 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.4 occurrences, Inappropriate behavior was 0.6 occurrence and No Interaction was 1.3 occurrences.

From the findings of the observation in the three phases, Participant 5 had improved in Appropriate behavior by 1.85 occurrences. Inappropriate behavior was reduced by 1.45 occurrences and the number of interactions increased by 2.15 occurrences.

c. Result of Snack time

During the baseline phase, Participant 5 achieved an average of 0.6 occurrence of Appropriate behavior; 1.6 occurrences of Inappropriate behavior; and 2.3 occurrences of No Interaction in the observation. During the intervention phase, Participant 5 achieved 2.3 occurrences of Appropriate behavior; 0.6 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.0 occurrences, Inappropriate behavior was 1.0 occurrence and No Interaction was 1.0 occurrence.
From the findings of the observation in the three phases, Participant 5 had improved in *Appropriate* behavior by 1.55 occurrences. *Inappropriate* behavior was reduced by 0.80 occurrence and the number of interactions increased by 1.35 occurrences.

d. Result of Washing hands

During the baseline phase, Participant 5 achieved an average of 0.3 occurrence of *Appropriate* behavior; 2.1 occurrences of *Inappropriate* behavior; and 3.8 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 5 achieved 1.4 occurrences of *Appropriate* behavior; 1.4 occurrences of *Inappropriate* behavior; and 2.3 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.5 occurrences, *Inappropriate* behavior was 1.2 occurrences and *No Interaction* was 2.3 occurrences.

From the findings of the observation in the three phases, Participant 5 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 0.80 occurrence and the number of interactions increased by 1.50 occurrences.

e. Result of Walking in the hallway

During the baseline phase, Participant 5 achieved an average of 0.60 occurrence of *Appropriate* behavior; 2.6 occurrences of *Inappropriate* behavior; and 2.0 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 5 achieved 1.80 occurrences of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 0.80 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.70 occurrences, *Inappropriate* behavior was 1.40 occurrences and *No Interaction* was 1.10 occurrences.

From the findings of the observation in the three phases, Participant 5 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 1.35 occurrences and the number of interactions increased by 1.05 occurrences.

Overall, the results of Participant 5 suggested that the introduction of SS presented in *I-Learn Social Story* had a considerable effect on the participant in changing his social behaviors.
VI. Participant 6

Figure 36 illustrates the comparison graphs of Participant 6’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 36 Participant 6’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 6 achieved an average of 1.3 occurrences of Appropriate behavior; 2.5 occurrences of Inappropriate behavior; and 1.2 occurrences of No Interaction in the observation. During the intervention phase, Participant 6 achieved 2.80 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.40 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.50 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.60 occurrence. From the findings of the observation in the three phases, Participant 6 had improved in Appropriate behavior by 1.35 occurrences. Inappropriate behavior was reduced by 1.40 occurrences and the number of interactions increased by 0.70 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 6 achieved an average of 2.30 occurrences of Appropriate behavior; 2.30 occurrences of Inappropriate behavior; and 1.90 occurrences of No Interaction in the observation. During the intervention phase, Participant 6 achieved 3.60 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.50 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 3.20 occurrences, Inappropriate behavior was 0.90 occurrence and No Interaction was 0.90 occurrence. From the findings of the observation in the three phases, Participant 6 had improved in Appropriate behavior by 1.10 occurrences. Inappropriate behavior was reduced by 1.45 occurrences and the number of interactions increased by 1.20 occurrences.

c. Result of Snack time

During the baseline phase, Participant 6 achieved an average of 2.10 occurrences of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 1.90 occurrences of No Interaction in the observation. During the intervention phase, Participant 6 achieved 2.90 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.50 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.80 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.80 occurrence. From the findings of the observation in the three phases, Participant 6 had improved in Appropriate behavior by 0.75 occurrence. Inappropriate behavior was reduced by 1.00 occurrence and the number of interactions increased by 1.25 occurrences.
**d. Result of Washing hands**

During the baseline phase, Participant 6 achieved an average of 0.50 occurrence of *Appropriate* behavior; 0.80 occurrence of *Inappropriate* behavior; and 2.0 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 6 achieved 1.50 occurrences of *Appropriate* behavior; 0.40 occurrence of *Inappropriate* behavior; and 0.60 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.50 occurrences, *Inappropriate* behavior was 0.40 occurrence and *No Interaction* was 0.80 occurrence. From the findings of the observation in the three phases, Participant 6 had improved in *Appropriate* behavior by 1.00 occurrences. *Inappropriate* behavior was reduced by 0.40 occurrence and the number of interactions increased by 1.30 occurrences.

Overall, the results collected suggested that the introduction of SS presented in *I-Learn Social Story* had a considerable and beneficial effect in changing Participant 6’s social behaviors.
VII. Participant 7

Figure 37 illustrates the comparison graphs of Participant 7's Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 37 Participant 7's behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 7 achieved an average of 1.50 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 2.90 occurrences of No Interaction in the observation. During the intervention phase, Participant 7 achieved 2.50 occurrences of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 0.80 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.40 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.90 occurrence. From the findings of the observation in the three phases, Participant 7 had improved in Appropriate behavior by 0.95 occurrence. Inappropriate behavior was reduced by 0.25 occurrence and the number of interactions increased by 2.05 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 7 achieved an average of 1.20 occurrences of Appropriate behavior; 2.00 occurrences of Inappropriate behavior; and 2.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 7 achieved 3.30 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.00 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences, Inappropriate behavior was 1.00 occurrence and No Interaction was 1.20 occurrences. From the findings of the observation in the three phases, Participant 7 has improved in Appropriate behavior by 1.9 occurrences. Inappropriate behavior was reduced by 0.95 occurrence and number of interactions increased by 0.90 occurrence.

c. Result of Snack time

During the baseline phase, Participant 7 achieved an average of 1.40 occurrences of Appropriate behavior; 2.40 occurrences of Inappropriate behavior; and 2.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 7 achieved 3.10 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.00 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.80 occurrence. From the findings of the observation in the three phases, Participant 7 had improved in Appropriate behavior by 1.60 occurrences. Inappropriate behavior was reduced by 1.25 occurrences and number of interactions increased by 1.10 occurrences.
d. Result of Washing hands

During the baseline phase, Participant 7 achieved an average of 0.80 occurrence of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 1.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 7 achieved 1.80 occurrences of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.60 occurrences, Inappropriate behavior was 1.10 occurrences and No Interaction was 1.10 occurrences. From the findings of the observation in the three phases, Participant 7 has improved in Appropriate behavior by 0.90 occurrence. Inappropriate behavior was reduced by 0.65 occurrence and number of interactions increased by 0.80 occurrence.

Overall, the results for Participant 7 suggested that the introduction of SS presented in I-Learn Social Story had a beneficial effect in changing his social behaviors.
VIII. Participant 8

Figure 38 illustrates the comparison graphs of Participant 8’s *Appropriate*, *Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 8's behavior graphs](image-url)

**Figure 38** Participant 8's behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 8 achieved an average of 0.3 occurrence of Appropriate behavior; 2.80 occurrences of Inappropriate behavior; and 2.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 8 achieved 1.60 occurrences of Appropriate behavior; 1.40 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.60 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 1.00.

From the findings of the observation in the three phases, Participant 8 had improved in Appropriate behavior by 1.30 occurrences. Inappropriate behavior was reduced by 1.50 occurrences and the number of interactions increased by 1.05 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 8 achieved an average of 0.60 occurrence of Appropriate behavior; 3.10 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 8 achieved 3.00 occurrences of Appropriate behavior; 1.60 occurrences of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.40 occurrence.

From the findings of the observation in the three phases, Participant 8 had improved in Appropriate behavior by 2.35 occurrences. Inappropriate behavior was reduced by 1.70 occurrences and the number of interactions increased by 0.75 occurrence.

c. Result of Snack time

During the baseline phase, Participant 8 achieved an average of 0.60 occurrence of Appropriate behavior; 2.40 occurrences of Inappropriate behavior; and 1.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 8 achieved 1.90 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 0.70 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.60 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 1.00 occurrence.
From the findings of the observation in the three phases, Participant 8 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 1.25 occurrences and the number of interaction increased by 0.65 occurrence.

d. Result of Washing hands

During the baseline phase, Participant 8 achieved an average of 1.00 occurrence of *Appropriate* behavior; 1.80 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 8 achieved 2.10 occurrences of *Appropriate* behavior; 1.80 occurrences of *Inappropriate* behavior; and 0.90 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.20 occurrences, *Inappropriate* behavior was 1.60 occurrences and *No Interaction* was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 8 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 0.10 occurrence and the number of interactions increased by 0.45 occurrence.

e. Result of Walking in the hallway

During the baseline phase, Participant 8 achieved an average of 0.70 occurrence of *Appropriate* behavior; 3.50 occurrences of *Inappropriate* behavior; and 1.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 8 achieved 2.10 occurrences of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 0.90 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.90 occurrences, *Inappropriate* behavior was 2.10 occurrences and *No Interaction* was 1.20 occurrences.

From the findings of the observation in the three phases, Participant 8 had improved in *Appropriate* behavior by 1.30 occurrences. *Inappropriate* behavior was reduced by 1.45 occurrences and the number of interactions increased by 0.75 occurrence.

Overall, the results for Participant 8 suggested that the introduction of SS presented in *I-Learn Social Story* had a considerable and beneficial effect in changing the participant’s *Appropriate* behaviors and *Inappropriate* behaviors, as well as increasing the number of social interactions made by the participant.
IX. Participant 9

Figure 39 illustrates the comparison graphs of Participant 9’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 39 Participant 9’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 9 achieved an average of 2.70 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.30 occurrence of No Interaction in the observation. During the intervention phase, Participant 9 achieved 3.40 occurrences of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 0.10 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 9 had improved in Appropriate behavior by 0.45 occurrence. Inappropriate behavior was reduced by 0.50 occurrence and the number of interactions increased by 0.10 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 9 achieved an average of 0.60 occurrence of Appropriate behavior; 5.20 occurrences of Inappropriate behavior; and 0.60 occurrence of No Interaction in the observation. During the intervention phase, Participant 9 achieved 3.10 occurrences of Appropriate behavior; 2.10 occurrences of Inappropriate behavior; and 0.70 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.60 occurrences, Inappropriate behavior was 1.90 occurrences and No Interaction was 0.50 occurrence.

From the findings of the observation in the three phases, Participant 9 had improved in Appropriate behavior by 2.25 occurrences. Inappropriate behavior was reduced by 3.20 occurrences and the number of interactions remained the same.

c. Result of Snack time

During the baseline phase, Participant 9 achieved an average of 2.90 occurrences of Appropriate behavior; 1.50 occurrences of Inappropriate behavior; and 1.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 9 achieved 4.30 occurrences of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 1.00 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 3.80 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.9 occurrence.
From the findings of the observation in the three phases, Participant 9 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 0.65 occurrence and the number of interactions increased by 0.65 occurrence.

**d. Result of Washing hands**

During the baseline phase, Participant 9 achieved an average of 1.10 occurrences of *Appropriate* behavior; 5.10 occurrences of *Inappropriate* behavior; and 0.30 occurrence of *No Interaction* in the observation. During the intervention phase, Participant 9 achieved 2.70 occurrences of *Appropriate* behavior; 2.50 occurrences of *Inappropriate* behavior; and 0.30 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.00 occurrences, *Inappropriate* behavior was 2.80 occurrences and *No Interaction* was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 9 had improved in *Appropriate* behavior by 1.25 occurrences. *Inappropriate* behavior was reduced by 2.45 occurrences and the number of interactions remained the same.

**e. Result of Walking in the hallway**

During the baseline phase, Participant 9 achieved an average of 0.80 occurrence of *Appropriate* behavior; 1.90 occurrences of *Inappropriate* behavior; and 0.60 occurrence of *No Interaction* in the observation. During the intervention phase, Participant 9 achieved 2.10 occurrences of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 0.70 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.00 occurrences, *Inappropriate* behavior was 0.90 occurrence and *No Interaction* was 0.60 occurrence.

From the findings of the observation in the three phases, Participant 9 had improved in *Appropriate* behavior by 1.25 occurrences. *Inappropriate* behavior was reduced by 0.90 occurrence and the number of interactions decreased by 0.05 occurrence.

Overall, the results for Participant 9 suggested that the introduction of SS presented in *I-Learn Social Story* had not substantially increased social interactions made by the participant, but it noticeably increased the number of *Appropriate* behaviors and decreased the number of *Inappropriate* behaviors made.
X. Participant 10

Figure 40 illustrates the comparison graphs of Participant 10’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 10's behavioral changes](image-url)
a. Result of How to greet someone at school

During the baseline phase, Participant 10 achieved an average of 2.50 occurrences of Appropriate behavior; 2.50 occurrences of Inappropriate behavior; and 2.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 10 achieved 3.10 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.50 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 3.10 occurrences, Inappropriate behavior was 0.60 occurrence and No Interaction was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 10 had improved in Appropriate behavior by 0.60 occurrence. Inappropriate behavior was reduced by 1.80 occurrences and the number of interactions increased by 1.60 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 10 achieved an average of 2.70 occurrences of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 2.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 10 achieved 3.40 occurrences of Appropriate behavior; 0.40 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 3.20 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 1.00 occurrence.

From the findings of the observation in the three phases, Participant 10 had improved in Appropriate behavior by 0.60 occurrence. Inappropriate behavior was reduced by 0.55 occurrence and the number of interactions increased by 1.85 occurrences.

c. Result of Snack time

During the baseline phase, Participant 10 achieved an average of 1.80 occurrences of Appropriate behavior; 0.40 occurrence of Inappropriate behavior; and 1.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 10 achieved 3.70 occurrences of Appropriate behavior; 0.10 occurrence of Inappropriate behavior; and 0.80 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 3.50 occurrences, Inappropriate behavior was 0.10 occurrence and No Interaction was 0.80 occurrence.
From the findings of the observation in the three phases, Participant 10 had improved in *Appropriate* behavior by 1.80 occurrences. *Inappropriate* behavior was reduced by 0.30 occurrence and the number of interactions increased by 1.00 occurrence.

d. Result of Walking in the hallway

During the baseline phase, Participant 10 achieved an average of 1.80 occurrences of *Appropriate* behavior; 0.20 occurrence of *Inappropriate* behavior; and 2.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 10 achieved 2.80 occurrences of *Appropriate* behavior; 0.00 occurrence of *Inappropriate* behavior; and 1.10 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 3.10 occurrences, *Inappropriate* behavior was 0.10 occurrence and *No Interaction* was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 10 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 1.85 occurrences.

e. Result of Washing hands

During the baseline phase, Participant 10 achieved an average of 1.90 occurrences of *Appropriate* behavior; 1.50 occurrences of *Inappropriate* behavior; and 1.90 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 10 achieved 2.90 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 0.50 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 3.30 occurrences, *Inappropriate* behavior was 0.40 occurrence and *No Interaction* was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 10 had improved in *Appropriate* behavior by 1.20 occurrences. *Inappropriate* behavior was reduced by 1.00 occurrence and the number of interactions increased by 1.50 occurrences.

Overall, the results for participant 10 suggested that the introduction of SS presented in *I-Learn Social Story* sizably increased the number of social interactions and *Appropriate* behaviors, as well as reducing the number of *Inappropriate* behaviors made by the participant.
XI. Participant 11

Figure 41 illustrates the comparison graphs of Participant 11’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 41 Participant 11’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 11 achieved an average of 1.10 occurrences of Appropriate behavior; 3.20 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 11 achieved 1.30 occurrences of Appropriate behavior; 2.20 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.10 occurrences, Inappropriate behavior was 2.30 occurrences and No Interaction was 1.30 occurrences.

From the findings of the observation in the three phases, Participant 11 had improved in Appropriate behavior by 0.10 occurrence. Inappropriate behavior was reduced by 0.95 occurrence and the number of interactions decreased by 0.20 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 11 achieved an average of 0.80 occurrence of Appropriate behavior; 4.30 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 11 achieved 1.50 occurrences of Appropriate behavior; 3.70 occurrences of Inappropriate behavior; and 1.60 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.20 occurrences, Inappropriate behavior was 3.60 occurrences and No Interaction was 1.70 occurrences.

From the findings of the observation in the three phases, Participant 11 had improved in Appropriate behavior by 0.55 occurrence. Inappropriate behavior was reduced by 0.65 occurrence and the number of interactions decreased by 0.35 occurrence.

c. Result of Snack time

During the baseline phase, Participant 11 achieved an average of 0.60 occurrence of Appropriate behavior; 3.70 occurrences of Inappropriate behavior; and 1.00 occurrence of No Interaction in the observation. During the intervention phase, Participant 11 achieved 0.80 occurrence of Appropriate behavior; 2.30 occurrences of Inappropriate behavior; and 1.70 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.90 occurrence, Inappropriate behavior was 2.30 occurrences and No Interaction was 1.60 occurrences.
From the findings of the observation in the three phases, Participant 11 had improved in *Appropriate* behavior by 0.25 occurrence. *Inappropriate* behavior was reduced by 1.40 occurrences and the number of interactions decreased by 0.65 occurrence.

### d. Result of Walking in the hallway

During the baseline phase, Participant 11 achieved an average of 0.80 occurrence of *Appropriate* behavior; 3.10 occurrences of *Inappropriate* behavior; and 1.90 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 11 achieved 0.90 occurrence of *Appropriate* behavior; 2.60 occurrences of *Inappropriate* behavior; and 1.80 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.80 occurrence, *Inappropriate* behavior was 2.50 occurrences and *No Interaction* was 1.60 occurrences.

From the findings of the observation in the three phases, Participant 11 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.55 occurrence and the number of interactions increased by 0.20 occurrence.

### e. Result of Washing hands

During the baseline phase, Participant 11 achieved an average of 0.40 occurrence of *Appropriate* behavior; 2.40 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 11 achieved 0.70 occurrence of *Appropriate* behavior; 2.20 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.50 occurrence, *Inappropriate* behavior was 2.30 occurrences and *No Interaction* was 1.20 occurrences.

From the findings of the observation in the three phases, Participant 11 had improved in *Appropriate* behavior by 0.20 occurrence. *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.05 occurrence.

Overall, the results for participant 11 suggested that the introduction of SS presented in *I-Learn Social Story* had a small effect in changing the participant’s social behaviors. It had a slight, noticeable effect in increasing *Appropriate* behaviors and decreasing *Inappropriate* behaviors, however it had slightly reduced the number of social interactions made by the participant.
XII. Participant 12

Figure 42 illustrates the comparison graphs of Participant 12’s *Appropriate*, *Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 12's behavioral changes](image)

Figure 42 Participant 12’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 12 achieved an average of 0.20 occurrence of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 4.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 12 achieved 1.30 occurrences of Appropriate behavior; 1.60 occurrences of Inappropriate behavior; and 2.90 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.80 occurrence, Inappropriate behavior was 1.20 occurrences and No Interaction was 2.90 occurrences.

From the findings of the observation in the three phases, Participant 12 had improved in Appropriate behavior by 0.85 occurrence. Inappropriate behavior was reduced by 0.40 occurrence and the number of interactions increased by 1.10 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 12 achieved an average of 0.30 occurrence of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 3.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 12 achieved 1.10 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 2.90 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.00 occurrence, Inappropriate behavior was 1.10 occurrences and No Interaction was 2.70 occurrences.

From the findings of the observation in the three phases, Participant 12 had improved in Appropriate behavior by 0.75 occurrence. Inappropriate behavior was reduced by 0.25 occurrence and the number of interactions increased by 1.00 occurrence.

c. Result of Snack time

During the baseline phase, Participant 12 achieved an average of 0.90 occurrence of Appropriate behavior; 1.90 occurrences of Inappropriate behavior; and 3.70 occurrences of No Interaction in the observation. During the intervention phase, Participant 12 achieved 1.40 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 2.10 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.10 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 2.20 occurrences.
From the findings of the observation in the three phases, Participant 12 had improved in *Appropriate* behavior by 0.35 occurrence. *Inappropriate* behavior was reduced by 0.75 occurrence and the number of interactions increased by 1.55 occurrences.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 12 achieved an average of 0.30 occurrence of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 4.90 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 12 achieved 0.90 occurrence of *Appropriate* behavior; 1.40 occurrences of *Inappropriate* behavior; and 3.80 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.90 occurrence, *Inappropriate* behavior was 1.30 occurrences and *No Interaction* was 4.20 occurrences.

