GESTURE-BASED VIDEO GAMING TO PROMOTE SOCIAL SKILLS FOR
YOUNG CHILDREN WITH DEVELOPMENTAL DELAYS

by

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Dedication

This is dedicated to my loving husband Tien, who supported me and accompanied my journey together.

Acknowledgements

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Abstract

GESTURE-BASED VIDEO GAMING TO PROMOTE SOCIAL SKILLS FOR
YOUNG CHILDREN WITH DEVELOPMENTAL DELAYS

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Young children with developmental delays demonstrate lack of developmental skills,

such as cognitive, social, and languages, which impede their opportunities to develop

social and emotional competence. Social skills interventions for young children with

developmental delays are critical to develop age-appropriate skills and behaviors, thereby

developing social and emotional competence. This single subject research study was

designed to examine the functional relation of gesture-based video gaming using Xbox

Kinect 360 to promote social skills for young children with developmental delays in

preschool settings. A multiple baseline design across participants was employed to

investigate the use of gesture-based video gaming as an intervention tool for preschool

children with developmental delays. Six student participants received the XbK

intervention to improve three target skills, including accurate gesture imitation, visual

attention during play, and turn taking. Three professionals provided their perspectives

and opinions through the social validity interviews related to the use of gesture-based video gaming for social skills intervention. Overall, the results of the study indicated that student participants showed increases of three target social skills and the improvements were immediate when the XbK intervention was introduced. All participants also maintained these target skills two weeks after the intervention. Furthermore, social validity interviews with professional participants suggested that the use of gesture based video gaming is feasible to implement in the classroom setting and socially significant. This study provided preliminary findings that gesture-based video gaming activities may be incorporated into social skills interventions to develop various behavioral skills for young children with disabilities in educational and clinical settings.

Chapter One

The Individuals with Disabilities Education Act (IDEA, 2004) and the No Child

Left Behind Act (NCLB, 2001) emphasize equal access for students with disabilities in

the general educational settings. Particularly, the Preschool Section of the IDEA 2004

(Part B, Section 619) grants a wide range of appropriate preschool special education and

related services to children with disabilities aged three to five. For preschoolers with

disabilities, integrating into the general settings may involve access to appropriate

community and educational activities (Carlson, Bitterman, & Daley, 2010). As young

children with disabilities have a tendency to show developmental delays in the

developmental milestones, they are required to receive special education or related

services in order to access those educational activities. This involves research-based

intervention to ensure appropriate special education and related services are required for

children with disabilities to support their growth and development.

The current study examined the functional relation of the use of gesture-based

video gaming to teach social skills for young children with developmental delays. The

study aimed at expanding on limited support from the existing body of literature in the

area of gesture-based video gaming in the preschool setting to enhance social skills for

young children with developmental delays.

Background of Problem

Typically, young children develop fundamental social skills in the early years, enabling them to grow as socially competent individuals (Howes & Phillipsen, 1998). Especially, young children naturally learn developmental skills, such as cognitive, social, and communication, by engaging in play with play materials and with peers (Thomas & Smith, 2004). For example, when young children play with toys, they watch and imitate others, and interact verbally and/or nonverbally with peers (Quill, 2000). However, young children with developmental delays demonstrate lack of these skills or challenged behaviors, which impede their opportunities to participate in social interactions with their peers (Harjusola-Webb, Hubbell, & Bedesem, 2012).

According to the IDEA (2004), a child with developmental delay is defined as "child with a disability for children ages three through nine (or any subset of that age range, including ages three through five), who are subject to the conditions described in Sec, 300.111(b), include a child (1) who is experiencing developmental delays, as defined by the State and as measured by appropriate diagnostic instruments and procedures, in one or more of the following areas: physical development, cognitive development, communication development, social or emotional development or adaptive developmental; and (2) who, by reason thereof, needs special education and related services". Pre-Elementary Education Longitudinal Study (PEELS, 2010) reported the characteristics of 3,104 children with disabilities between the ages of three and five in 2003 to 2004. The results indicated that the primary disabilities were speech or language impairment (47%) and developmental delay (28%). The PEELS surveyed preschool

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children with disabilities who received special education services. The results showed that children with developmental delays demonstrated a significant increase in early literacy and numeracy, language, and social skills scores at kindergarten and elementary levels. This indicated that early detection and preventative intervention are critical for young children with disabilities to enhance their growth and development (Huffman, Mehlinger, & Kerivan, 2000; Jeon et al., 2011).