From the findings of the observation in the three phases, Participant 12 had improved in *Appropriate* behavior by 0.60 occurrence. *Inappropriate* behavior was reduced by 0.65 occurrence and the number of interactions increased by 0.90 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 12 achieved an average of 0.80 occurrence of *Appropriate* behavior; 1.80 occurrences of *Inappropriate* behavior; and 3.90 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 12 achieved 1.00 occurrence of *Appropriate* behavior; 1.50 occurrences of *Inappropriate* behavior; and 2.30 occurrences of *No Interaction* during the observation. During the withdrawalal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.10 occurrences, *Inappropriate* behavior was 1.50 occurrences and *No Interaction* was 2.30 occurrences.

From the findings of the observation in the three phases, Participant 12 had improved in *Appropriate* behavior by 0.25 occurrence. *Inappropriate* behavior was reduced by 0.30 occurrence and the number of interactions increased by 1.60 occurrences.

Overall, the results of Participant 12 suggested that the introduction of SS presented in *I-Learn Social Story* had slightly increased the number of *Appropriate* behaviors and decreasing the number of *Inappropriate* behaviors, and had considerably increased the number of social interactions made by the participant.
XIII. Participant 13

Figure 43 illustrates the comparison graphs of Participant 13’s *Appropriate*, *Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

**Participant 13 (How to greet someone at school)**

**Participant 13 (Play and sing with friends)**

**Participant 13 (Snack time)**

**Participant 13 (Walking in the hallway)**

**Participant 13 (Washing hands)**

Figure 43 Participant 13’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 13 achieved an average of 0.90 occurrence of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 1.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 13 achieved 2.10 occurrences of Appropriate behavior; 0.40 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.20 occurrences, Inappropriate behavior was 0.60 occurrence and No Interaction was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 13 had improved in Appropriate behavior by 1.25 occurrences. Inappropriate behavior was reduced by 0.40 occurrence and the number of interactions increased by 0.50 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 13 achieved an average of 0.90 occurrence of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 13 achieved 2.60 occurrences of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.30 occurrences, Inappropriate behavior was 0.50 occurrence and No Interaction was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 13 had improved in Appropriate behavior by 1.55 occurrences. Inappropriate behavior was reduced by 0.55 occurrence and the number of interactions increased by 0.75 occurrence.

c. Result of Snack time

During the baseline phase, Participant 13 achieved an average of 0.80 occurrence of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 1.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 13 achieved 2.10 occurrences of Appropriate behavior; 0.50 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.30 occurrences, Inappropriate behavior was 0.40 occurrence and No Interaction was 0.70 occurrence.
From the findings of the observation in the three phases, Participant 13 had improved in *Appropriate* behavior by 1.40 occurrences. *Inappropriate* behavior was reduced by 0.45 occurrence and the number of interactions increased by 0.70 occurrence.

### d. Result of Walking in the hallway

During the baseline phase, Participant 13 achieved an average of 1.00 occurrence of *Appropriate* behavior; 2.10 occurrences of *Inappropriate* behavior; and 2.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 13 achieved 1.90 occurrences of *Appropriate* behavior; 1.20 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.80 occurrences, *Inappropriate* behavior was 1.50 occurrences and *No Interaction* was 1.50 occurrences.

From the findings of the observation in the three phases, Participant 13 has improved in *Appropriate* behavior by 0.85 occurrence. *Inappropriate* behavior was reduced by 0.75 occurrence and the number of interactions increased by 0.90 occurrence.

### e. Result of Washing hands

During the baseline phase, Participant 13 achieved an average of 1.50 occurrences of *Appropriate* behavior; 1.30 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 13 achieved 2.20 occurrences of *Appropriate* behavior; 0.90 occurrence of *Inappropriate* behavior; and 0.80 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.10 occurrences, *Inappropriate* behavior was 0.60 occurrence and *No Interaction* was 1.00 occurrence.

From the findings of the observation in the three phases, Participant 13 had improved in *Appropriate* behavior by 0.65 occurrence. *Inappropriate* behavior was reduced by 0.55 occurrence and the number of interactions increased by 0.40 occurrence.

Overall, the results for Participant 13 suggested that the introduction of SS presented in *I-Learn Social Story* had substantially influenced the increased number of *Appropriate* behaviors and the decreased number of *Inappropriate* behaviors, as well as the increased number of social interactions made by the participant.
XIV. Participant 14

Figure 44 illustrates the comparison graphs of Participant 14’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 44 Participant 14’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 14 achieved an average of 1.70 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.50 occurrence of No Interaction in the observation. During the intervention phase, Participant 14 achieved 2.70 occurrences of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 0.20 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.80 occurrences, Inappropriate behavior was 0.40 occurrence and No Interaction was 0.20 occurrence.

From the findings of the observation in the three phases, Participant 14 had improved in Appropriate behavior by 1.05 occurrences. Inappropriate behavior was reduced by 0.65 occurrence and the number of interactions increased by 0.30 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 14 achieved an average of 1.10 occurrences of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction in the observation. During the intervention phase, Participant 14 achieved 2.20 occurrences of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 0.20 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.00 occurrences, Inappropriate behavior was 0.40 occurrence and No Interaction was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 14 had improved in Appropriate behavior by 1.00 occurrence. Inappropriate behavior was reduced by 1.30 occurrences and the number of interactions increased by 0.65 occurrence.

c. Result of Snack time

During the baseline phase, Participant 14 achieved an average of 1.90 occurrences of Appropriate behavior; 1.40 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction in the observation. During the intervention phase, Participant 14 achieved 3.10 occurrences of Appropriate behavior; 0.50 occurrence of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences, Inappropriate behavior was 0.60 occurrence and No Interaction was 0.30 occurrence.
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From the findings of the observation in the three phases, Participant 14 had improved in *Appropriate* behavior by 1.10 occurrences. *Inappropriate* behavior was reduced by 0.85 occurrence and the number of interactions increased by 0.60 occurrence.

d. Result of Walking in the hallway

During the baseline phase, Participant 14 achieved an average of 1.30 occurrences of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 1.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 14 achieved 2.30 occurrences of *Appropriate* behavior; 0.50 occurrence of *Inappropriate* behavior; and 0.40 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.10 occurrences, *Inappropriate* behavior was 0.50 occurrence and *No Interaction* was 0.20 occurrence.

From the findings of the observation in the three phases, Participant 14 had improved in *Appropriate* behavior by 0.90 occurrence. *Inappropriate* behavior was reduced by 0.60 occurrence and the number of interactions increased by 1.50 occurrences.

e. Result of Washing hands

During the baseline phase, Participant 14 achieved an average of 0.60 occurrence of *Appropriate* behavior; 1.30 occurrences of *Inappropriate* behavior; and 1.10 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 14 achieved 1.70 occurrences of *Appropriate* behavior; 0.50 occurrence of *Inappropriate* behavior; and 0.40 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.80 occurrences, *Inappropriate* behavior was 0.40 occurrence and *No Interaction* was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 14 had improved in *Appropriate* behavior by 1.15 occurrences. *Inappropriate* behavior was reduced by 0.85 occurrence and the number of interactions increased by 0.75 occurrence.

Overall, the results for Participant 14 suggested that the introduction of SS presented in *I-Learn Social Story* had substantially increased the number of *Appropriate* behaviors and the number of social interactions, as well as decreasing the number of *Inappropriate* behaviors made by the participant.
XV. Participant 15

Figure 45 illustrates the comparison graphs of Participant 15’s *Appropriate, Inappropriate* and *No Interaction* behavior during baseline (A), *intervention* (B) and *reversal baseline* (A) for each of the social stories that the participant went through, as discussed below:

**Figure 45** Participant 15’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 15 achieved an average of 0.60 occurrence of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 2.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 15 achieved 2.90 occurrences of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 0.10 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.70 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 0.20 occurrence.

From the findings of the observation in the three phases, Participant 15 had improved in Appropriate behavior by 2.20 occurrences. Inappropriate behavior was reduced by 0.90 occurrence and the number of interactions increased by 2.25 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 15 achieved an average of 1.00 occurrence of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 2.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 15 achieved 2.90 occurrences of Appropriate behavior; 0.10 occurrence of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.70 occurrences, Inappropriate behavior was 0.40 occurrence and No Interaction was 0.40 occurrence.

From the findings of the observation in the three phases, Participant 15 had improved in Appropriate behavior by 1.80 occurrences. Inappropriate behavior was reduced by 0.85 occurrence and the number of interactions increased by 2.05 occurrences.

c. Result of Snack time

During the baseline phase, Participant 15 achieved an average of 1.00 occurrence of Appropriate behavior; 0.50 occurrence of Inappropriate behavior; and 2.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 15 achieved 2.20 occurrences of Appropriate behavior; 0.10 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.20 occurrences, Inappropriate behavior was 0.10 occurrence and No Interaction was 0.70 occurrence.
From the findings of the observation in the three phases, Participant 15 had improved in *Appropriate* behavior by 1.20 occurrences. *Inappropriate* behavior was reduced by 0.40 occurrence and the number of interactions increased by 1.75 occurrences.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 15 achieved an average of 0.60 occurrence of *Appropriate* behavior; 0.90 occurrence of *Inappropriate* behavior; and 3.20 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 15 achieved 3.80 occurrences of *Appropriate* behavior; 0.10 occurrence of *Inappropriate* behavior; and 0.30 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 3.40 occurrences, *Inappropriate* behavior was 0.20 occurrence and *No Interaction* was 0.20 occurrence.

From the findings of the observation in the three phases, Participant 15 had improved in *Appropriate* behavior by 3.00 occurrences. *Inappropriate* behavior was reduced by 0.75 occurrence and the number of interactions increased by 2.95 occurrences.

**e. Result of Washing hands**

During the baseline phase, Participant 15 achieved an average of 0.90 occurrence of *Appropriate* behavior; 0.40 occurrence of *Inappropriate* behavior; and 0.80 occurrence of *No Interaction* in the observation. During the intervention phase, Participant 15 achieved 2.40 occurrences of *Appropriate* behavior; 0.10 occurrence of *Inappropriate* behavior; and 0.10 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.30 occurrences, *Inappropriate* behavior was 0.20 occurrence and *No Interaction* was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 15 had improved in *Appropriate* behavior by 1.45 occurrences. *Inappropriate* behavior was reduced by 0.25 occurrence and the number of interactions increased by 0.60 occurrence.

Overall, the results for Participant 15 suggested that the introduction of SS presented in *I-Learn Social Story* had a considerable effect in increasing the *Appropriate* behaviors and the number of social interactions made, as well as substantially reducing the number of *Inappropriate* behaviors made by the participant.
XVI. Participant 16

Figure 46 illustrates the comparison graphs of Participant 16’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Graphs showing Participant 16's behavioral changes](image1)

![Graphs showing Participant 16's behavioral changes](image2)

![Graphs showing Participant 16's behavioral changes](image3)

![Graphs showing Participant 16's behavioral changes](image4)

Figure 46 Participant 16’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 16 achieved an average of 0.70 occurrence of Appropriate behavior; 2.70 occurrences of Inappropriate behavior; and 1.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 16 achieved 2.30 occurrences of Appropriate behavior; 1.40 occurrences of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.00 occurrences, Inappropriate behavior was 1.30 occurrences and No Interaction was 0.40 occurrence.

From the findings of the observation in the three phases, Participant 16 had improved in Appropriate behavior by 1.45 occurrences. Inappropriate behavior was reduced by 1.35 occurrences and the number of interactions increased by 1.25 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 16 achieved an average of 0.30 occurrence of Appropriate behavior; 2.80 occurrences of Inappropriate behavior; and 2.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 16 achieved 2.10 occurrences of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 1.20 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.00 occurrences, Inappropriate behavior was 1.10 occurrences and No Interaction was 1.20 occurrences.

From the findings of the observation in three phases, Participant 16 had improved in Appropriate behavior by 1.75 occurrences. Inappropriate behavior was reduced by 1.65 occurrences and the number of interactions increased by 1.60 occurrences.

c. Result of Snack time

During the baseline phase, Participant 16 achieved an average of 0.20 occurrence of Appropriate behavior; 3.60 occurrences of Inappropriate behavior; and 0.50 occurrence of No Interaction in the observation. During the intervention phase, Participant 16 achieved 2.10 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.10 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.40 occurrence.
From the findings of the observation in the three phases, Participant 16 had improved in *Appropriate* behavior by 1.90 occurrences. *Inappropriate* behavior was reduced by 2.50 occurrences and the number of interactions increased by 0.15 occurrence.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 16 achieved an average of 0.30 occurrence of *Appropriate* behavior; 2.90 occurrences of *Inappropriate* behavior; and 0.90 occurrence of *No Interaction* in the observation. During the intervention phase, Participant 16 achieved 2.40 occurrences of *Appropriate* behavior; 0.80 occurrence of *Inappropriate* behavior; and 0.30 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.20 occurrences, *Inappropriate* behavior was 1.00 occurrence and *No Interaction* was 0.40 occurrence.

From the findings of the observation in the three phases, Participant 16 had improved in *Appropriate* behavior by 2.00 occurrences. *Inappropriate* was behavior reduced by 2.00 occurrences and the number of interactions increased by 0.55 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 16 achieved an average of 0.70 occurrence of *Appropriate* behavior; 2.20 occurrences of *Inappropriate* behavior; and 0.80 occurrence of *No Interaction* in the observation. During the intervention phase, Participant 16 achieved 2.30 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 0.10 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.80 occurrences, *Inappropriate* behavior was 0.70 occurrence and *No Interaction* was 0.20 occurrence.

From the findings of the observation in the three phases, Participant 16 had improved in *Appropriate* behavior by 1.35 occurrences. *Inappropriate* behavior was reduced by 1.55 occurrences and number of interactions increased by 0.65 occurrence.

Overall, the results of Participant 16 suggested that the introduction of SS presented in *I-Learn Social Story* had a sizeable effect in increasing *Appropriate* behaviors and decreasing *Inappropriate* behaviors, as well as substantially increasing the number of social interactions made by the participant.
XVII. Participant 17

Figure 47 illustrates the comparison graphs of Participant 17’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 47 Participant 17’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 17 achieved an average of 0.20 occurrence of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 4.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 17 achieved 0.20 occurrence of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 4.30 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.30 occurrence, Inappropriate behavior was 0.70 occurrence and No Interaction was 4.80 occurrences.

From the findings of the observation in the three phases, Participant 17 had improved in Appropriate behavior by 0.05 occurrence. Inappropriate behavior increased by 0.05 occurrence and the number of interactions increased by 0.05 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 17 achieved an average of 0.30 occurrence of Appropriate behavior; 1.70 occurrences of Inappropriate behavior; and 3.70 occurrences of No Interaction in the observation. During the intervention phase, Participant 17 achieved 0.20 occurrence of Appropriate behavior; 1.50 occurrences of Inappropriate behavior; and 3.80 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.30 occurrence, Inappropriate behavior was 1.60 occurrences and No Interaction was 3.90 occurrences.

From the findings of the observation in the three phases, Participant 17 had decreased in Appropriate behavior by 0.05 occurrence. Inappropriate behavior was reduced by 0.15 occurrence and the number of interactions decreased by 0.15 occurrence.

c. Result of Snack time

During the baseline phase, Participant 17 achieved an average of 0.20 occurrence of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 4.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 17 achieved 0.30 occurrence of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 4.30 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.30 occurrence, Inappropriate behavior was 0.50 occurrence and No Interaction was 4.60 occurrences.
From the findings of the observation in the three phases, Participant 17 had improved in *Appropriate* behavior by 0.10 occurrence. *Inappropriate* behavior increased by 0.10 occurrence and the number of interactions increased by 0.05 occurrence.

### d. Result of Walking in the hallway

During the baseline phase, Participant 17 achieved an average of 0.60 occurrence of *Appropriate* behavior; 0.50 occurrence of *Inappropriate* behavior; and 4.20 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 17 achieved 0.60 occurrence of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 4.30 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.70 occurrence, *Inappropriate* behavior was 0.50 occurrence and *No Interaction* was 4.10 occurrences.

From the findings of the observation in the three phases, Participant 17 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior increased by 0.05 occurrence and the number of interactions made remained the same.

### e. Result of Washing hands

During the baseline phase, Participant 17 achieved an average of 0.20 occurrence of *Appropriate* behavior; 0.70 occurrence of *Inappropriate* behavior; and 3.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 17 achieved 0.30 occurrence of *Appropriate* behavior; 0.50 occurrence of *Inappropriate* behavior; and 3.70 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.20 occurrence, *Inappropriate* behavior was 0.60 occurrence and *No Interaction* was 3.80 occurrences.

From the findings of the observation in the three phases, Participant 17 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.05 occurrence.

Overall, the results for participant 17 suggested that the introduction of SS presented in *I-Learn Social Story* had a small effect in changing the participant’s social behaviors.
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XVIII. Participant 18

Figure 48 illustrates the comparison graphs of Participant 18’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 18 (How to greet someone at school)](image1)

![Participant 18 (Play and sing with friends)](image2)

![Participant 18 (Snack time)](image3)

![Participant 18 (Walking in the hallway)](image4)

![Participant 18 (Washing hands)](image5)

Figure 48 Participant 18’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 18 achieved an average of 0.60 occurrence of Appropriate behavior; 2.80 occurrences of Inappropriate behavior; and 1.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 18 achieved 1.90 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.80 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.90 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 18 had improved in Appropriate behavior by 1.30 occurrences. Inappropriate behavior was reduced by 1.70 occurrences and the number of interactions increased by 1.00 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 18 achieved an average of 0.40 occurrence of Appropriate behavior; 2.30 occurrences of Inappropriate behavior; and 3.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 18 achieved 2.10 occurrences of Appropriate behavior; 0.70 occurrence of Inappropriate behavior; and 1.60 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.30 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 1.40 occurrences.

From the findings of the observation in the three phases, Participant 18 had improved in Appropriate behavior by 1.80 occurrences. Inappropriate behavior was reduced by 1.55 occurrences and the number of interactions increased by 1.50 occurrences.

c. Result of Snack time

During the baseline phase, Participant 18 achieved an average of 0.80 occurrence of Appropriate behavior; 1.90 occurrences of Inappropriate behavior; and 3.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 18 achieved 2.00 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 1.90 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.80 occurrences, Inappropriate behavior was 0.70 occurrence and No Interaction was 1.70 occurrences.
From the findings of the observation in the three phases, Participant 18 had improved in *Appropriate* behavior by 1.10 occurrences. *Inappropriate* behavior was reduced by 1.15 occurrences and the number of interactions increased by 1.30 occurrences.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 18 achieved an average of 0.80 occurrence of *Appropriate* behavior; 1.60 occurrences of *Inappropriate* behavior; and 3.10 occurrences of *No Interaction* in the observation. During the intervention phase,Participant 18 achieved 2.30 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 1.10 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.80 occurrences, *Inappropriate* behavior was 1.00 occurrence and *No Interaction* was 1.20 occurrences.

From the findings of the observation in the three phases, Participant 18 had improved in *Appropriate* behavior by 1.25 occurrences. *Inappropriate* behavior was reduced by 0.80 occurrence and the number of interactions increased by 1.95 occurrences.

**e. Result of Washing hands**

During the baseline phase, Participant 18 achieved an average of 0.50 occurrence of *Appropriate* behavior; 3.00 occurrences of *Inappropriate* behavior; and 2.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 18 achieved 1.90 occurrences of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 1.90 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.90 occurrences, *Inappropriate* behavior was 1.20 occurrences and *No Interaction* was 1.20 occurrences.

From the findings of the observation in the three phases, Participant 18 had improved in *Appropriate* behavior by 1.40 occurrences. *Inappropriate* behavior was reduced by 1.85 occurrences and the number of interactions increased by 0.75 occurrence.

Overall, the results for Participant 18 suggested that the introduction of SS presented in *I-Learn Social Story* had considerably increase the number of *Appropriate* behaviors and had decreased the number of *Inappropriate* behaviors, as well as increasing the number of social interactions made by the participant.
XIX. Participant 19

Figure 49 illustrates the comparison graphs of Participant 19’s **Appropriate**, **Inappropriate** and **No Interaction** behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 49 Participant 19’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 19 achieved an average of 0.10 occurrence of Appropriate behavior; 1.70 occurrences of Inappropriate behavior; and 5.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 19 achieved 0.40 occurrence of Appropriate behavior; 1.40 occurrences of Inappropriate behavior; and 4.10 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.30 occurrence, Inappropriate behavior was 1.40 occurrences and No Interaction was 4.30 occurrences.

From the findings of the observation in the three phases, Participant 19 had improved in Appropriate behavior by 0.25 occurrence. Inappropriate behavior was reduced by 0.30 occurrence and the number of interactions increased by 1.30 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 19 achieved an average of 0.10 occurrence of Appropriate behavior; 2.90 occurrences of Inappropriate behavior; and 3.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 19 achieved 0.30 occurrence of Appropriate behavior; 2.70 occurrences of Inappropriate behavior; and 2.90 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.20 occurrence, Inappropriate behavior was 2.80 occurrences and No Interaction was 3.00 occurrences.

From the findings of the observation in the three phases, Participant 19 had improved in Appropriate behavior by 0.15 occurrence. Inappropriate behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.45 occurrence.

c. Result of Snack time

During the baseline phase, Participant 19 achieved an average of 0.40 occurrence of Appropriate behavior; 3.10 occurrences of Inappropriate behavior; and 2.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 19 achieved 0.50 occurrence of Appropriate behavior; 2.80 occurrences of Inappropriate behavior; and 2.20 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.60 occurrence, Inappropriate behavior was 2.90 occurrences and No Interaction was 2.30 occurrences.
From the findings of the observation in the three phases, Participant 19 had improved in *Appropriate* behavior by 0.15 occurrence. *Inappropriate* behavior was reduced by 0.25 occurrence and the number of interactions increased by 0.35 occurrence.

### d. Result of Walking in the hallway

During the baseline phase, Participant 19 achieved an average of 0.40 occurrence of *Appropriate* behavior; 4.60 occurrences of *Inappropriate* behavior; and 3.20 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 19 achieved 0.80 occurrence of *Appropriate* behavior; 4.30 occurrences of *Inappropriate* behavior; and 2.80 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.60 occurrence, *Inappropriate* behavior was 4.30 occurrences and *No Interaction* was 3.10 occurrences.

From the findings of the observation in the three phases, Participant 19 had improved in *Appropriate* behavior by 0.30 occurrence. *Inappropriate* behavior was reduced by 0.30 occurrence and the number of interactions increased by 0.25 occurrence.

### e. Result of Washing hands

During the baseline phase, Participant 19 achieved an average of 0.20 occurrence of *Appropriate* behavior; 3.00 occurrences of *Inappropriate* behavior; and 4.60 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 19 achieved 0.60 occurrence of *Appropriate* behavior; 2.80 occurrences of *Inappropriate* behavior; and 4.20 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.40 occurrence, *Inappropriate* behavior was 2.90 occurrences and *No Interaction* was 4.30 occurrences.

From the findings of the observation in the three phases, Participant 19 had improved in *Appropriate* behavior by 0.30 occurrence. *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.35 occurrence.

Overall, the results of Participant 19 suggested that the introduction of SS presented in *I-Learn Social Story* had a small effect in changing the participant’s *Appropriate* and *Inappropriate* behaviors, as well as a noticeable effect in increasing the number of social interactions made by the participant.
XX. Participant 20

Figure 50 illustrates the comparison graphs of Participant 20’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Graph 1: Participant 20 (How to greet someone at school)]

![Graph 2: Participant 20 (Play and sing with friends)]

![Graph 3: Participant 20 (Snack time)]

![Graph 4: Participant 20 (Walking in the hallway)]

Figure 50 Participant 20’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 20 achieved an average of 0.00 occurrence of Appropriate behavior; 3.40 occurrences of Inappropriate behavior; and 5.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 20 achieved 0.00 occurrence of Appropriate behavior; 3.10 occurrences of Inappropriate behavior; and 5.60 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.90 occurrences and No Interaction was 5.40 occurrences.

From the findings of the observation in the three phases, Participant 20’s Appropriate behavior and the number of interactions made remained the same, but his Inappropriate behavior was reduced by 0.40 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 20 achieved an average of 0.10 occurrence of Appropriate behavior; 6.70 occurrences of Inappropriate behavior; and 2.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 20 achieved 0.10 occurrence of Appropriate behavior; 7.00 occurrences of Inappropriate behavior; and 2.80 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.10 occurrence, Inappropriate behavior was 6.90 occurrences and No Interaction was 2.60 occurrences.

From the findings of the observation in the three phases, Participant 20’s Appropriate behavior remained the same. His Inappropriate behavior increased by 0.25 occurrence and the number of interactions decreased by 0.10 occurrence.

c. Result of Snack time

During the baseline phase, Participant 20 achieved an average of 0.10 occurrence of Appropriate behavior; 8.20 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 20 achieved 0.20 occurrence of Appropriate behavior; 8.20 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.10 occurrence, Inappropriate behavior was 7.80 occurrences and No Interaction was 1.20 occurrences.
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From the findings of the observation in the three phases, Participant 20 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.20 occurrence and the number of interactions decreased by 0.05 occurrence.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 20 achieved an average of 0.30 occurrence of *Appropriate* behavior; 5.80 occurrences of *Inappropriate* behavior; and 1.40 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 20 achieved 2.3 occurrences of *Appropriate* behavior; 5.90 occurrences of *Inappropriate* behavior; and 1.30 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.20 occurrence, *Inappropriate* behavior was 6.30 occurrences and *No Interaction* was 1.20 occurrences.

From the findings of the observation in the three phases, Participant 20 had decreased in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was increased by 0.30 occurrence and the number of interactions increased by 0.15 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 20 achieved an average of 0.10 occurrence of *Appropriate* behavior; 4.80 occurrences of *Inappropriate* behavior; and 3.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 20 achieved 0.10 occurrence of *Appropriate* behavior; 5.00 occurrences of *Inappropriate* behavior; and 3.70 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.10 occurrence, *Inappropriate* behavior was 4.60 occurrences and *No Interaction* was 4.00 occurrences.

From the findings of the observation in the three phases, Participant 20’s *Appropriate* and *Inappropriate* behavior remained the same, and the number of interactions was decreased by 0.05 occurrence.

Overall, the results for participant 20 suggested that the introduction of SS presented in *I-Learn Social Story* had no effect in changing the participant’s social behaviors.
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XXI. Participant 21

Figure 51 illustrates the comparison graphs of Participant 21’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 51 Participant 21’s behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 21 achieved an average of 0.30 occurrence of Appropriate behavior; 2.40 occurrences of Inappropriate behavior; and 1.60 occurrences of No Interaction in the observation. During the intervention phase, Participant 21 achieved 1.10 occurrences of Appropriate behavior; 1.50 occurrences of Inappropriate behavior; and 0.50 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.90 occurrence, Inappropriate behavior was 1.80 occurrences and No Interaction was 0.60 occurrence.

From the findings of the observation in the three phases, Participant 21 had improved in Appropriate behavior by 0.70 occurrence. Inappropriate behavior was reduced by 0.75 occurrence and the number of interactions increased by 1.05 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 21 achieved an average of 0.30 occurrence of Appropriate behavior; 1.30 occurrences of Inappropriate behavior; and 1.90 occurrences of No Interaction in the observation. During the intervention phase, Participant 21 achieved 1.20 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.40 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.00 occurrence and No Interaction was 1.30 occurrences.

From the findings of the observation in the three phases, Participant 21 had improved in Appropriate behavior by 0.90 occurrence. Inappropriate behavior was reduced by 0.25 occurrence and the number of interactions increased by 0.55 occurrence.

c. Result of Snack time

During the baseline phase, Participant 21 achieved an average of 1.00 occurrence of Appropriate behavior; 2.10 occurrences of Inappropriate behavior; and 1.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 21 achieved 1.50 occurrences of Appropriate behavior; 1.30 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.30 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 1.00 occurrence.
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From the findings of the observation in the three phases, Participant 21 had improved in Appropriate behavior by 0.40 occurrence. Inappropriate behavior was reduced by 0.85 occurrence and the number of interactions increased by 0.55 occurrence.

d. Result of Walking in the hallway

During the baseline phase, Participant 21 achieved an average of 0.50 occurrence of Appropriate behavior; 1.60 occurrences of Inappropriate behavior; and 2.00 occurrences of No Interaction in the observation. During the intervention phase, Participant 21 achieved 1.60 occurrences of Appropriate behavior; 1.30 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.40 occurrences, Inappropriate behavior was 1.30 occurrences and No Interaction was 0.90 occurrence.

From the findings of the observation in the three phases, Participant 21 had improved in Appropriate behavior by 1.00 occurrence. Inappropriate behavior was reduced by 0.30 occurrence and the number of interactions increased by 1.00 occurrence.

e. Result of Washing hands

During the baseline phase, Participant 21 achieved an average of 0.20 occurrence of Appropriate behavior; 2.20 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 21 achieved 1.00 occurrence of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.20 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 2.00 occurrences.

From the findings of the observation in the three phases, Participant 21 had improved in Appropriate behavior by 0.90 occurrence. Inappropriate behavior was reduced by 1.35 occurrences and number of interactions decreased by 2.00 occurrences.

Overall, the results for participant 21 suggested that the introduction of SS presented in I-Learn Social Story had a substantial effect in increasing Appropriate behaviors, decreasing Inappropriate behaviors, and increasing the number of social interactions made by the participant.
XXII. Participant 22

Figure 52 illustrates the comparison graphs of Participant 22’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:
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a. Result of How to greet someone at school

During the baseline phase, Participant 22 achieved an average of 1.80 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction in the observation. During the intervention phase, Participant 22 achieved 3.10 occurrences of Appropriate behavior; 0.20 occurrence of Inappropriate behavior; and 0.20 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.70 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 0.10 occurrence.

From the findings of the observation in the three phases, Participant 22 had improved in Appropriate behavior by 1.10 occurrences. Inappropriate behavior was reduced by 0.75 occurrence and the number of interactions increased by 0.75 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 22 achieved an average of 1.70 occurrences of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 1.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 22 achieved 3.30 occurrences of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.70 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.40 occurrence.

From the findings of the observation in the three phases, Participant 22 had improved in Appropriate behavior by 1.30 occurrences. Inappropriate behavior was reduced by 1.10 occurrences and the number of interactions increased by 1.00 occurrence.

c. Result of Snack time

During the baseline phase, Participant 22 achieved an average of 1.60 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 2.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 22 achieved 2.20 occurrences of Appropriate behavior; 0.20 occurrence of Inappropriate behavior; and 0.40 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.30 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 0.60 occurrence.
From the findings of the observation in the three phases, Participant 22 had improved in *Appropriate* behavior by 0.65 occurrence. *Inappropriate* behavior was reduced by 0.55 occurrence and the number of interactions increased by 1.90 occurrences.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 22 achieved an average of 1.70 occurrences of *Appropriate* behavior; 0.90 occurrence of *Inappropriate* behavior; and 2.40 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 22 achieved 3.30 occurrences of *Appropriate* behavior; 0.30 occurrence of *Inappropriate* behavior; and 1.00 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 3.00 occurrences, *Inappropriate* behavior was 0.50 occurrence and *No Interaction* was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 22 had improved in *Appropriate* behavior by 1.45 occurrences. *Inappropriate* behavior was reduced by 0.50 occurrence and the number of interactions increased by 1.55 occurrences.

**e. Result of Washing hands**

During the baseline phase, Participant 22 achieved an average of 1.60 occurrences of *Appropriate* behavior; 1.90 occurrences of *Inappropriate* behavior; and 2.10 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 22 achieved 2.90 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 1.20 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.50 occurrences, *Inappropriate* behavior was 0.40 occurrence and *No Interaction* was 1.60 occurrences.

From the findings of the observation in the three phases, Participant 22 had improved in *Appropriate* behavior by 1.10 occurrences. *Inappropriate* behavior was reduced by 1.40 occurrences and the number of interactions increased by 0.70 occurrence.

Overall, the results for participant 22 suggested that the introduction of SS presented in *I-Learn Social Story* had a substantial effect in changing the participant’s *Appropriate* behaviors and *Inappropriate* behaviors, as well as increasing the number of social interactions made.
XXIII. Participant 23

Figure 53 illustrates the comparison graphs of Participant 23’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:
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a. Result of How to greet someone at school

During the baseline phase, Participant 23 achieved an average of 0.90 occurrence of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 1.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 23 achieved 1.40 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.70 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.20 occurrences, Inappropriate behavior was 0.70 occurrence and No Interaction was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 23 had improved in Appropriate behavior by 0.40 occurrence. Inappropriate behavior was reduced by 0.45 occurrence and the number of interactions increased by 0.70 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 23 achieved an average of 1.10 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 23 achieved 1.70 occurrences of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 0.80 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.60 occurrences, Inappropriate behavior was 0.70 occurrence and No Interaction was 0.60 occurrence.

From the findings of the observation in the three phases, Participant 23 had improved in Appropriate behavior by 0.55 occurrence. Inappropriate behavior was reduced by 0.45 occurrence and number of interactions increased by 0.60 occurrence.

c. Result of Snack time

During the baseline phase, Participant 23 achieved an average of 0.80 occurrence of Appropriate behavior; 1.30 occurrences of Inappropriate behavior; and 1.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 23 achieved 1.40 occurrences of Appropriate behavior; 0.70 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.10 occurrences, Inappropriate behavior was 0.60 occurrence and No Interaction was 0.70 occurrence.
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From the findings of the observation in the three phases, Participant 23 had improved in *Appropriate* behavior by 0.45 occurrence. *Inappropriate* behavior was reduced by 0.65 occurrence and the number of interactions increased by 0.40 occurrence.

d. Result of Walking in the hallway

During the baseline phase, Participant 23 achieved an average of 0.90 occurrence of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 1.70 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 23 achieved 1.60 occurrences of *Appropriate* behavior; 0.80 occurrence of *Inappropriate* behavior; and 1.00 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.20 occurrences, *Inappropriate* behavior was 0.70 occurrence and *No Interaction* was 1.10 occurrences.

From the findings of the observation in the three phases, Participant 23 had improved in *Appropriate* behavior by 0.50 occurrence. *Inappropriate* behavior was reduced by 0.35 occurrence and the number of interactions increased by 0.65 occurrence.

e. Result of Washing hands

During the baseline phase, Participant 23 achieved an average of 1.10 occurrences of *Appropriate* behavior; 0.80 occurrence of *Inappropriate* behavior; and 1.20 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 23 achieved 1.30 occurrences of *Appropriate* behavior; 0.40 occurrence of *Inappropriate* behavior; and 0.90 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.30 occurrences, *Inappropriate* behavior was 0.50 occurrence and *No Interaction* was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 23 had improved in *Appropriate* behavior by 0.20 occurrence. *Inappropriate* behavior was reduced by 0.35 occurrence and the number of interactions increased by 0.35 occurrence.

Overall, the results for participant 23 suggested that the introduction of SS presented in *I-Learn Social Story* had beneficial effects on the participant.
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XXIV. Participant 24

Figure 54 illustrates the comparison graphs of Participant 24’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 24 (How to greet someone at school)](image1)

![Participant 24 (Play and sing with friends)](image2)

![Participant 24 (Snack time)](image3)

![Participant 24 (Walking in the hallway)](image4)

![Participant 24 (Washing hands)](image5)

Figure 54 Participant 24’s behavioral changes
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a. Result of *How to greet someone at school*

During the baseline phase, Participant 24 achieved an average of 0.10 occurrence of *Appropriate* behavior; 2.90 occurrences of *Inappropriate* behavior; and 3.60 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 24 achieved 0.00 occurrence of *Appropriate* behavior; 3.10 occurrences of *Inappropriate* behavior; and 3.50 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.90 occurrences and *No Interaction* was 3.30 occurrences. 

From the findings of the observation in the three phases, Participant 24’s *Appropriate* behavior remained the same. *Inappropriate* behavior increased by 0.10 occurrence and the number of interactions increased by 0.20 occurrence.

b. Result of *Play and sing with friends*

During the baseline phase, Participant 24 achieved an average of 0.20 occurrence of *Appropriate* behavior; 1.90 occurrences of *Inappropriate* behavior; and 3.40 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 24 achieved 0.10 occurrence of *Appropriate* behavior; 1.80 occurrences of *Inappropriate* behavior; and 3.00 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.70 occurrences and *No Interaction* was 3.10 occurrences.

From the findings of the observation in the three phases, Participant 24 had decreased in *Appropriate* behavior by 0.10 occurrence. *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.35 occurrence.

c. Result of *Snack time*

During the baseline phase, Participant 24 achieved an average of 0.90 occurrence of *Appropriate* behavior; 2.60 occurrences of *Inappropriate* behavior; and 2.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 24 achieved 0.90 occurrence of *Appropriate* behavior; 2.50 occurrences of *Inappropriate* behavior; and 2.60 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.00 occurrence, *Inappropriate* behavior was 2.50 occurrences and *No Interaction* was 2.40 occurrences.
From the findings of the observation in the three phases, Participant 24 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.10 occurrence and the number of interactions increased by 0.30 occurrence.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 24 achieved an average of 0.50 occurrence of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 4.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 24 achieved 0.40 occurrence of *Appropriate* behavior; 1.20 occurrences of *Inappropriate* behavior; and 4.70 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.40 occurrence, *Inappropriate* behavior was 1.20 occurrences and *No Interaction* was 4.80 occurrences.

From the findings of the observation in the three phases, Participant 24 had decreased in *Appropriate* behavior by 0.10 occurrence. *Inappropriate* behavior was increased by 0.10 occurrence and the number of interactions increased by 0.05 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 24 achieved an average of 0.30 occurrence of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 6.20 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 24 achieved 0.20 occurrence of *Appropriate* behavior; 2.30 occurrences of *Inappropriate* behavior; and 6.00 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.30 occurrence, *Inappropriate* behavior was 2.20 occurrences and *No Interaction* was 6.10 occurrences.

From the findings of the observation in the three phases, Participant 24 had decreased in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was increased by 0.25 occurrence and the number of interactions increased by 0.15 occurrence.

Overall, the results of Participant 24 suggested that the introduction of SS presented in *I-Learn Social Story* had small effects on the participant’s social behaviors changes; there was a slight degree of increment in the number of social interactions made, however, the *Appropriate* and *Inappropriate* behaviors changes were slightly negative.
XXV. Participant 25

Figure 55 illustrates the comparison graphs of Participant 25’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 55 Participant 25’s behavioral changes
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**a. Result of How to greet someone at school**

During the baseline phase, Participant 25 achieved an average of 0.80 occurrence of Appropriate behavior; 2.60 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 25 achieved 2.20 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.00 occurrences, Inappropriate behavior was 1.10 occurrences and No Interaction was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 25 had improved in Appropriate behavior by 1.30 occurrences. Inappropriate behavior was reduced by 1.50 occurrences and the number of interactions increased by 0.65 occurrence.

**b. Result of Play and sing with friends**

During the baseline phase, Participant 25 achieved an average of 0.80 occurrence of Appropriate behavior; 2.30 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 25 achieved 2.00 occurrences of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.60 occurrences, Inappropriate behavior was 0.70 occurrence and No Interaction was 0.60 occurrence.

From the findings of the observation in the three phases, Participant 25 had improved in Appropriate behavior by 1.00 occurrence. Inappropriate behavior was reduced by 1.50 occurrences and the number of interactions increased by 0.70 occurrence.

**c. Result of Snack time**

During the baseline phase, Participant 25 achieved an average of 0.60 occurrence of Appropriate behavior; 0.70 occurrence of Inappropriate behavior; and 2.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 25 achieved 1.80 occurrences of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.50 occurrences, Inappropriate behavior was 0.30 occurrence and No Interaction was 1.10 occurrences.
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From the findings of the observation in the three phases, Participant 25 had improved in *Appropriate* behavior by 1.05 occurrences. *Inappropriate* behavior was reduced by 0.40 occurrence and the number of interactions increased by 1.20 occurrences.

d. Result of Walking in the hallway

During the baseline phase, Participant 25 achieved an average of 0.50 occurrence of *Appropriate* behavior; 1.70 occurrences of *Inappropriate* behavior; and 1.40 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 25 achieved 1.10 occurrences of *Appropriate* behavior; 1.00 occurrence of *Inappropriate* behavior; and 0.90 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.10 occurrences, *Inappropriate* behavior was 1.10 occurrences and *No Interaction* was 1.00 occurrence.

From the findings of the observation in the three phases, Participant 25 had improved in *Appropriate* behavior by 0.60 occurrence. *Inappropriate* behavior was reduced by 0.65 occurrence and the number of interactions increased by 0.45 occurrence.

e. Result of Washing hands

During the baseline phase, Participant 25 achieved an average of 0.40 occurrence of *Appropriate* behavior; 2.10 occurrences of *Inappropriate* behavior; and 1.70 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 25 achieved 1.30 occurrences of *Appropriate* behavior; 1.30 occurrences of *Inappropriate* behavior; and 0.60 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.40 occurrences, *Inappropriate* behavior was 1.50 occurrences and *No Interaction* was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 25 had improved in *Appropriate* behavior by 0.95 occurrence. *Inappropriate* behavior was reduced by 0.70 occurrence and the number of interactions increased by 1.05 occurrences.

Overall, the results for Participant 25 suggested that the introduction of SS presented in *I-Learn Social Story* had beneficially influenced the increase in the number of *Appropriate* behaviors and the decrease in the number of *Inappropriate* behaviors, as well as increasing the number of social interactions made by the participant.
XXVI. Participant 26

Figure 56 illustrates the comparison graphs of Participant 26’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 56 Participant 26’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 26 achieved an average of 0.20 occurrence of Appropriate behavior; 2.00 occurrences of Inappropriate behavior; and 4.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 26 achieved 0.10 occurrence of Appropriate behavior; 1.90 occurrences of Inappropriate behavior; and 4.00 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.20 occurrence, Inappropriate behavior was 1.80 occurrences and No Interaction was 4.30 occurrences.

From the findings of the observation in the three phases, Participant 26 had decreased in Appropriate behavior by 0.05 occurrence. Inappropriate behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.05 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 26 achieved an average of 0.40 occurrence of Appropriate behavior; 3.90 occurrences of Inappropriate behavior; and 5.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 26 achieved 0.40 occurrence of Appropriate behavior; 3.90 occurrences of Inappropriate behavior; and 5.70 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.30 occurrence, Inappropriate behavior was 3.40 occurrences and No Interaction was 5.10 occurrences.

From the findings of the observation in the three phases, Participant 26 had decreased in Appropriate behavior by 0.05 occurrence. Inappropriate behavior was reduced by 0.25 occurrence and the number of interactions decreased by 0.30 occurrence.

c. Result of Snack time

During the baseline phase, Participant 26 achieved an average of 0.60 occurrence of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 3.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 26 achieved 0.70 occurrence of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 3.10 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.60 occurrence, Inappropriate behavior was 1.00 occurrence and No Interaction was 3.30 occurrences.
From the findings of the observation in the three phases, Participant 26 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.10 occurrence and the number of interactions has not change.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 26 achieved an average of 0.30 occurrence of *Appropriate* behavior; 2.90 occurrences of *Inappropriate* behavior; and 2.00 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 26 achieved 0.40 occurrence of *Appropriate* behavior; 2.80 occurrences of *Inappropriate* behavior; and 2.20 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.30 occurrence, *Inappropriate* behavior was 2.90 occurrences and *No Interaction* was 2.10 occurrences.

From the findings of the observation in the three phases, Participant 26 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.05 occurrence and the number of interactions decreased by 0.15 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 26 achieved an average of 0.10 occurrence of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 3.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 26 achieved 0.10 occurrence of *Appropriate* behavior; 1.90 occurrences of *Inappropriate* behavior; and 3.40 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.10 occurrence, *Inappropriate* behavior was 1.90 occurrences and *No Interaction* was 3.30 occurrences.

From the findings of the observation in the three phases, Participant 26’s *Appropriate* behavior remained the same. His *Inappropriate* behavior was reduced by 0.10 occurrence and the number of interactions decreased by 0.05 occurrence.

Overall, the results for Participant 26 suggested that the introduction of SS presented in *I-Learn Social Story* had no effect in increasing *Appropriate* behaviors, the number of social interactions made was slightly reduced, however, *Inappropriate* behaviors was also slightly reduced.
XXVII. Participant 27

Figure 57 illustrates the comparison graphs of Participant 27’s *Appropriate*, *Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Comparison graphs of Participant 27's Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through.](image)

Figure 57 Participant 27's behavioral changes
a. Result of How to greet someone at school

During the baseline phase, Participant 27 achieved an average of 0.60 occurrence of Appropriate behavior; 2.80 occurrences of Inappropriate behavior; and 1.10 occurrences of No Interaction in the observation. During the intervention phase, Participant 27 achieved 2.10 occurrences of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 0.90 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.70 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.60 occurrence.

From the findings of the observation in the three phases, Participant 27 had improved in Appropriate behavior by 1.30 occurrences. Inappropriate behavior was reduced by 1.95 occurrences and the number of interactions increased by 0.35 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 27 achieved an average of 0.70 occurrence of Appropriate behavior; 1.90 occurrences of Inappropriate behavior; and 0.90 occurrence of No Interaction in the observation. During the intervention phase, Participant 27 achieved 2.90 occurrences of Appropriate behavior; 0.60 occurrence of Inappropriate behavior; and 0.40 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.50 occurrences, Inappropriate behavior was 0.70 occurrence and No Interaction was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 27 had improved in Appropriate behavior by 2.00 occurrences. Inappropriate behavior was reduced by 1.25 occurrences and the number of interactions increased by 0.55 occurrence.

c. Result of Snack time

During the baseline phase, Participant 27 achieved an average of 0.90 occurrence of Appropriate behavior; 1.90 occurrences of Inappropriate behavior; and 1.40 occurrences of No Interaction in the observation. During the intervention phase, Participant 27 achieved 2.90 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.70 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.80 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 1.00 occurrence.
From the findings of the observation in the three phases, Participant 27 had improved in *Appropriate* behavior by 1.95 occurrences. *Inappropriate* behavior was reduced by 0.90 occurrence and the number of interactions increased by 0.55 occurrence.

### d. Result of Walking in the hallway

During the baseline phase, Participant 27 achieved an average of 0.60 occurrence of *Appropriate* behavior; 2.10 occurrences of *Inappropriate* behavior; and 1.40 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 27 achieved 1.60 occurrences of *Appropriate* behavior; 1.30 occurrences of *Inappropriate* behavior; and 0.50 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.60 occurrences, *Inappropriate* behavior was 1.40 occurrences and *No Interaction* was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 27 had improved in *Appropriate* behavior by 1.00 occurrence. *Inappropriate* behavior was reduced by 0.75 occurrence and the number of interactions increased by 0.80 occurrence.

### e. Result of Washing hands

During the baseline phase, Participant 27 achieved an average of 0.70 occurrence of *Appropriate* behavior; 1.20 occurrences of *Inappropriate* behavior; and 2.00 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 27 achieved 1.60 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 1.00 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.60 occurrences, *Inappropriate* behavior was 0.80 occurrence and *No Interaction* was 0.80 occurrence.

From the findings of the observation in the three phases, Participant 27 had improved in *Appropriate* behavior by 0.90 occurrence. *Inappropriate* behavior was reduced by 0.50 occurrence and the number of interactions increased by 1.10 occurrences.

Overall, the results of Participant 27 suggested that the introduction of SS presented in *I-Learn Social Story* had a beneficial effect in increasing *Appropriate* behaviors and in decreasing *Inappropriate* behaviors, as well as a sizeable increase in the number of social interactions made by the participant.
XXVIII. Participant 28

Figure 58 illustrates the comparison graphs of Participant 28’s *Appropriate, Inappropriate* and *No Interaction* behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

![Participant 28's behavioral changes](image-url)


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a. Result of How to greet someone at school

During the baseline phase, Participant 28 achieved an average of 0.50 occurrence of Appropriate behavior; 2.60 occurrences of Inappropriate behavior; and 1.90 occurrences of No Interaction in the observation. During the intervention phase, Participant 28 achieved 1.30 occurrences of Appropriate behavior; 1.40 occurrences of Inappropriate behavior; and 0.80 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.50 occurrences, Inappropriate behavior was 1.20 occurrences and No Interaction was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 28 had improved in Appropriate behavior by 0.90 occurrence. Inappropriate behavior was reduced by 1.30 occurrences and the number of interactions increased by 1.15 occurrences.

b. Result of Play and sing with friends

During the baseline phase, Participant 28 achieved an average of 0.60 occurrence of Appropriate behavior; 2.60 occurrences of Inappropriate behavior; and 2.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 28 achieved 1.90 occurrences of Appropriate behavior; 1.10 occurrences of Inappropriate behavior; and 1.00 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.70 occurrences, Inappropriate behavior was 1.00 occurrence and No Interaction was 0.90 occurrence.

From the findings of the observation in the three phases, Participant 28 had improved in Appropriate behavior by 1.20 occurrences. Inappropriate behavior was reduced by 1.55 occurrences and the number of interactions increased by 1.25 occurrences.

c. Result of Snack time

During the baseline phase, Participant 28 achieved an average of 0.70 occurrence of Appropriate behavior; 2.20 occurrences of Inappropriate behavior; and 1.20 occurrences of No Interaction in the observation. During the intervention phase, Participant 28 achieved 1.60 occurrences of Appropriate behavior; 1.00 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.70 occurrences, Inappropriate behavior was 1.10 occurrences and No Interaction was 0.50 occurrence.
From the findings of the observation in the three phases, Participant 28 had improved in *Appropriate* behavior by 0.95 occurrence. *Inappropriate* behavior was reduced by 1.15 occurrences and the number of interactions increased by 0.65 occurrence.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 28 achieved an average of 1.10 occurrences of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 1.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 28 achieved 1.60 occurrences of *Appropriate* behavior; 1.00 occurrence of *Inappropriate* behavior; and 0.80 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.70 occurrences, *Inappropriate* behavior was 1.10 occurrences and *No Interaction* was 0.90 occurrence.

From the findings of the observation in the three phases, Participant 28 had improved in *Appropriate* behavior by 0.55 occurrence. *Inappropriate* behavior was reduced by 0.95 occurrence and the number of interactions increased by 0.95 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 28 achieved an average of 0.70 occurrence of *Appropriate* behavior; 2.00 occurrences of *Inappropriate* behavior; and 2.00 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 28 achieved 1.70 occurrences of *Appropriate* behavior; 0.90 occurrence of *Inappropriate* behavior; and 1.00 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.50 occurrences, *Inappropriate* behavior was 1.00 occurrence and *No Interaction* was 1.00 occurrence.

From the findings of the observation in the three phases, Participant 28 had improved in *Appropriate* behavior by 0.90 occurrence. *Inappropriate* behavior was reduced by 1.05 occurrences and the number of interactions increased by 1.00 occurrence.

Overall, the results for Participant 28 suggested that the introduction of SS presented in *I-Learn Social Story* produced a substantial effect in increasing *Appropriate* behaviors, decreasing *Inappropriate* behaviors, as well as in increasing the number of social interactions made by the participant.
XXIX. Participant 29

Figure 59 illustrates the comparison graphs of Participant 29’s Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

Figure 59 Participant 29’s behavioral changes
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a. Result of How to greet someone at school

During the baseline phase, Participant 29 achieved an average of 0.10 occurrence of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 4.80 occurrences of No Interaction in the observation. During the intervention phase, Participant 29 achieved 0.00 occurrence of Appropriate behavior; 0.30 occurrence of Inappropriate behavior; and 4.80 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.10 occurrence, Inappropriate behavior was 0.30 occurrence and No Interaction was 5.00 occurrences.

From the findings of the observation in the three phases, Participant 29 had decreased in Appropriate behavior by 0.05 occurrence. Inappropriate behavior remained the same and the number of interactions was reduced by 0.10 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 29 achieved an average of 0.00 occurrence of Appropriate behavior; 1.80 occurrences of Inappropriate behavior; and 4.50 occurrences of No Interaction in the observation. During the intervention phase, Participant 29 achieved 0.10 occurrence of Appropriate behavior; 2.00 occurrences of Inappropriate behavior; and 4.20 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.10 occurrence, Inappropriate behavior was 1.90 occurrences and No Interaction was 4.60 occurrences.

From the findings of the observation in the three phases, Participant 29 had improved in Appropriate behavior by 0.10 occurrence. Inappropriate behavior increased by 0.15 occurrence and the number of interactions increased by 0.10 occurrence.

c. Result of Snack time

During the baseline phase, Participant 29 achieved an average of 0.10 occurrence of Appropriate behavior; 1.30 occurrences of Inappropriate behavior; and 5.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 29 achieved 0.20 occurrence of Appropriate behavior; 1.20 occurrences of Inappropriate behavior; and 5.30 occurrences of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 0.10 occurrence, Inappropriate behavior was 1.30 occurrences and No Interaction was 5.10 occurrences.
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From the findings of the observation in the three phases, Participant 29 had improved in *Appropriate* behavior by 0.05 occurrence. *Inappropriate* behavior was reduced by 0.05 occurrence and the number of interactions increased by 0.10 occurrence.

**d. Result of Walking in the hallway**

During the baseline phase, Participant 29 achieved an average of 0.30 occurrence of *Appropriate* behavior; 3.60 occurrences of *Inappropriate* behavior; and 4.30 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 29 achieved 0.30 occurrence of *Appropriate* behavior; 3.40 occurrences of *Inappropriate* behavior; and 4.00 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.30 occurrence, *Inappropriate* behavior was 3.50 occurrences and *No Interaction* was 4.20 occurrences.

From the findings of the observation in the three phases, Participant 29’s *Appropriate* behavior remained the same. His *Inappropriate* behavior was reduced by 0.15 occurrence and the number of interactions increased by 0.20 occurrence.

**e. Result of Washing hands**

During the baseline phase, Participant 29 achieved an average of 0.10 occurrence of *Appropriate* behavior; 2.80 occurrences of *Inappropriate* behavior; and 3.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 29 achieved 0.10 occurrence of *Appropriate* behavior; 2.90 occurrences of *Inappropriate* behavior; and 3.60 occurrences of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 0.10 occurrence, *Inappropriate* behavior was 2.70 occurrences and *No Interaction* was 3.90 occurrences.

From the findings of the observation in the three phases, Participant 29’s *Appropriate* behavior and *Inappropriate* behavior remained the same and the number of interactions increased by 0.05 occurrence.

Overall, the results for participant 29 suggested that the introduction of SS presented in *I-Learn Social Story* had not influenced behavior changes in the participant; however, the number of social interactions made by the participant was slightly increased.
XXX. Participant 30

Figure 60 illustrates the comparison graphs of Participant 30's Appropriate, Inappropriate and No Interaction behavior during baseline (A), intervention (B) and reversal baseline (A) for each of the social stories that the participant went through, as discussed below:

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**Figure 60 Participant 30’s behavioral changes**
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a. Result of How to greet someone at school

During the baseline phase, Participant 30 achieved an average of 1.20 occurrences of Appropriate behavior; 2.10 occurrences of Inappropriate behavior; and 0.80 occurrence of No Interaction in the observation. During the intervention phase, Participant 30 achieved 2.80 occurrences of Appropriate behavior; 0.40 occurrence of Inappropriate behavior; and 0.30 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.40 occurrences, Inappropriate behavior was 0.80 occurrence and No Interaction was 0.30 occurrence.

From the findings of the observation in the three phases, Participant 30 had improved in Appropriate behavior by 1.40 occurrences. Inappropriate behavior was reduced by 1.50 occurrences and the number of interactions increased by 0.50 occurrence.

b. Result of Play and sing with friends

During the baseline phase, Participant 30 achieved an average of 1.20 occurrences of Appropriate behavior; 1.70 occurrences of Inappropriate behavior; and 1.30 occurrences of No Interaction in the observation. During the intervention phase, Participant 30 achieved 2.80 occurrences of Appropriate behavior; 0.80 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 2.50 occurrences, Inappropriate behavior was 0.50 occurrence and No Interaction was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 30 had improved in Appropriate behavior by 1.45 occurrences. Inappropriate behavior was reduced by 1.05 occurrences and the number of interactions increased by 0.65 occurrence.

c. Result of Snack time

During the baseline phase, Participant 30 achieved an average of 0.50 occurrence of Appropriate behavior; 0.90 occurrence of Inappropriate behavior; and 1.70 occurrences of No Interaction in the observation. During the intervention phase, Participant 30 achieved 2.20 occurrences of Appropriate behavior; 0.40 occurrence of Inappropriate behavior; and 0.60 occurrence of No Interaction during the observation. During the withdrawal (reversal baseline) phase, the data collected for Appropriate behavior was 1.90 occurrences, Inappropriate behavior was 0.50 occurrence and No Interaction was 0.70 occurrence.
From the findings of the observation in the three phases, Participant 30 had improved in *Appropriate* behavior by 1.55 occurrences. *Inappropriate* behavior was reduced by 0.45 occurrence and the number of interactions increased by 1.05 occurrences.

d. Result of Walking in the hallway

During the baseline phase, Participant 30 achieved an average of 0.90 occurrence of *Appropriate* behavior; 1.10 occurrences of *Inappropriate* behavior; and 1.80 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 30 achieved 2.60 occurrences of *Appropriate* behavior; 0.60 occurrence of *Inappropriate* behavior; and 0.40 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 2.40 occurrences, *Inappropriate* behavior was 0.70 occurrence and *No Interaction* was 0.70 occurrence.

From the findings of the observation in the three phases, Participant 30 had improved in *Appropriate* behavior by 1.60 occurrences. *Inappropriate* behavior was reduced by 0.45 occurrence and the number of interactions increased by 1.25 occurrences.

e. Result of Washing hands

During the baseline phase, Participant 30 achieved an average of 0.90 occurrence of *Appropriate* behavior; 0.90 occurrence of *Inappropriate* behavior; and 1.60 occurrences of *No Interaction* in the observation. During the intervention phase, Participant 30 achieved 2.30 occurrences of *Appropriate* behavior; 0.30 occurrence of *Inappropriate* behavior; and 0.60 occurrence of *No Interaction* during the observation. During the withdrawal (reversal baseline) phase, the data collected for *Appropriate* behavior was 1.90 occurrences, *Inappropriate* behavior was 0.40 occurrence and *No Interaction* was 0.50 occurrence.

From the findings of the observation in the three phases, Participant 30 had improved in *Appropriate* behavior by 1.20 occurrences. *Inappropriate* behavior was reduced by 0.55 occurrence and the number of interactions increased by 1.05 occurrences.

Overall, the results for Participant 30 suggested that the introduction of SS presented in *I-Learn Social Story* had considerably increased the number of *Appropriate* behaviors, substantially decreased the number of *Inappropriate* behaviors, as well as sizably increasing the number of social interactions made by the participant.
5.5.2 Results collected for individual social story

This section discusses the behavioral changes (from Table 14 to Table 28 for five designated social stories) in three groups of participants: the low cognitive functioning, the high cognitive functioning and the combination of both (refer to section 5.2.1.2 Participants’ profiles for the definition of the cognitive functioning). Each table contains two main sections: Section on the left displays the average value of Appropriate, Inappropriate and No Interaction results for each phase (Baseline, Intervention & Reversal Baseline); section on the right displays the behavioral changes from baseline to intervention [Intervention – Baseline], from baseline to reversal baseline [Reversal Baseline – Baseline], and the summary of the overall behavioral changes for each of Appropriate, Inappropriate and No Interaction social behavior [(Intervention + Reversal Baseline)/2]-Baseline. The occurrence of behavioral changes was measured in every 10-minute session. SD represents the standard deviations while p represents the significance value of t-test.

5.5.2.1 How to greet someone at school

Table 14 illustrates the behavioral changes of the low cognitive functioning participants’ for the How to greet someone at school social story. In the baseline phase, the average occurrence of the Appropriate behavior is 0.36, Inappropriate behavior is 2.14, and No Interaction is 3.59. In the intervention phase, the average occurrence of the Appropriate behavior is 0.54, Inappropriate behavior is 1.76 and No Interaction is 3.44. In the reversal baseline phase, the average occurrence of the Appropriate behavior is 0.56, Inappropriate behavior is 1.71 and No Interaction is 3.54. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 0.19, a decrease in occurrence of Inappropriate behavior i.e. 0.41, and a decrease in occurrence of No Interaction of 0.09.

Table 14 Behavioral changes observed in low cognitive functioning group for ‘How to greet someone at school’

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>Inappropriate</td>
<td>No Interaction</td>
<td>Appropriate</td>
</tr>
<tr>
<td>11 (19 yrs)</td>
<td>1.30</td>
<td>3.20</td>
<td>1.10</td>
<td>0.20</td>
</tr>
<tr>
<td>17 (10 yrs)</td>
<td>1.30</td>
<td>2.20</td>
<td>1.30</td>
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<tr>
<td>20 (11 yrs)</td>
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<td>2.20</td>
<td>1.30</td>
<td>0.20</td>
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<tr>
<td>24 (11 yrs)</td>
<td>1.30</td>
<td>2.20</td>
<td>1.30</td>
<td>0.20</td>
</tr>
<tr>
<td>26 (12 yrs)</td>
<td>1.30</td>
<td>2.20</td>
<td>1.30</td>
<td>0.20</td>
</tr>
<tr>
<td>28 (13 yrs)</td>
<td>1.30</td>
<td>2.20</td>
<td>1.30</td>
<td>0.20</td>
</tr>
<tr>
<td>29 (17 yrs)</td>
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<td>2.20</td>
<td>1.30</td>
<td>0.20</td>
</tr>
<tr>
<td>Average</td>
<td>0.36</td>
<td>2.14</td>
<td>3.59</td>
<td>0.19</td>
</tr>
<tr>
<td>SD</td>
<td>0.87</td>
<td>1.13</td>
<td>1.84</td>
<td>0.41</td>
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</table>

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.
Table 15 illustrates the behavioral changes of the high cognitive functioning group. In the baseline phase, the average occurrence of the Appropriate behavior is 0.91, Inappropriate behavior is 1.91, and No Interaction is 1.97. In the intervention phase, the average occurrence of Appropriate behavior is 2.11, Inappropriate behavior is 0.88 and No Interaction is 0.81. In the reversal baseline phase, the average occurrence of Appropriate behavior is 1.87, Inappropriate behavior is 0.87 and No Interaction is 0.86. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 1.09, a decrease in occurrence of Inappropriate behavior i.e. 1.03, and a decrease in occurrence of No Interaction i.e. 1.13.

Table 15 Behavioral changes observed in high cognitive functioning group for  ‘How to greet someone at school’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline)/2] – Baseline.

Table 16 illustrates the behavioral changes observed in all participants. In the baseline phase, all participants have 0.78 occurrences in Appropriate behavior, 1.96 occurrences for Inappropriate behavior, and 2.35 occurrences of No Interaction. In the intervention phase, the average occurrence of Appropriate behavior for all the participants is 1.74, the average occurrence of Inappropriate behavior is 1.09 and No Interaction is 1.43. In the reversal baseline phase, the average occurrence of Appropriate behavior for all of the participants is 1.59, the average occurrence of Inappropriate behavior made by all of the participants is 1.07 and No Interaction is 1.49. The overall behavioral changes: an increment in Appropriate behavior of
0.88 occurrence, a decrease in *Inappropriate* behavior of 0.89 occurrence, and an increment in social interaction of 0.89 occurrence.

**Chapter 5: Prototype Testing and Evaluation**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline A</th>
<th>Intervention B</th>
<th>Reversal Baseline A</th>
<th>Average Behavioral Changes</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase</td>
<td>Decrease</td>
<td>Increase</td>
<td>Appropriate</td>
<td>Inappropriate</td>
</tr>
<tr>
<td>1 (4 yrs)</td>
<td>16</td>
<td>5</td>
<td>32</td>
<td>0.50 ± 0.40</td>
<td>0.85 ± 1.00</td>
</tr>
<tr>
<td>2 (5 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>1.60 ± 0.85</td>
<td>1.95 ± 1.20</td>
</tr>
<tr>
<td>3 (5 yrs)</td>
<td>12</td>
<td>2</td>
<td>16</td>
<td>1.40 ± 0.90</td>
<td>1.55 ± 1.00</td>
</tr>
<tr>
<td>4 (6 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>2.00 ± 1.70</td>
<td>2.15 ± 2.00</td>
</tr>
<tr>
<td>5 (6 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>1.80 ± 1.70</td>
<td>1.70 ± 1.60</td>
</tr>
<tr>
<td>6 (6 yrs)</td>
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<td>4</td>
<td>32</td>
<td>1.90 ± 1.70</td>
<td>1.20 ± 1.10</td>
</tr>
<tr>
<td>7 (7 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>2.00 ± 1.70</td>
<td>0.80 ± 0.90</td>
</tr>
<tr>
<td>8 (7 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>1.00 ± 0.90</td>
<td>0.50 ± 0.70</td>
</tr>
<tr>
<td>9 (8 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.70 ± 0.90</td>
<td>0.40 ± 0.50</td>
</tr>
<tr>
<td>10 (8 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.60 ± 0.60</td>
<td>0.10 ± 0.10</td>
</tr>
<tr>
<td>11 (9 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>12 (9 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>13 (9 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>14 (9 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>15 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>16 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>17 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>18 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>19 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>20 (10 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>21 (11 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>22 (11 yrs)</td>
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<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>23 (11 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>24 (11 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>25 (12 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>26 (12 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>27 (12 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>28 (13 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>29 (13 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>30 (13 yrs)</td>
<td>16</td>
<td>4</td>
<td>32</td>
<td>0.20 ± 0.50</td>
<td>0.05 ± 0.05</td>
</tr>
<tr>
<td>Average 1</td>
<td>0.69 ± 0.85</td>
<td>0.14 ± 0.14</td>
<td>0.70 ± 0.14</td>
<td>0.67 ± 0.58</td>
<td>0.62 ± 0.64</td>
</tr>
<tr>
<td>SD</td>
<td>0.05 ± 0.40</td>
<td>0.05 ± 0.40</td>
<td>0.05 ± 0.40</td>
<td>0.07 ± 0.41</td>
<td>0.06 ± 0.41</td>
</tr>
</tbody>
</table>

**Table 16 Behavioral changes observed in all participants for ‘How to greet someone at school’**

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from ([Intervention + Reversal Baseline]) / 2 – Baseline.

The highest *Appropriate* behavioral change is obtained by Participant 15 with an increment in *Appropriate* behavior of 2.20 occurrences. On the other hand, Participant 26 and Participant 29 have the lowest *Appropriate* behavioral change, where their *Appropriate* behaviors are decreased by 0.05 occurrence. Participant 27 has the highest decrease in *Inappropriate* behavior that is reduced by 1.95 occurrences. Participant 24 has the least change in the *Inappropriate* behavior that is reduced by 0.10 occurrence. The highest number of social interaction change is achieved by Participant 15 with an increment of 2.25 occurrences while the lowest is Participant 11, whose number of No Interaction only reduced by 0.20 occurrence.

**5.5.2.2 Play and sing with friends**

Table 17 illustrates the behavioral changes of the low cognitive functioning participants’ for the Play and sing with friends social story. In the baseline phase, the average occurrence of the
Appropriate behavior is 0.37, Inappropriate behavior is 3.23, and No Interaction is 3.13. In the intervention phase, the average occurrence of the Appropriate behavior is 0.63, Inappropriate behavior is 2.97 and No Interaction is 3.10. In the reversal baseline phase, the average occurrence of the Appropriate behavior is 0.53, Inappropriate behavior is 2.83 and No Interaction is 3.09. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 0.21, a decrease in occurrence of Inappropriate behavior i.e. 0.33, and a decrease in occurrence of ‘No Interaction’ of 0.04.

### Table 17 Behavioral changes observed in low cognitive functioning group for ‘Play and sing with friends’

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (4 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.90</td>
<td>0.10</td>
</tr>
<tr>
<td>2 (5 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.80</td>
<td>0.10</td>
</tr>
<tr>
<td>3 (5 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.70</td>
<td>0.10</td>
</tr>
<tr>
<td>4 (6 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.60</td>
<td>0.10</td>
</tr>
<tr>
<td>5 (6 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.50</td>
<td>0.10</td>
</tr>
<tr>
<td>6 (7 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.40</td>
<td>0.10</td>
</tr>
<tr>
<td>7 (8 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.30</td>
<td>0.10</td>
</tr>
<tr>
<td>8 (9 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.20</td>
<td>0.10</td>
</tr>
<tr>
<td>9 (10 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>10 (11 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>11 (12 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>12 (13 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>13 (14 yrs)</td>
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<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>14 (15 yrs)</td>
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<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>Average</td>
<td>0.10</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.

### Table 18 Behavioral changes observed in high cognitive functioning group for ‘Play and sing with friends’

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (4 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.90</td>
<td>0.10</td>
</tr>
<tr>
<td>2 (5 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.80</td>
<td>0.10</td>
</tr>
<tr>
<td>3 (5 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.70</td>
<td>0.10</td>
</tr>
<tr>
<td>4 (6 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.60</td>
<td>0.10</td>
</tr>
<tr>
<td>5 (6 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.50</td>
<td>0.10</td>
</tr>
<tr>
<td>6 (7 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.40</td>
<td>0.10</td>
</tr>
<tr>
<td>7 (8 yrs)</td>
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<td>0.10</td>
<td>0.30</td>
<td>0.10</td>
</tr>
<tr>
<td>8 (9 yrs)</td>
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<td>0.10</td>
<td>0.20</td>
<td>0.10</td>
</tr>
<tr>
<td>9 (10 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>10 (11 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>11 (12 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>12 (13 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>13 (14 yrs)</td>
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<td>0.10</td>
<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>14 (15 yrs)</td>
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<td>0.00</td>
<td>0.10</td>
</tr>
<tr>
<td>Average</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.
Table 18 illustrates the behavioral changes of the high cognitive functioning group. In the baseline phase, the average occurrence of the Appropriate behavior is 0.87, Inappropriate behavior is 2.05, and No Interaction is 2.15. In the intervention phase, the average occurrence of Appropriate behavior is 2.43, Inappropriate behavior is 0.91 and No Interaction is 1.00. In the reversal baseline phase, the average occurrence of Appropriate behavior is 2.20, Inappropriate behavior is 0.90 and No Interaction is 0.99. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 1.45, a decrease in occurrence of Inappropriate behavior i.e. 1.14, and a decrease in occurrence of ‘No Interaction’ i.e. 1.16.

Table 19 Behavioral changes observed in all participants for ‘Play and sing with friends’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline]/2 – Baseline.

Table 19 illustrates the behavioral changes observed in all participants. In the baseline phase, all participants have 0.75 occurrences in Appropriate behavior, 2.32 occurrences for Inappropriate behavior, and 2.38 occurrences of No Interaction. In the intervention phase, the average of Appropriate behavior for all the participants is 2.01, the average of Inappropriate behavior is 1.39 and No Interaction is 1.49. In the reversal baseline phase, the average occurrence of Appropriate behavior for all of the participants is 1.81, the average occurrence
of Inappropriate behavior made by all of the participants is 1.35 and No Interaction is 1.48. The overall behavioral changes: an increment in Appropriate behavior of 1.16 occurrences, a decrease in Inappropriate behavior of 0.95 occurrence, and an increment in social interaction of 0.90 occurrence.

The highest Appropriate behavioral change is obtained by Participant 8 with an increment in Appropriate behavior of 2.35. On the other hand, Participant 24 has the lowest Appropriate behavioral change, where his Appropriate behaviors is decreased by 0.10 occurrence. Participant 9 has the highest decrease in Inappropriate behavior that is reduced by 3.20 occurrences. Participant 20 has the least change in the Inappropriate behavior that is increased by 0.25 occurrence. The highest number of social interaction change is achieved by Participant 1 with an increment of 2.75 occurrences while the lowest is Participant 11, whose number of No Interaction only reduced by 0.35 occurrence.

### 5.5.2.3 Snack time

Table 20 illustrates the behavioral changes of the low cognitive functioning participants’ for the Snack time social story. In the baseline phase, the average occurrence of the Appropriate behavior is 0.44, Inappropriate behavior is 2.60, and No Interaction is 2.87. In the intervention phase, the average occurrence of the Appropriate behavior is 0.70, Inappropriate behavior is 2.34 and No Interaction is 2.71. In the reversal baseline phase, the average occurrence of the Appropriate behavior is 0.64, Inappropriate behavior is 2.24 and No Interaction is 2.76. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 0.23, a decrease in occurrence of Inappropriate behavior i.e. 0.31, and a decrease in occurrence of ‘No Interaction’ of 0.14.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
<td>Inappropriate</td>
<td>No Interaction</td>
<td>Appropriate</td>
</tr>
<tr>
<td>11 (9 yrs)</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>0.20</td>
</tr>
<tr>
<td>17 (10 yrs)</td>
<td>16</td>
<td>0.20</td>
<td>4.50</td>
<td>0.10</td>
</tr>
<tr>
<td>20 (11 yrs)</td>
<td>16</td>
<td>0.10</td>
<td>2.20</td>
<td>0.10</td>
</tr>
<tr>
<td>24 (12 yrs)</td>
<td>16</td>
<td>0.00</td>
<td>2.60</td>
<td>0.00</td>
</tr>
<tr>
<td>25 (12 yrs)</td>
<td>16</td>
<td>0.00</td>
<td>2.20</td>
<td>0.00</td>
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<tr>
<td>26 (13 yrs)</td>
<td>16</td>
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<td>2.00</td>
<td>0.00</td>
</tr>
<tr>
<td>25 (17 yrs)</td>
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<tr>
<td>SD</td>
<td>0.31</td>
<td>2.71</td>
<td>1.62</td>
<td>0.078</td>
</tr>
</tbody>
</table>

Table 20 Behavioral changes observed in low cognitive functioning group for ‘Snack time’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline)/2 – Baseline].

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Table 21 illustrates the behavioral changes of the high cognitive functioning group. In the baseline phase, the average occurrence of the Appropriate behavior is 1.04, Inappropriate behavior is 1.77, and No Interaction is 2.05. In the intervention phase, the average occurrence of Appropriate behavior is 2.30, Inappropriate behavior is 0.86 and No Interaction is 0.93. In the reversal baseline phase, the average occurrence of Appropriate behavior is 2.14, Inappropriate behavior is 0.92 and No Interaction is 0.99. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 1.18, a decrease in occurrence of Inappropriate behavior i.e. 0.88, and a decrease in occurrence of ‘No Interaction’ i.e. 1.08.

Table 21 Behavioral changes observed in high cognitive functioning group for ‘Snack time’

<table>
<thead>
<tr>
<th>Participant (4 yrs)</th>
<th>Appropriate</th>
<th>Inappropriate</th>
<th>No Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.20</td>
<td>1.15</td>
<td>1.90</td>
</tr>
<tr>
<td>2</td>
<td>1.50</td>
<td>1.20</td>
<td>1.80</td>
</tr>
<tr>
<td>3</td>
<td>1.70</td>
<td>1.60</td>
<td>1.80</td>
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<tr>
<td>4</td>
<td>2.00</td>
<td>1.80</td>
<td>1.80</td>
</tr>
<tr>
<td>5</td>
<td>1.90</td>
<td>1.80</td>
<td>1.90</td>
</tr>
<tr>
<td>6</td>
<td>2.00</td>
<td>1.80</td>
<td>1.90</td>
</tr>
<tr>
<td>7</td>
<td>2.10</td>
<td>1.80</td>
<td>1.90</td>
</tr>
<tr>
<td>8</td>
<td>2.20</td>
<td>1.80</td>
<td>1.90</td>
</tr>
<tr>
<td>9</td>
<td>2.30</td>
<td>1.80</td>
<td>1.90</td>
</tr>
<tr>
<td>Average</td>
<td>2.10</td>
<td>1.80</td>
<td>1.90</td>
</tr>
</tbody>
</table>

| SD                  | 0.45        | 0.50          | 0.50           |

Table 22 illustrates the behavioral changes observed in all participants. In the baseline phase, all participants have 0.90 occurrences in Appropriate behavior, 1.96 occurrences for Inappropriate behavior, and 2.24 occurrences of No Interaction. In the intervention phase, the average of Appropriate behavior for all the participants is 1.92, the average of Inappropriate behavior is 1.20 and No Interaction is 1.35. In the reversal baseline phase, the average occurrence of Appropriate behavior for all of the participants is 1.79, the average occurrence of Inappropriate behavior made by all of the participants is 1.23 and No Interaction is 1.40. The overall behavioral changes: an increment in Appropriate behavior of 0.96 occurrence, a
decrease in Inappropriate behavior of 0.75 occurrence, and an increase in social interaction of 0.86 occurrence.

<table>
<thead>
<tr>
<th>Average of behavioral changes during baseline (A), Intervention (B) and Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant</td>
<td>Baseline (A)</td>
</tr>
<tr>
<td>1 (4 y)</td>
<td>0.70</td>
</tr>
<tr>
<td>3 (y)</td>
<td>0.80</td>
</tr>
<tr>
<td>5 (y)</td>
<td>0.70</td>
</tr>
<tr>
<td>7 (y)</td>
<td>0.80</td>
</tr>
<tr>
<td>5 (y)</td>
<td>0.60</td>
</tr>
<tr>
<td>9 (y)</td>
<td>0.20</td>
</tr>
<tr>
<td>7 (y)</td>
<td>1.40</td>
</tr>
<tr>
<td>8 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>8 (y)</td>
<td>1.80</td>
</tr>
<tr>
<td>10 (y)</td>
<td>1.00</td>
</tr>
<tr>
<td>11 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>12 (y)</td>
<td>0.90</td>
</tr>
<tr>
<td>13 (y)</td>
<td>0.80</td>
</tr>
<tr>
<td>14 (y)</td>
<td>1.00</td>
</tr>
<tr>
<td>15 (y)</td>
<td>2.00</td>
</tr>
<tr>
<td>16 (y)</td>
<td>2.10</td>
</tr>
<tr>
<td>17 (y)</td>
<td>0.20</td>
</tr>
<tr>
<td>18 (y)</td>
<td>0.80</td>
</tr>
<tr>
<td>19 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>20 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>21 (y)</td>
<td>1.00</td>
</tr>
<tr>
<td>22 (y)</td>
<td>1.00</td>
</tr>
<tr>
<td>23 (y)</td>
<td>0.80</td>
</tr>
<tr>
<td>24 (y)</td>
<td>0.90</td>
</tr>
<tr>
<td>25 (y)</td>
<td>1.00</td>
</tr>
<tr>
<td>26 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>27 (y)</td>
<td>0.00</td>
</tr>
<tr>
<td>28 (y)</td>
<td>0.70</td>
</tr>
<tr>
<td>29 (y)</td>
<td>0.10</td>
</tr>
<tr>
<td>30 (y)</td>
<td>0.50</td>
</tr>
<tr>
<td>Average</td>
<td>0.60</td>
</tr>
<tr>
<td>SD</td>
<td>0.62</td>
</tr>
</tbody>
</table>

Table 22 Behavioral changes observed in all participants for ‘Snack time’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline/2] – Baseline.

The highest Appropriate behavioral change is obtained by Participant 27 with an increment in Appropriate behavior of 1.95. On the other hand, Participant 20, 24, 26 and 29 have the lowest Appropriate behavior change, where their Appropriate behaviors are decreased by 0.05 occurrence. Participant 16 has the highest decrease in Inappropriate behavior that is reduced by 2.50 occurrences. Participant 17 has the least change in the Inappropriate behavior that is increases by 0.10 occurrence. The highest number of social interaction change is achieved by Participant 4 with an increment of 2.25 occurrences while the lowest is Participant 11, whose number of No Interaction only reduced by 0.65 occurrence.

5.5.2.4 Walking in the hallway

Table 23 illustrates the behavioral changes of the low cognitive functioning participants’ for the Walking in the hallway social story. In the baseline phase, the average occurrence of the

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Appropriate behavior is 0.47, Inappropriate behavior is 2.67, and No Interaction is 2.86. In the intervention phase, the average occurrence of the Appropriate behavior is 0.57, Inappropriate behavior is 2.50 and No Interaction is 2.74. In the reversal baseline phase, the average occurrence of the Appropriate behavior is 0.54, Inappropriate behavior is 2.57 and No Interaction is 2.71. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 0.09, a decrease in occurrence of Inappropriate behavior i.e. 0.14, and a decrease in occurrence of ‘No Interaction’ of 0.13.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Appropriate (A)</th>
<th>Inappropriate (B)</th>
<th>No Interaction (A)</th>
<th>Appropriate (A)</th>
<th>Inappropriate (B)</th>
<th>No Interaction (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (9 yrs)</td>
<td>0.80</td>
<td>2.60</td>
<td>1.00</td>
<td>0.80</td>
<td>2.60</td>
<td>1.00</td>
</tr>
<tr>
<td>12 (10 yrs)</td>
<td>0.60</td>
<td>2.40</td>
<td>1.00</td>
<td>0.60</td>
<td>2.40</td>
<td>1.00</td>
</tr>
<tr>
<td>13 (11 yrs)</td>
<td>0.40</td>
<td>2.20</td>
<td>1.00</td>
<td>0.40</td>
<td>2.20</td>
<td>1.00</td>
</tr>
<tr>
<td>14 (12 yrs)</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>15 (13 yrs)</td>
<td>0.00</td>
<td>1.80</td>
<td>1.00</td>
<td>0.00</td>
<td>1.80</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 23 Behavioral changes observed in low cognitive functioning group for Walking in the hallway.

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Appropriate (A)</th>
<th>Inappropriate (B)</th>
<th>No Interaction (A)</th>
<th>Appropriate (A)</th>
<th>Inappropriate (B)</th>
<th>No Interaction (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 (4 yrs)</td>
<td>0.80</td>
<td>2.60</td>
<td>1.00</td>
<td>0.80</td>
<td>2.60</td>
<td>1.00</td>
</tr>
<tr>
<td>15 (5 yrs)</td>
<td>0.60</td>
<td>2.40</td>
<td>1.00</td>
<td>0.60</td>
<td>2.40</td>
<td>1.00</td>
</tr>
<tr>
<td>16 (6 yrs)</td>
<td>0.40</td>
<td>2.20</td>
<td>1.00</td>
<td>0.40</td>
<td>2.20</td>
<td>1.00</td>
</tr>
<tr>
<td>17 (7 yrs)</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 24 Behavioral changes observed in high cognitive functioning group for ‘Walking in the hallway’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.
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Table 24 illustrates the behavioral changes of the high cognitive functioning group. In the baseline phase, the average occurrence of the Appropriate behavior is 0.84, Inappropriate behavior is 1.89, and No Interaction is 2.22. In the intervention phase, the average occurrence of Appropriate behavior is 2.09, Inappropriate behavior is 1.08 and No Interaction is 1.08. In the reversal baseline phase, the average occurrence of Appropriate behavior is 1.93, Inappropriate behavior is 1.18 and No Interaction is 1.15. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 1.17, a decrease in occurrence of Inappropriate behavior i.e. 0.76, and a decrease in occurrence of No Interaction i.e. 1.11.

Table 25 Behavioral changes observed in all participants for 'Walking in the hallway'

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.

Table 25 illustrates the behavioral changes observed in all participants. In the baseline phase, all participants have 0.73 occurrences in Appropriate behavior, 2.12 occurrences for Inappropriate behavior, and 2.40 occurrences of No Interaction. In the intervention phase, the average of Appropriate behavior for all the participants is 1.65, the average of Inappropriate behavior is 1.50 and No Interaction is 1.56. In the reversal baseline phase, the average occurrence of Appropriate behavior for all of the participants is 1.53, the average occurrence
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of Inappropriate behavior made by all of the participants is 1.58 and No Interaction is 1.60. The overall behavioral changes: an increment in Appropriate behavior of 0.85 occurrence, a decrease in Inappropriate behavior of 0.58 occurrence, and an increment in social interaction of 0.82 occurrence.

The highest Appropriate behavioral change is obtained by Participant 15 with an increment in Appropriate behavior of 3.00 occurrences. On the other hand, Participant 24 has the lowest Appropriate behavioral change, where their Appropriate behaviors are decreased by 0.10 occurrence. Participant 16 has the highest decrease in Inappropriate behavior that is reduced by 2.00 occurrences. Participant 20 has the least change in the Inappropriate behavior that is increased by 0.30 occurrence. The highest number of social interaction change is achieved by Participant 15 with an increment of 2.95 occurrences while the lowest is Participant 26, whose number of No Interaction only reduced by 0.15 occurrence.

5.5.2.5 Washing hands

Table 26 illustrates the behavioral changes of the low cognitive functioning participants’ for the Washing hands social story. In the baseline phase, the average occurrence of the Appropriate behavior is 0.23, Inappropriate behavior is 2.40, and No Interaction is 3.41. In the intervention phase, the average occurrence of the Appropriate behavior is 0.40, Inappropriate behavior is 2.30 and No Interaction is 3.19. In the reversal baseline phase, the average occurrence of the Appropriate behavior is 0.39, Inappropriate behavior is 2.26 and No Interaction is 3.29. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 0.16, a decrease in occurrence of Inappropriate behavior i.e. 0.12, and a decrease in occurrence of ‘No Interaction’ of 0.18.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
<td>Inappropriate</td>
<td>No Interaction</td>
<td>Appropriate</td>
</tr>
<tr>
<td>11 (9 yrs)</td>
<td>0.40</td>
<td>2.30</td>
<td>1.00</td>
<td>0.40</td>
</tr>
<tr>
<td>12 (10 yrs)</td>
<td>0.20</td>
<td>2.70</td>
<td>0.80</td>
<td>0.20</td>
</tr>
<tr>
<td>13 (11 yrs)</td>
<td>0.10</td>
<td>4.80</td>
<td>3.80</td>
<td>0.10</td>
</tr>
<tr>
<td>14 (12 yrs)</td>
<td>0.30</td>
<td>2.80</td>
<td>6.20</td>
<td>0.25</td>
</tr>
<tr>
<td>15 (12 yrs)</td>
<td>0.40</td>
<td>2.10</td>
<td>1.70</td>
<td>0.40</td>
</tr>
<tr>
<td>16 (13 yrs)</td>
<td>0.10</td>
<td>2.00</td>
<td>3.00</td>
<td>0.10</td>
</tr>
<tr>
<td>17 (14 yrs)</td>
<td>0.10</td>
<td>2.40</td>
<td>3.00</td>
<td>0.10</td>
</tr>
<tr>
<td>Average</td>
<td>0.21</td>
<td>2.40</td>
<td>3.40</td>
<td>0.40</td>
</tr>
<tr>
<td>SD</td>
<td>0.14</td>
<td>1.24</td>
<td>1.61</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table 26 Behavioral changes observed in low cognitive functioning group for ‘Washing hands’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline)/2) – Baseline].
Table 27 Behavioral changes observed in high cognitive functioning group for ‘Washing hands’

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
<td>Inappropriate</td>
<td>No Interaction</td>
<td>Appropriate</td>
</tr>
<tr>
<td></td>
<td>% (A)</td>
<td>% (B)</td>
<td>% (A)</td>
<td>% (A)</td>
</tr>
<tr>
<td>1 (4 yrs)</td>
<td>16</td>
<td>2.00</td>
<td>3.75</td>
<td>15</td>
</tr>
<tr>
<td>2 (5 yrs)</td>
<td>16</td>
<td>2.00</td>
<td>3.50</td>
<td>16</td>
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<tr>
<td>3 (5 yrs)</td>
<td>16</td>
<td>1.00</td>
<td>2.00</td>
<td>16</td>
</tr>
<tr>
<td>4 (6 yrs)</td>
<td>16</td>
<td>0.90</td>
<td>2.40</td>
<td>16</td>
</tr>
<tr>
<td>5 (6 yrs)</td>
<td>16</td>
<td>1.00</td>
<td>2.10</td>
<td>16</td>
</tr>
<tr>
<td>6 (6 yrs)</td>
<td>16</td>
<td>0.50</td>
<td>9.00</td>
<td>16</td>
</tr>
<tr>
<td>7 (7 yrs)</td>
<td>16</td>
<td>0.80</td>
<td>1.80</td>
<td>16</td>
</tr>
<tr>
<td>8 (7 yrs)</td>
<td>16</td>
<td>1.60</td>
<td>1.80</td>
<td>16</td>
</tr>
<tr>
<td>9 (8 yrs)</td>
<td>16</td>
<td>1.10</td>
<td>1.00</td>
<td>16</td>
</tr>
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</tr>
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<td>12 (9 yrs)</td>
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<td>2.00</td>
<td>16</td>
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<td>13 (9 yrs)</td>
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<td>1.00</td>
<td>1.80</td>
<td>16</td>
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<td>14 (9 yrs)</td>
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<td>0.60</td>
<td>1.30</td>
<td>16</td>
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<td>15 (10 yrs)</td>
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<td>0.90</td>
<td>0.90</td>
<td>20</td>
</tr>
<tr>
<td>16 (10 yrs)</td>
<td>20</td>
<td>0.70</td>
<td>1.00</td>
<td>20</td>
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<td>17 (10 yrs)</td>
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<td>0.50</td>
<td>2.00</td>
<td>20</td>
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<td>18 (10 yrs)</td>
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<td>0.20</td>
<td>1.30</td>
<td>20</td>
</tr>
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<td>19 (10 yrs)</td>
<td>20</td>
<td>0.20</td>
<td>1.20</td>
<td>20</td>
</tr>
<tr>
<td>20 (11 yrs)</td>
<td>16</td>
<td>0.90</td>
<td>1.00</td>
<td>16</td>
</tr>
<tr>
<td>21 (11 yrs)</td>
<td>16</td>
<td>1.00</td>
<td>2.10</td>
<td>16</td>
</tr>
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<td>22 (11 yrs)</td>
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<td>1.10</td>
<td>2.00</td>
<td>16</td>
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<td>23 (11 yrs)</td>
<td>16</td>
<td>1.00</td>
<td>2.00</td>
<td>16</td>
</tr>
<tr>
<td>25 (13 yrs)</td>
<td>16</td>
<td>0.70</td>
<td>1.20</td>
<td>16</td>
</tr>
<tr>
<td>26 (13 yrs)</td>
<td>16</td>
<td>0.70</td>
<td>2.00</td>
<td>16</td>
</tr>
<tr>
<td>27 (17 yrs)</td>
<td>16</td>
<td>0.90</td>
<td>1.00</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>0.77</td>
<td>1.90</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>0.47</td>
<td>0.96</td>
<td>1.08</td>
</tr>
</tbody>
</table>

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [Intervention + Reversal Baseline)/2] – Baseline.

Table 27 illustrates the behavioral changes of the high cognitive functioning group. In the baseline phase, the average occurrence of the Appropriate behavior is 0.77, Inappropriate behavior is 1.90, and No Interaction is 2.01. In the intervention phase, the average occurrence of Appropriate behavior is 1.83, Inappropriate behavior is 0.97 and No Interaction is 1.03. In the reversal baseline phase, the average occurrence of Appropriate behavior is 1.72, Inappropriate behavior is 0.95 and No Interaction is 1.24. The overall behavioral changes: An increment in occurrence of Appropriate behavior i.e. 1.01, a decrease in occurrence of Inappropriate behavior i.e. 0.94, and a decrease in occurrence of ‘No Interaction’ i.e. 0.87.

Table 28 illustrates the behavioral changes observed in all participants. In the baseline phase, all participants have 0.64 occurrences in Appropriate behavior, 2.01 occurrences for Inappropriate behavior, and 2.34 occurrences of No Interaction. In the intervention phase, the average of Appropriate behavior for all the participants is 1.49, the average of Inappropriate behavior is 1.28 and No Interaction is 1.54. In the reversal baseline phase, the average occurrence of Inappropriate behavior made by all of the participants is 1.26 and No Interaction is 1.72. The overall behavioral changes: an increment in Appropriate behavior of 0.81 occurrence, a
decrease in Inappropriate behavior of 0.75 occurrence, and an increment in social interaction of 0.71 occurrence.

### Table 28 Behavioral changes observed in all participants for ‘Washing hands’

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (A)</th>
<th>Intervention (B)</th>
<th>Reversal Baseline (A)</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Interaction</td>
<td>No Interaction</td>
<td></td>
<td>No Interaction</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>SD</td>
<td>Average</td>
<td>SD</td>
</tr>
<tr>
<td>1 (4 yrs)</td>
<td>0.20</td>
<td>0.20</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>2 (5 yrs)</td>
<td>0.10</td>
<td>0.10</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>3 (5 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>4 (6 yrs)</td>
<td>0.90</td>
<td>0.90</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>5 (6 yrs)</td>
<td>0.30</td>
<td>0.30</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>6 (7 yrs)</td>
<td>0.50</td>
<td>0.50</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>7 (7 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>8 (7 yrs)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>9 (8 yrs)</td>
<td>1.10</td>
<td>1.10</td>
<td>1.00</td>
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</tr>
<tr>
<td>10 (8 yrs)</td>
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<td>1.00</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>11 (9 yrs)</td>
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<td>0.40</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>12 (9 yrs)</td>
<td>0.60</td>
<td>0.60</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>13 (9 yrs)</td>
<td>0.50</td>
<td>0.50</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>14 (9 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>15 (10 yrs)</td>
<td>0.90</td>
<td>0.90</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>16 (10 yrs)</td>
<td>0.70</td>
<td>0.70</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>17 (10 yrs)</td>
<td>0.20</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>18 (10 yrs)</td>
<td>0.50</td>
<td>0.50</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>19 (10 yrs)</td>
<td>0.30</td>
<td>0.30</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>20 (11 yrs)</td>
<td>0.20</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>21 (11 yrs)</td>
<td>0.10</td>
<td>0.10</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>22 (11 yrs)</td>
<td>0.20</td>
<td>0.20</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>23 (11 yrs)</td>
<td>0.10</td>
<td>0.10</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>24 (11 yrs)</td>
<td>0.10</td>
<td>0.10</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>25 (12 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>26 (12 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>27 (12 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>28 (13 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>29 (17 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>30 (17 yrs)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Average</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 28 Behavioral changes observed in all participants for ‘Washing hands’

Note: The figures in column 1 (a to b) is calculated from [Intervention – Baseline], the figures in column 2 (a to a) is calculated from [Reversal Baseline – Baseline], and the figures in column 3 (Overall) is calculated from [(Intervention + Reversal Baseline)/2] – Baseline.

The highest Appropriate behavioral change is obtained by Participant 4 with an increment in Appropriate behavior of 1.65. On the other hand, Participant 24 has the lowest Appropriate behavioral change, where their Appropriate behaviors are decreased by 0.05 occurrence. Participant 9 has the highest decrease in Inappropriate behavior that is reduced by 2.45 occurrences. Participant 24 has the least change in the Inappropriate behavior that is increased by 0.25 occurrence. The highest number of social interaction change is achieved by Participant 1 with an increment of 2.70 occurrences while the lowest is Participant 21, whose number of No Interaction reduced by 2.00 occurrences.

#### 5.5.3 Overall results

The overall changes in the Appropriate, Inappropriate and No Interaction behaviors are measured by averaging the occurrences (in every 10-minute session) for all the social stories.
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Table 29 presents the results of the low cognitive functioning participants whereby Table 30 shows high functioning participants and Table 31 shows all participants. On the left side of the table is the overall changes in the Appropriate, Inappropriate and No Interaction behavior in each SS. On the right side of the table is the overall changes in the Appropriate, Inappropriate and No Interaction behavior in all the social stories.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
</tr>
<tr>
<td>14 (1yr)</td>
<td>0.10</td>
</tr>
<tr>
<td>17 (10yr)</td>
<td>0.05</td>
</tr>
<tr>
<td>20 (11yr)</td>
<td>0.00</td>
</tr>
<tr>
<td>24 (11yr)</td>
<td>0.00</td>
</tr>
<tr>
<td>25 (12yr)</td>
<td>1.30</td>
</tr>
<tr>
<td>26 (13yr)</td>
<td>-0.05</td>
</tr>
<tr>
<td>29 (17yr)</td>
<td>-0.05</td>
</tr>
<tr>
<td>Average</td>
<td>0.19</td>
</tr>
<tr>
<td>SD</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Table 29 The overall result obtained from all of the social stories on low cognitive functioning participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Overall Behavioral Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appropriate</td>
</tr>
<tr>
<td>1 (4yr)</td>
<td>0.45</td>
</tr>
<tr>
<td>2 (5yr)</td>
<td>1.40</td>
</tr>
<tr>
<td>3 (1yr)</td>
<td>1.15</td>
</tr>
<tr>
<td>4 (6yr)</td>
<td>1.00</td>
</tr>
<tr>
<td>5 (6yr)</td>
<td>1.15</td>
</tr>
<tr>
<td>6 (6yr)</td>
<td>1.15</td>
</tr>
<tr>
<td>7 (7yr)</td>
<td>0.95</td>
</tr>
<tr>
<td>8 (7yr)</td>
<td>1.30</td>
</tr>
<tr>
<td>9 (8yr)</td>
<td>0.45</td>
</tr>
<tr>
<td>10 (8yr)</td>
<td>0.60</td>
</tr>
<tr>
<td>12 (9yr)</td>
<td>0.10</td>
</tr>
<tr>
<td>13 (9yr)</td>
<td>1.20</td>
</tr>
<tr>
<td>14 (9yr)</td>
<td>1.00</td>
</tr>
<tr>
<td>15 (10yr)</td>
<td>2.20</td>
</tr>
<tr>
<td>16 (10yr)</td>
<td>1.45</td>
</tr>
<tr>
<td>18 (10yr)</td>
<td>1.30</td>
</tr>
<tr>
<td>19 (10yr)</td>
<td>0.25</td>
</tr>
<tr>
<td>21 (11yr)</td>
<td>0.70</td>
</tr>
<tr>
<td>22 (11yr)</td>
<td>1.10</td>
</tr>
<tr>
<td>23 (11yr)</td>
<td>0.40</td>
</tr>
<tr>
<td>27 (15yr)</td>
<td>1.30</td>
</tr>
<tr>
<td>28 (16yr)</td>
<td>0.90</td>
</tr>
<tr>
<td>30 (17yr)</td>
<td>1.40</td>
</tr>
<tr>
<td>Average</td>
<td>1.00</td>
</tr>
<tr>
<td>SD</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Table 30 The overall result obtained from all of the social stories on high cognitive functioning participants

As shown in Table 31, overall change in the Appropriate behavior has an increment of 0.95 (SD=0.59), while Inappropriate behavior has a decrease of 0.80 (SD=0.50) and No Interaction has a decrease of 0.87 (SD=0.65). Figure 61 illustrates the overall results in graphs. At the top is the overall change in the Appropriate behavior; in the middle is the overall change in the Inappropriate behavior; and at the bottom is the overall change in No Interaction behavior. It
shows that the intervention is effective for twenty three participants. There are two participants (11 & 19) with only a slight improvement, and five participants (17, 20, 24, 26 and 29) with no improvement in social skills.

### Table 31: The overall result obtained from all of the social stories on all participants

As shown in Table 31, the **Appropriate** behavior in *How to greet someone at school* has an increment of 0.88 (SD=0.62), **Inappropriate** behavior is reduced by 0.89 (SD=0.64), and social interaction made increases by 0.89 (SD=0.70) for all participants. For the low functioning group (Table 14), the average of increment in **Appropriate** behavior is 0.19 (SD=0.49), decrement in **Inappropriate** behavior is 0.41 (SD=0.60) and increment in social interaction made is 0.09 (SD=0.28). For the high functioning group (Table 15), the increment of **Appropriate** behavior is 1.09 (SD=0.49), decrement in **Inappropriate** behavior is 1.03 (SD=0.58) and increment in social interaction made is 1.13 (SD=0.61).

As shown in Table 31, the **Appropriate** behavior in *Play and sing with friends* has an increment of 1.16 (SD = 0.76), **Inappropriate** behavior is reduced by 0.95 (SD = 0.74) and No Interaction is reduced by 0.90 (SD = 0.77) for all participants. For the low functioning group (Table 17), the increment in **Appropriate** behavior is 0.21 (SD=0.41), decrement in **Inappropriate** behavior is
0.33 (SD=0.59) and increment in social interaction made is 0.04 (SD=0.38). For the high functioning group (Table 18), the increment of *Appropriate* behavior is 1.45 (SD=0.58), decrement in *Inappropriate* behavior is 1.14 (SD=0.68) and increment in social interaction made is 1.16 (SD=0.66).

As shown in Table 31, the *Appropriate* behavior in *Snack time* has an increment of 0.96 in a ten-minute session (SD = 0.64). *Inappropriate* behavior is on average reduced by 0.75 (SD = 0.56). The number of social interaction made is increased on average by 0.86 (SD = 0.70). For the low functioning group (Table 20), the average of increment in *Appropriate* behavior is 0.23 (SD = 0.37), decrement in *Inappropriate* behavior is 0.31 (SD = 0.51) and increment in number of social interactions made is 0.14 (SD = 0.55). For the high functioning group (Table 21), the average of increment of *Appropriate* behavior is 1.18 (SD = 0.53), decrement in *Inappropriate* behavior is 0.88 (SD = 0.52) and increment in number of social interaction made is 1.08 (SD = 0.59).

As shown in Table 31, the *Appropriate* behavior in *Walking in the hallway* has an increment of 0.85 (SD=0.74), *Inappropriate* behavior is reduced by 0.58 (SD=0.52) and social interaction is increased by 0.82 (SD=0.75) for all the participants. Table 23 shows that the low functioning group has improvement of 0.09 (SD=0.23) in *Appropriate* behavior, decrement in *Inappropriate* behavior of 0.14 (SD=0.35) and increment in social interactions made of 0.13 (SD=0.19). Table 24 shows the high functioning group achieving an improvement in *Appropriate* behavior of 1.17 (SD=0.64), decrement in *Inappropriate* behavior is 0.76 (SD = 0.47) and increment in number of social interaction made is 1.11 (SD = 0.71).

As shown in Table 31, the *Appropriate* behavior in *Washing hands* has increased by 0.81 (SD=0.52), while the *Inappropriate* behavior is reduced by 0.75 (SD=0.65) and the occurrence of *No Interaction* is reduced by 0.71 (SD=0.83) for all the participants. For the low functioning group alone (Table 26), the *Appropriate* behavior has improved by 0.16 (SD=0.36), *Inappropriate* behavior is reduced by 0.12 (SD=0.29) and the social interaction has increased by 0.18 (SD = 0.39). On the other hand, the high functioning group (Table 27) obtained an improvement of 1.01 (SD=0.39) in *Appropriate* behavior, a decrease of 0.94 (SD=0.61) in *Inappropriate* behavior and the occurrence of *No Interaction* is reduced by 0.87 (SD=0.86).
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Figure 61 Overall changes in Appropriate, Inappropriate and No Interaction behavior

The highest Appropriate behavior change was obtained by Participant 15 with an increment of 1.93 occurrences; and the lowest Appropriate behavior change was obtained by Participant 24 with a slight decrease of 0.04 occurrences (see Figure 61 for graph). The Appropriate behavior changes made by all of the participants has an increment of 0.95 (SD=0.59). For the low functioning group (Table 29), the Appropriate behavior has an increment of 0.18 (SD=0.37). For the high functioning group (Table 30), the Appropriate behavior has an increment of 1.19 (SD=0.42).

The highest Inappropriate behavior change was obtained by Participant 16 with a decrease of Inappropriate behavior by 1.81 occurrences. On the other hand, the lowest Inappropriate behavior change was obtained by Participant 24, whose Inappropriate behavior is increased by 0.04 occurrences (see Figure 61 for graph). The average Inappropriate behavioral changes for
all participants have decreased by 0.80 (SD=0.50). For the low functioning group, on average *Inappropriate* behavior reduced by 0.26 (SD=0.41). For the high functioning group, *Inappropriate* behavior is reduced by 0.97 (SD=0.41).

The highest increase of interactions was scored by Participant 1, who increased the social interaction by 2.24 and the lowest increment in social interactions was obtained by Participant 11, whose social interactions were reduced by 0.19 (see Figure 61 for graph). The average increment of social interactions over all of the participants is 0.87 (SD= 0.65). In low functioning group, social interaction increases by 0.11 (SD= 0.33). In high functioning group, social interaction increases by 1.09 (SD=0.54).

### 5.6 Findings and discussion

This is the first study of SS to demonstrate its effectiveness as computer animation, and one of only few studies to show clear, statistically significant effects. Numerous previous studies proved the positive effect of SS intervention on children with ASD. However, most of the studies on SS intervention were conducted with a small number of participants; with very few studies report their results with any statistical significance tests. Table 32 briefly summarizes these studies.

#### 5.6.1 Statistical significance

Only two previous studies on SS have had a sufficiently large cohort for a statistical analysis (Table 32). Pettigrew (1998) had the highest number of participants, she tested SS on 69 children with language impairment. She divided them into three groups: an experimental group of 31 who used SS with scaffolding activities; a control group of 24 who read library book with no social meaning; and a comparison group of 14 who read a library book and participated in scaffolding activities. In this study, teachers were asked to complete the pre- and post-test ratings of the students. Result showed that the experimental group had an increase in social competence. However, it is statistically confusing and inconsistent. There was disagreement between the data presented in the figures and the texts, as argued by Washburn (2006). The numbers used for Chi-square analysis were inconsistent with the number in the text. Another suspect source of inconsistency is due to the fact that the teachers, instead of the researcher, rated the behaviors. On the other hand, Feinberg (2001) tested SS to a control group of 14 normally developed children and experimental group of 34 children with ASD. SS was read to the experimental group while regular story was read to the
control group. Result show there is a significant change for the experimental group only in certain behaviors ($p<0.005$).

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Variation of SS</th>
<th>Design</th>
<th>Duration</th>
<th>Result/Effectiveness</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agosta et al (2004)</td>
<td>1</td>
<td>Teacher as active researcher</td>
<td>ABCA</td>
<td>&gt;22 days</td>
<td>Positive behavioral changes, counted in occurrences per session.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Brownell (2002)</td>
<td>4</td>
<td>Musical social story</td>
<td>ABAC</td>
<td>&gt;8 days each</td>
<td>Reading (B) and singing (C) phase were significantly more effective than control phase (A)</td>
<td>t-test p&lt;0.05</td>
</tr>
<tr>
<td>Crozier &amp; Tincani (2005)</td>
<td>1</td>
<td>Drawing illustration</td>
<td>ABAC</td>
<td>Unknown</td>
<td>Reduction in disruptive behavior, counted in occurrences per observation session.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Crozier &amp; Tincani (2007)</td>
<td>3</td>
<td>Color icon illustration</td>
<td>ABAB</td>
<td>Unknown</td>
<td>Overall, there was a reduction in inappropriate behavior and increase in appropriate behavior, counted per session. However, SS alone insufficient for one participant.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Delano &amp; Snell (2006)</td>
<td>3</td>
<td>Picture symbols</td>
<td>Multiple baseline</td>
<td>Unknown</td>
<td>Increase in the duration of social engagement, counted duration (seconds) and frequency of social engagement</td>
<td>Not tested</td>
</tr>
<tr>
<td>Haggerty et al (2005)</td>
<td>1</td>
<td>Drawing illustration</td>
<td>AB</td>
<td>4 weeks</td>
<td>Maladaptive behaviors decreased in frequency, duration and intensity</td>
<td>Not tested</td>
</tr>
<tr>
<td>Hagiwara &amp; Myles (1999)</td>
<td>3</td>
<td>Visual symbol on computer (multimedia)</td>
<td>Multiple baseline</td>
<td>15-24 days</td>
<td>Increased the skills level of some participants in certain settings, counted by percentage of completion day-by-day</td>
<td>Not tested</td>
</tr>
<tr>
<td>Ivey &amp; Alberto (2004)</td>
<td>3</td>
<td>Digital photographs</td>
<td>ABAB</td>
<td>11 weeks</td>
<td>Increase in participation during novel event, counted in number of targeted skills occurrences.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Kutter et al (1998)</td>
<td>1</td>
<td>Prize reinforcer</td>
<td>ABAB</td>
<td>19 days</td>
<td>Behavior improve further after the second intervention phase</td>
<td>Not tested</td>
</tr>
<tr>
<td>Kuoch &amp; Miranda (2003)</td>
<td>3</td>
<td>Cartoon pictures, Verbal reminder</td>
<td>ABA(2) ACABA(1)</td>
<td>Unknown</td>
<td>Reduction in rate of problem behaviors, counted in number of behavior per minute</td>
<td>Not tested</td>
</tr>
<tr>
<td>Litas et al (2010)</td>
<td>3</td>
<td>Video self-modeling</td>
<td>Multiple baseline</td>
<td>Unknown</td>
<td>Effective in improving target behaviors, counted in frequency in percentage per session</td>
<td>Not tested</td>
</tr>
<tr>
<td>Lorimer et al (2002)</td>
<td>1</td>
<td>Picture illustration</td>
<td>ABAB</td>
<td>24 days</td>
<td>Behavior returned to baseline when intervention withdrawn</td>
<td>Not tested</td>
</tr>
<tr>
<td>Norris &amp; Dattilo (1999)</td>
<td>1</td>
<td>Picture symbols</td>
<td>AB</td>
<td>18 days</td>
<td>Reduction in inappropriate behavior, however no effect in increasing appropriate behavior</td>
<td>Not tested</td>
</tr>
<tr>
<td>Rowe (1999)</td>
<td>1</td>
<td>Support assistant</td>
<td>Case</td>
<td>12 weeks</td>
<td>Immediate response, however it is anecdotal, as it is an extremely informal and brief case study</td>
<td>Not tested</td>
</tr>
<tr>
<td>Roger &amp; Myles (2001)</td>
<td>1</td>
<td>Comic Strip Conversation</td>
<td>Case study/AB</td>
<td>5 days</td>
<td>CSC show greater effects than SS alone</td>
<td>Not tested</td>
</tr>
<tr>
<td>Swaggert et al (1995)</td>
<td>3</td>
<td>Verbal prompting</td>
<td>AB</td>
<td>27-28 days</td>
<td>Increase in appropriate behaviors</td>
<td>Not tested</td>
</tr>
<tr>
<td>Sansosti &amp; Powell-Smith (2008)</td>
<td>3</td>
<td>Computer and video modeling</td>
<td>Multiple baseline</td>
<td>Unknown</td>
<td>Effective in improving the rates of social communication, counted by percentage of intervals of social communication.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Scattone et al (2006)</td>
<td>3</td>
<td>None</td>
<td>Multiple baseline</td>
<td>11 weeks</td>
<td>SS alone may be effective for some children with ASD, counted in percentage of intervals during 10-min session.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Scattone (2008)</td>
<td>3</td>
<td>Video modeling</td>
<td>Multiple baseline</td>
<td>15 weeks</td>
<td>Increase in 2 out of 3 targeted skills, counted in percentage of intervals per 5-min session.</td>
<td>Not tested</td>
</tr>
<tr>
<td>Schneider &amp; Goldstein (2009)</td>
<td>3</td>
<td>Pictures illustration</td>
<td>Multiple baseline</td>
<td>Unknown</td>
<td>Modest improvement in classroom on-task behaviors, counted in percentage of intervals of behaviors</td>
<td>Not tested</td>
</tr>
<tr>
<td>Thiemann &amp; Goldstein (2001)</td>
<td>5</td>
<td>Card cues, video feedback and verbal prompting</td>
<td>Multiple baseline</td>
<td>15-19 weeks</td>
<td>Increases in target social communication skills, counted in number of behaviors per 10-min session</td>
<td>Not tested</td>
</tr>
<tr>
<td>Pettigrew (1998)</td>
<td>69</td>
<td>Scaffolding activities</td>
<td>Experim not design</td>
<td>Unknown</td>
<td>Increase in social competence</td>
<td>Chi-square test</td>
</tr>
<tr>
<td>Feinberg (2001)</td>
<td>34</td>
<td>Verbal prompting</td>
<td>Pre-post test</td>
<td>Unknown</td>
<td>Significant change in certain behaviors</td>
<td>t-test</td>
</tr>
</tbody>
</table>

Table 32 Summary of previous social story studies
Chapter 5: Prototype Testing and Evaluation

The current study showed statistically significant improvements, especially in the high functioning group. The t-test results shown in Table 15, Table 18, Table 21, Table 24 and Table 27 show that the results observed in participants with high cognitive functioning group are significant with $p<0.01$. From these significance values, it is proven that the proposed intervention using the prototype is effective in assisting the participants with high cognitive functioning in improving their social skills.

For the low functioning group as shown in Table 14, Table 17, Table 20, Table 23 and Table 26, the result of the t-test were not significant, $p>0.05$. Thus, the effectiveness of SS for this group is not proven. The lack of statistical significance may be due, at least in part, to the small number of participants in this group.

In our study, a statistical test was performed, the t-test result of behavior changes obtained from the thirty participants were significant at the $p<0.01$ for overall comparisons, hence the null hypothesis presented in chapter 3 is rejected. These results were consistent with majority of the previous studies (presented in Table 32) which resulted with positive change in social behaviors after the SS intervention.

5.6.2 Effectiveness of our proposed intervention

Previous authors tested the effectiveness of SS intervention mostly by observation and descriptions (Table 32). In our study, the effectiveness of the intervention was measured quantitatively and qualitatively by observation and statistical analysis.

Participants of the study showed their interest in the prototype, as they found it interactive and they learned something from it. As illustrated in the graphs, I-Learn Social Story has been shown to be effective in changing the social behavior of the participants. The combinations of SS and 2D animation in computer-presented medium showed a clear beneficial effect in increasing appropriate behaviors of children with ASD. The results also showed a significant reduction in the inappropriate behavior as well as an increase in the number of social interactions performed by the participants.

However, irrespective of the positive achievement in the average result of all of the social stories, the number of behavioral changes varied across the participants in the present study. This might be due to the individual’s cognitive functioning, as it was shown that participants with high cognitive functioning obtained higher positive results compared with the participants with low cognitive functioning, who showed a decrease in appropriate behavior after the
intervention (Participant 24), an increment in inappropriate behavior (Participant 24), and a decrease in social interaction (Participants 11, 26 and 17).

There were also participants whose positive behavior changes were not significant. This might be due to their lack of interest in the computer and/or to their delayed cognitive skill, since the method used, environmental stimuli and schedule for reviewing each social story were same among all participants. The results showed that verbal abilities did not have much effect on the positive result. Many of the participants who were without verbal skills were able to achieve high positive results, maybe due to their interest in using the computer, and thus they could learn from the *I-Learn Social Story* during the intervention time. These students, after the first few sessions of the intervention, were able to demonstrate the skills learnt from *I-Learn Social Story* and showed slightly increased levels of verbal communication and social interaction with others.

It was also noted that some of the participants generalized the skills across to other settings, such as holding a friend’s hand not only while walking in the hallway. And interestingly, the average of positive behavior changes doubled from the baseline phase to the reversal baseline phase for most of the participants.

Thus, the analysis of the results confirmed that most of the participants showed an increase in appropriate behavior, a decrease in inappropriate behavior and an increment in the number of social interactions made. In a few of the cases, changes in their social interaction were detected soon after the intervention and remained relatively consistent.

5.6.3 Social skills acquisition/behavioral changes

Behavioral change has been described qualitatively by most previous authors (Table 32). Thiemann & Goldstein (2001) measured the behavioral changes by the number of occurrence per session for each child. Sansosti & Powell-Smith (2008) measured the behavioral changes by percentage of social communication intervals for each child. Our current study had both qualitative and quantitative measures by measuring the behaviors change of an individual child and also in groups (low functioning, high functioning and combination of both), as described in the earlier sections.

There were different paces of development in the social skills acquisition across the participants. Some participants showed fast skill acquisition and others were slower. Most of the participants took around 3 to 4 sessions for the acquisition of skills, while some were rapid.
Participant 15 could apply the social skills learned immediately after he had finished with the first session of the intervention phase. After the intervention prior to the walking in the hallway activity, Participant 15 held one of his friend’s hands and walked together quietly, which he had not done before. He also showed some generalization of the skills across other settings.

From the pilot testing, it was also found that participants could generalize the skills across other settings, proving that this method was engaging for children with ASD. In one of the participants for the pilot testing, after the intervention, while he was playing with some pair-up puzzle, every time he paired one, he would speak out “next” and would move to the next puzzle. This would go on until he had finished with the last pair and he would say “well done” and clapped his hands, as in the prototype. The researcher and teacher were much amazed by this.

The social skills acquisition learned from I-Learn Social Story is rather fast compared to the other methods of SS learning from other studies, which in average would take 12 days to 12 weeks for individual participants, such as reported in Hanley-Hochdorfer et al. (2010), Rowe (1999), Lorimer et al. (2002) and Scattone et al. (2002).

5.6.4 Treatment integrity

Based on National Dissemination Center for Children with Disabilities (http://nichcy.org/research/basics/researchterms), treatment integrity is also known as fidelity of implementation is “the extent to which the administration of an intervention complies with that intended original design”. In this study, the data for the treatment integrity for each participant was collected everyday by the author, and the classroom teacher/class helper using the checklist that detailed the steps of the experimental study (Appendix E). The number of steps completed correctly was divided by the total number of steps, and then multiplied by 100. A score of 100% meant that the treatment integrity had been achieved. If the score was less than 100%, the author would thus correct any deficiencies before the next session. The 100% treatment integrity was achieved on an average of the 3rd day of intervention for all of the participants.

5.6.5 Social validity and acceptability

Social validity is a measure of whether objectives, procedures and outcomes of an intervention are meaningful and appropriate for a child and his caretaker (Lloyd & Heubusch 1996; Wolfe
Chapter 5: Prototype Testing and Evaluation

1994). As suggested by Fawcett (1991) and Wolf (1978), it is important to consider social validity in designing and evaluating any intervention program. Social validity is important for an intervention program to be adopted widely. Sansosti & Powell-Smith (2008) stated that variables such as teacher’s time and motivation produce an important effect on the success or failure of an intervention while working in the school setting, thus, teacher’s satisfaction is one way to investigate the social validity of an intervention program.

Following the end of the study on each class, teachers and class helpers were asked for their comments on and perception of the intervention of I-Learn Social Story. Social validity (Appendix F) questionnaire was used to assess the teacher’s and class helper’s satisfaction on the intervention through I-Learn Social Story. From the results and comments, generally it was found that they were happy and satisfied with the intervention as they found the intervention is useful for the students, and in fact, there was not a single teacher or class helper who gave feedback below the adequate satisfaction of the intervention. They even commented that there were noticeable behavioral changes of the participants after the intervention and would likely to use the intervention again, which had provided further evidence of the social validity of the intervention.

When the author introduced SS to the teachers, most of them were aware of the effectiveness of this type of intervention, but did not use it in the school, as the traditional SS was too time consuming to be implemented in a large classroom setting. However, I-Learn Social Story which was presented in computer-based format demonstrated time effectiveness in learning social skills from SS, thus it could be said to be highly accepted by the teachers as they could easily play it in the classroom computer during the students’ free time, making I-Learn Social Story as an effective intervention that is readily accepted. The information gathered from the informal interviews with the teachers and class helpers agree that they are satisfied with the noticeable behavioral changes in most of the students after the intervention of I-Learn Social Story. The teachers at Perkata Special School were ready to adopt I-Learn Social Story as the easy-to-use classroom teaching materials, however, some consideration had to be made concerning the time and skills required to implement 2D animation and the construction of SS based on Gray’s guidelines, the solution of which will be discussed in Section 6.3.

5.6.6 Inter observational agreement

For the inter-observational agreement, either the classroom teacher or classroom helper was asked by the author to be a second observer to validate the target behaviors performed by
Chapter 5: Prototype Testing and Evaluation

participants. Prior to the data collection, the target behavior of each story was explained to them.

The researcher, as the first observer, was responsible for the main data collection, using traditional tally method count, by marking with an “I” on the appropriate column in the Data Collection Sheet (Appendix C) for each of the target behavior performed by the participants. Once data collection was completed for one session, the first observer would then ask the second observer if he/she agreed to the data collected by the first observer.

The score for the inter-observational agreement was calculated on a session-by-session basis on target behavior occurrences in each session, with the first and the second observer agreeing on the target behaviors occurred. The calculation was done by adding the number of agreements, dividing it by the total number of agreements and disagreements, and multiplying it by 100, as suggested by Kazdin (1982).

A minimum percentage of 80% is needed to support the inter-observational agreement. If the agreement was less than 80%, which was not the case in this study, the definition of Appropriate, Inappropriate and No Interaction behaviors would have been reviewed by the first observer with the second observer, and the inter-observer calibration procedure would have continued until the 80% mark has been reached.

5.7 Summary

This chapter discussed the testing and evaluation of I-Learn Social Story in detail. It covered the research design and procedures used in the testing, the analysis and result, as well as the discussion of the findings.

As hypothesized earlier, the overall significant result generated from all the participants of the study indicated that the combination of SS with 2D animation and computer-presentation was associated with improvements in the appropriate behaviors, a decrease in the inappropriate social behavior, and an increase in the number of social interactions. In addition, most of the participants were able to behave more appropriately in the school setting, and they were able to manage these appropriate behaviors even after they were no longer using I-Learn Social Story. This indicated that I-Learn Social Story was connected with the behavioral changes in the participants after the intervention, thus, it can be used in facilitating social skills learning in children with ASD.
From the experimental design that was conducted, it was noted that the participants’ response to the prototype was positive; they showed their enthusiasm and were looking forward to the testing session where they could use the prototype to learn social skills.

The research questions presented in section 3.2 have been answered in the discussions throughout this chapter. The hypothesis presented in section 3.4 has also been tested statistically by analyzing the significance of the results. In summary, the findings from this current experimental study are consistent with previous studies that demonstrated the positive effect of using SS (Adams et al. 2004; Bledsoe et al. 2003; Crozier & Tincani 2005; Crozier & Tincani 2007; Delano & Snell 2006; Demiri 2004; Kuoch & Mirenda 2003; Ozdemir 2008; Sansosti & Powell-Smith 2006, Sansosti & Powell-Smith 2008; Scattone et al. 2002; Scattone et al. 2006, Schneider & Goldstein 2009) and 2D animation in teaching and learning for children (Bosselar & Massaro 2003; Baron-Cohen et al. 2009; Rosset et al. 2008; van der Geest et al. 2002; Grelotti et al. 2005; Mayer & Moreno 2002; Mayer 2003). It is proven that this study is timely, relevant and needed.
Chapter 6: Conclusion

The growing number of cases of ASD demands the creation of dynamic learning tools for social skill learning. On the basis of this, the research presented in this thesis has six aims which have been achieved, as presented in this thesis. The following sections present the main contributions and limitations of the current study.

6.1 Main contributions

This thesis reflects the work in the design, development and evaluation of SS intervention through the computer assisted learning application, I-Learn Social Story. It presents the 2D animated social stories with computers for the purpose of assisting children with ASD to learn social skills.

It is arguable that the study presented in this thesis is important to the research on ASD and can be used to support a larger population and program involving researchers from multiple fields, such as in computing or special education. This could be the foundation step to establish a larger study.

Furthermore, the prototype developed and the experimental study conducted are believed to be beneficial to the field of the study and as a whole, as we developed a treatment method that can be used effectively in helping children with ASD learn social skills. The specific contribution of this master’s research includes:

- A preliminary study

It has been often suggested that a preliminary study is a crucial element of a good study design, thus, in the current study, a preliminary study had been conducted on three children with ASD. The main purpose of the preliminary study was not to collect data, but rather to refine the prototype features and the testing procedures. This study was used to get a complete description of the proposed solution by checking on its feasibility thus the final decision on usability, feature, functionality, performance, cost and procedure could be made.

In the current study, this testing served as an initial exploration and a review of issues related to the quality of the proposed prototype, identifying the key features to be addressed. A preliminary study is potentially valuable; anything missing in the pilot test can be added to a later prototype to improve the chances of clear outcomes.
Chapter 6: Conclusion

Pilot testing can greatly reduce a number of unanticipated problems as it gives an opportunity to redesign parts of the prototype that are not effective, thus it rectifies the problems that have been revealed in the pilot study. It improves the quality and efficiency of the revised prototype. It can reveal deficiencies in the design or procedures, thus giving chances for early correction.

The result of this study was necessary to ensure and to verify that the final model will cater adequately to the needs of the targeted users. The final model was built based upon the result gained from this study.

- **The development of social stories**

As a major part of the prototype, social stories in the final prototype had been developed or were selected carefully. There were five social stories entitled *How to greet someone at school, Play and sing with friends, Snack time, Walking in the hallway* and *Washing hands*, which had been incorporated into the prototype, as discussed in Chapter 4.

*How to greet someone at school* was taken from a website; it was selected without modification as it had fulfilled the requirements set by Carol Gray, and the story was more suitable to be used for the setting in the current study. *Snack time* social story was taken from one of the published papers by Crozier & Tincani (2007); this story as well followed Gray’s guidelines in writing SS and had been tested on participants with ASD. The rest of the three social stories were developed with consideration of the skills that generally needed to be obtained by the participants, as reported in Chapter 4. It was also ensured that these stories followed the guidelines set by Carol Gray, the author of SS.

- **The development of I-Learn Social Story**

One of the research objectives was to develop a computer assisted learning application to be used for children with ASD. In regard to this, the prototype, titled *I-Learn Social Story* had been constructed using the up-to-date ICT technology (Adobe Flash) that is powerful in creating animation and portable contents (discussed in Chapter 4).

The development of the prototype was important as an instrument or tool that realized the proposed idea of helping children with ASD learn social skills in a way that they were attracted to. The prototype was developed based on the findings generated from the observation, literature review, consultation with teachers, as well as data gathered from the preliminary study.
The evaluation of **I-Learn Social Story**

Testing and evaluation on the developed prototype are crucial for the verification and quality checking of its effectiveness, and are important for drawing the appropriate conclusions. The testing and evaluation on the current research had been done by involving thirty children with ASD in a special school setting. This number had fulfilled the minimum requirements of participants to ensure that the results of the experimental study are generalized across individuals with ASD.

Testing and evaluation is useful in determining if the developed prototype has been designed properly. Thus, it was found from the testing results from **I-Learn Social Story** that it is an effective tool that can be used to engage children with ASD in their social skill learning.

This testing and evaluation had also verified that the prototype is suitable, appropriate and effective to children with ASD, as well as to analyze the limitations of the prototype, as presented in the following section.

### 6.2 Limitations and directions for future works

In the light of the findings from the experimental study, the results which showed positive changes in the participants’ social behavior after **I-Learn Social Story** intervention proved that this approach is an effective intervention technique. However, more empirical research should be conducted to produce more rigorous results. The following are six points of the current study’s limitation and suggested direction for future research endeavors:

- **Experimental control**

  The author is aware that the current study was lacking in accurate experimental control. During the testing of the prototype, although separated at quite a distance, the participants were in the same classroom with their classmates, thus they were often distracted during the intervention. For future work it is advisable for future researchers to conduct an experimental study in a controlled environment during the testing process, to avoid distraction.

- **Examine the critical target behavior for each individual**

  In the current study, social stories were presented based on the generic nature that met the targeted behavior of every one of the thirty participants. This is an effective way to reduce the development time of social stories for common social skills. As for exclusive social skill required
by a child, it is more advisable to develop an individualized SS related to his/her personal environment and interest.

- **Additional language option**

In order to fully comprehend the teaching material, language is an important factor, thus the same goes for the *I-Learn Social Story* intervention. The participants of the current study were learning in an environment that was using a language different from the one spoken at home. Thus, future work could feature different language options for social stories to cater to the needs of participants in a multi-lingual society, such as Mandarin, other Chinese dialects and Sarawak Malay, and as stated by Murphy (2011) the academic benefits of a mother tongue program are well documented.

- **Creation of tools which provides ready-made template**

As suggested by Sansosti et al. (2004), the implementation of social stories on a continuous basis is necessary to achieve the desired results. Teachers have suggested making 2D animated social stories to be widely used in the school setting and to provide them with tools/2D animation framework for social stories, to enable them to create 2D animated social stories independently.

However, it is relatively difficult, time consuming and costly to create 2D animate social stories as it requires expertise in technology, specifically from the multimedia stream. This resource limitation affects the possibility of a continuous production of subsequent social stories, especially when it is specifically tailored to specific needs of the children. To make this deployment possible, further studies could emphasize the possibility of creating a tool or application which provides ready-made templates for creating 2D animation for social stories, such as Tab Kids, a software for children to create simple animation, available at [http://www.tabkids.com/htm/product.htm](http://www.tabkids.com/htm/product.htm)

- **Support and training for the expert users**

In order to ensure the software is used consistently, teachers, parents or caregivers as the expert users would need to master the use of the software. Thus, one of the future works could be investigating ways to train the expert users to work with the software more effectively. Professional development such as training to write SS based on Gray’s guidelines could also be done. This support and training would eventually help to sustain the use of the software with the children.
6.3 Final conclusion

In view of the rising cases of ASD, remedial aid has to be developed to provide adequate support for children diagnosed with ASD to learn social skills in order to provide them with the opportunity to lead a normal social life within an inclusive environmental setting.

SS is an old, yet effective intervention in teaching social skills to children with ASD by describing specific social situations in words in order to help them resolve related cognitive confusion. To increase the effectiveness of SS, this study introduced computer-presented SS in the form of 2D animation; social stories enacted in computerized 2D animation are more appealing and engaging especially for children as they are visual learners and this could in turn accelerate their learning process and stimulate their curiosity in exploring exciting ideas.

In the study, this novel approach of intervention was developed and tested on the targeted users. As expected, the results of the intervention produced positive outcomes, and teachers were ready to accept I-Learn Social Story as part of their teaching materials, especially when dealing with students with ASD. However, there are still some problems for the prototype to be acquainted in the classroom, such as the issues with implementation.

The results of the study suggest that the intervention developed through I-Learn Social Story offer a positive and relatively unobtrusive type of intervention for children with ASD. Certainly, it offers several advantages over the traditional method used for children with ASD in social skill learning. I-Learn Social Story is technologically friendly and has the benefit of producing results relatively quickly; the results are seemingly effective and generalizable across settings. The social skill literacy level increases naturally when the participants successfully apply the skills they have learnt into their daily activities. This positive generalization and quick acquisition of social skills may be due to the result of stimulus control of animation and the use of the computer, and as said earlier that learning is best when motivated. If they are motivated to learn, they would pay attention and acquire the knowledge presented in the content, thus, they would be able to present the skills learned in a real life situation when the behavior or skill is called for.

In conclusion, this study has contributed to the emerging research on SS by supporting the clinical recommendations of using SS in combination with other methods, in teaching social skills to children with ASD (Attwood 2000; Rogers 2000; Gray 1998). This study has also made a contribution to literature by the establishment of a novel intervention which combines SS with 2D animation and the computer to help children with ASD learn social skills.
It is believed that the issues discussed in this thesis, and the development of *I-Learn Social Story*, have contributed to the overall goal of the development and evaluation of computer assisted learning tools for children with ASD, and it is believed that this work enriches the understanding and knowledge of the field.
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Glossary of terms

2D animation: one type of visual cue, it is a rapid display of a sequence of images in order to create an illusion of movement.

Autism Spectrum Disorders: a range of developmental disorders that are characterized by problems in areas of social development, communication and stereotypic behaviors.

Baseline phase: a phase of collecting information of a subject’s behavior before the treatment/intervention.

Experimental design: research design to investigate cause-and-effect relationships between interventions and outcomes.

Intervention phase: a phase where the subject is exposed to treatment/intervention


Reversal baseline phase: a phase of collecting information on a subject’s behavior after the treatment/intervention.

Single-subject design: a research design where the subject serves as his/her own control, rather than using that of another individual/group.

Social behavior: behavior directed towards society.

Social skills: set of skills that is used to facilitate interaction and communication with one another.

Social Story™: short stories written for children with ASD with the purpose of helping them to understand social situations and to behave appropriately in such situations.

Visual cues: illustrations using visual objects such as images, graphics, or colors.
Appendix A: Ethical Clearance Approval

From: Ann Gaeth <AGAETH@groupwise.swin.edu.au>
Sent: Tuesday, 17 May, 2011 2:17 PM
To: BeeTheng Lau; Vivi Mandasari
Cc: Resethics; Clement Kuek
Subject: SUHREC Project 2011/032 Ethics clearance

To: Dr Lau Bee Theng, Sarawak; Ms Vivi Mandasari
CC: Assoc Prof Clement Kuek

Dear Dr Theng and Ms Mandasari,

SUHREC Project 2011/032 The use of information communication and technology (ICT) to assist the communication and learning needs of children with autism and cerebral palsy
Dr Lau Bee Thong Sarawak Ms Vivi Mandasari
Approved duration from 17/05/2011 To 17/02/2012 [Adjusted]

Ethical review of the above project protocol was undertaken by the Swinburne’s Human Research Ethics Committee (SUHREC) at a meeting held 11 March 2011. Your response to the review as received on 13 and 16 May 2011 were put to a nominated SUHREC delegate for review.

I am pleased to advise that the Subcommittee delegates have determined that the project, as submitted to date, meets Swinburne’s standards for human research including with respect to the National Statement on Ethical Conduct in Human Research. On-going ethics clearance conditions relate to the following:

- All human research activity undertaken under Swinburne auspices must conform to Swinburne and external regulatory standards, including the current National Statement on Ethical Conduct of Human Research and with respect to secure data use, retention and disposal.

- The named Swinburne Chief Investigator/Supervisor remains responsible for any personnel appointed to or associated with the Swinburne student project being made aware of ethics clearance conditions, including research and consent procedures or instruments approved. Any change in chief investigator/supervisor requires timely notification and appropriate endorsement.

- The above project has been approved as submitted for ethical review by or on behalf of SUHREC. Amendments to approved procedures or instruments ordinarily require prior ethical appraisal/clearance. SUHREC must be notified immediately or as soon as possible thereafter of (a) any serious or unexpected adverse effects on participants and any redress measures; (b) proposed changes in protocols; and (c) unforeseen events which might affect continued ethical acceptability of the project.

- At a minimum, an annual report on the progress of the project is required as well as at the conclusion (or abandonment) of the project.

- A duly authorised external or internal audit of the project may be undertaken at any time.

Please contact me if you have any queries about the Swinburne ethical review determination, citing the SUHREC project number. Copies of communication emails should be retained as part of project record-keeping.

Best wishes for the project.

Yours sincerely

Ann Gaeth
Appendix B: Informed Consent

**Informed Consent**

*Consent to take part in a research (for parents of a child with Autism Spectrum Disorders)*

**Introduction**

This research study is being conducted by Dr. Lau Bee Theng and Ms. Vivi Mandasari from School of Engineering, Computing and Science, Swinburne University of Technology Sarawak Campus. This project also contributes to the completion of the postgraduate study.

This research aims to study the effectiveness of Information Communication and Technology (ICT) application, particularly our ICT software called 2D Animated Social Story, to assist children in their learning of social skills. 2D Animated Social Story is software that contains social stories in 2D animation form.

Your child is selected because he/she is currently studying at the PERKATA Special School.

**Procedures**

We will ask your child to watch the 2D animated social story presented on a laptop. This will take about 15 minutes of your child’s time daily for 10 school days. All testing will take place in the school’s classroom during their free time.

On the other hand, for continuous verification, we will be observer in the classroom, take notes of how they utilize the social skills learnt from the software in their interactions with teachers and classmates for the duration of 8 weeks.

No video, image or audio recording will be done throughout the observation and testing sessions.

**Risks/Discomforts**

Your child will only be involved during his/her recess or free time during normal school hours. We will work closely with all teachers to ensure that this research activity do not conflict with the normal educational activities.

**Benefits**

It is hoped that the research will help educators to find a new channel to improve social skills learning of children with ASD.
Confidentiality

Your child’s participation will be confidential. No child’s names/pictures will be associated to the research materials and your child’s name/picture will never be used in connection with any presentation/publication of this research.

Participation

Participation is voluntary. If you give permission to include your child in the study, he/she will also be asked if he/she would like to participate. Even if you give consent, your child may withdraw at any time without penalty. Also, you may withdraw him/her at any time.

As a result of your participation, we will discuss with you on your child’s response towards the learning to explain whether and how our software improved the social skills learning.

Question about the research

If you have any questions concerning the study, please do not hesitate to contact the principal researcher, Dr. Lau Bee Theng at (+6) 019-8861016 or 082-260686, email: blau@swinburne.edu.my or Ms. Vivi Mandasari at (+6) 014-6945235, email: vmandasari@swinburne.edu.my You may also extend your queries or concerns to the Manager, Research and Consultancy, Assoc. Prof. Clement Kuek, at 082-416353, email: ckuek@swinburne.edu.my.

I have read, understand, and receive a copy of the above consent and of my own free will allow my child to participate in the study

Signature: ________________
Parent Name: ________________
IC Number: ________________
Child Name: ________________
Date: ________________
# Appendix C: Data Collection Sheet

**I Learn Social Story Data collection sheet**

Phase: (Baseline/Intervention/Reversal)

Participant ID: ______________________

Date: ______________________

<table>
<thead>
<tr>
<th>Session</th>
<th>How to greet someone at school</th>
<th>Play and sing with friends</th>
<th>Snack time</th>
<th>Walking in the hallway</th>
<th>Washing hands</th>
<th>Note/Comment</th>
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</table>

**Legend**

- A = Appropriate
- I = Inappropriate
- NI = No Interaction

**How to use this data collection sheet:**
For every behaviour occurred for appropriate (A), inappropriate (I) or no interaction (NI), Mark with | in the appropriate column.
Appendix D: Student Assent Form

Student Assent Form to take part in a Research
(For student with Autism Spectrum Disorders)

Introduction (what we are doing)
My name is Vivi. I am taking my Master’s study at Swinburne University of Technology Sarawak Campus. I want to tell you about the study that we are doing. We would like to know more about the effect of learning social skills with computer; therefore I would like to ask for your help by watching the animation that I have in my laptop.

Procedures (what will happen)
If you agree to join this study, I will ask you to watch 5 social stories that have been incorporated into 2D animation form. You will need to watch the animation for 10 days. You need to spend time together with me around 15 minutes in every session of this testing.

Risks (possible problems)
You might miss some class time, But, I will work closely with your teacher to make sure that you will not miss that important lesson or fun activities in the class.

Benefits (good things that will happen)
You will be able to watch animation from computer every time you work with me.

Confidentiality (who will know about this work)
Names or pictures of yours, your parents or your teacher will not be used in any presentation or publications of the research. No one will know that you are working with us. I will give you an initial name.

Participation (working with us)
You do not have to join this study if you do not wish to. Even if you have participated, you are allowed to change your time anytime you wish. Any information about you will be deleted and will not be kept for any other purposes. No one will mad at you if you change your mind.

Questions about the research
If you have any questions concerning this study, please feel free to ask me. You can also ask your parents or teacher before you agree to begin this study.

I want to join in this study.

Signature: ______________________
Name: _________________________
Date: ________________________

Swinburne University of Technology Sarawak Campus
## Appendix E: Treatment Integrity

**Treatment Integrity**

Participant ID: _______________

Date: _______________

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>The session of intervention takes place in a quiet corner of the classroom, where the teacher and class helper can still look over the participants’ behaviour.</td>
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<tr>
<td>The session takes place in the participant’s free time but before an activity related to the target behaviour starts</td>
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<tr>
<td>The observer reaches the classroom at the same time each day</td>
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<td>The observer and the participant are seated side by side at a table, at a comfortable conversation zone</td>
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<td>The I-Learn Social Story is presented to the participant using a notebook</td>
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<td>The participants are encouraged to participate in a social situation immediately after the intervention</td>
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<td>The observer immediately observes the participant’s social interaction after the intervention</td>
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Treatment integrity maintained? Yes No

Corrections to be made:

________________________________________________________________________
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Appendix F: Social Validity

Social validity questionnaire

Please read each item carefully and circle the number that best describe your response. Use the following scale to determine how each statement reflects your opinion.

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<tr>
<td>Not at all</td>
<td>Just a little</td>
<td>Somewhat</td>
<td>Quite a bit</td>
<td>Exactly</td>
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</tbody>
</table>

1. I believe I Learn Social Story is useful for my students
   1 2 3 4 5

2. This intervention would be appropriate to be used with a variety of situations
   1 2 3 4 5

3. This intervention would produce a lasting improvement in my student’s functioning
   1 2 3 4 5

4. I am likely to use this intervention again
   1 2 3 4 5

5. I would suggest this intervention to others
   1 2 3 4 5

Please write any comments that you have about I Learn Social Story intervention

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Thank you for your time and participation in this study.
## Appendix G: Research timeline

<table>
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<th>Parameters</th>
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### GENERAL

1. Research proposal
   - a. Literature Review
   - b. Visit to school (Initial visit)
   - c. Problem identified and proposed solution

2. Information and explanation gathered from the School Principal, teachers, and class assistants

3. Informed consent sent to parents by the School Principal

### PRELIMINARY STUDY

1. Develop the sample prototype

2. Intervention using the developed sample prototype to 3 students

3. Analyze the student’s response and important notes gathered (such as procedure, etc.) from the intervention

4. Identify the general target behaviors for 30 participants (observation and information from teachers)

### FINAL prototype implementation

1. Develop social story based on the general target behavior identified from the 30 participants

2. Develop the final prototype, which is the refined model based on the preliminary study results

### TESTING & EVALUATION

1. Class 1 testing
   - a. Collect baseline data
   - b. Intervention
<table>
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<th>Appendixes</th>
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<tr>
<td>1. Class 2 testing</td>
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<td>b. Intervention</td>
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<td>c. Fading/Maintenance</td>
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<td>d. Follow up (2 visits)</td>
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<td>c. Fading/Maintenance</td>
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<td>d. Follow up (3 visits)</td>
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<td>c. Fading/Maintenance</td>
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<td>6. RESULT ANALYSIS</td>
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<td>1. Analyse individual result for behavioral changes</td>
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<td>2. Analyse the overall results</td>
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<td>3. Graph the results for visual analysis</td>
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