Young children with developmental delays exhibit ongoing significant or mild delay in the development of gross or fine motor, language, and social skills (Petersen, Kube, & Palmer, 1998). These developmental delays can significantly impact their lower social and emotional competence compared to typically developing children when they grow up (Bowman, Donovan, & Burns, 2001). For instance, children with social and emotional competence difficulties may demonstrate lack of appropriate social interactions with others and encounter peer rejection or social isolations from others (Campbell, 2002). These could also lead to the potential challenge in their academic competencies during their school years (Flook, Repetti, & Ullman, 2005). Fantuzzo et al. (2007) provided evidence of the relationship between social and cognitive competencies and low school readiness for pre-school children with disabilities. Regulated behaviors, including positive attitude toward learning, attention, and persistence, are highly associated with the prediction of high academic outcomes. However, academically disengaged behaviors, such as aggressive, inattentive, and hyperactive manners, contribute to low classroom learning competence, such as low cognitive skills, and challenges for social engagement and coordinated movement. Particularly, social skills

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are foundation for developing social and emotional competence and the success of individuals' quality lives, including positive social interactions in their homes, schools, and community (Huffman et al., 2000). This indicates that there is a need for social skills interventions for young children with developmental delays to develop age-appropriate skills and behaviors (Flook et al.; Guglielmo & Tryon, 2001; Jordan, 2003).

Therefore, research has been focused on increasing social skills of students with disabilities across different ages and developmental stages (Parker & Asher, 1987). Particularly, Vaughn et al. (2003) argued that social skills interventions should vary based on the students' age levels. Depending on the developmental stages, the required social skills may be different. This means that effective school-aged social skills interventions may not be equally applicable for preschool children with disabilities (Guralnick & Neville, 1997). For example, social skills interventions for school-aged children with disabilities were mainly focused on enhancing peer relations through initiating and maintaining communications and engaging in group activities with same-aged peers. Meanwhile, for preschool children with disabilities, the aims for social skills interventions were to develop play skills and peer interactions.

In this regard, the use of play can help with social skills interventions for children with disabilities in preschool (Jung & Sainato, 2013; Lang et al., 2009). Engaging the appropriate play through systematic interventions provides opportunities for children with disabilities to increase social interactions, language development, and cognitive skills (Jung & Sainato). Furthermore, while play helps children acquire social skills, inappropriate and negative behaviors as a collateral effect may be decreased. Playing

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various games can engage children with disabilities to develop social skills (Jung &
Sainato). Lang et al. (2009) asserted that directly teaching play skills using games enable
children with disabilities to develop appropriate social skills in naturalistic settings,
which fundamentally help them to increase social interactions and engagement in general
settings.

   With advances in technology, technology-based intervention has been actively
utilized to teach social and play skills for individuals with disabilities (Bioulac et al.,
2014; Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; Cardon, & Wilcox, 2011; Ferguson,
Gillis, & Sevlever, 2013; Ke & Im, 2013; Wainer & Ingersoll, 2011; Wuang, Chiang, Su,
& Wang, 2011). Recent advances in technology, such as mobile technology, virtual
reality, and robotics, have supported educating individuals with disabilities (Goodwin,
2008). Several meta-analysis studies provided evidences that effective technology-based
interventions have improved social skills for students with disabilities (Bellini &
Akullian, 2007; Grynszpan, Weiss, Perez-Diaz, & Gal, 2014; Wehmeyer, Palmer, Smith,
Davies, & Stock, 2008). Particularly, Goodwin (2008) identified several advantages of
the use of technology to educate students with autism; (a) promote individualized
interventions to develop the necessary skills as individual with autism tend to show
interest and are motivated by computerized technology, (b) enhance student learning by
engaging through practice, and (c) reduce the cost of treatment by less reliance on costly
professional consultation. However, related to social skills, the predominant technology
was limited to the use of video technologies for video modeling (Bellini & Akullian).

Recently, digital gaming using advanced technology has provided not only entertainment for users, but also aid in learning (Johnson, Levine, Smith, & Stone, 2011; Kandroudi & Bratitsis, 2012; Prensky, 2007). Research argued that digital gaming in education is socially valid because it brings motivation and engagement for individuals (Johnson et al.; Kandroudi & Bratitsis; Prensky; Ferguson et al., 2013). Especially, gesture-based technology, such as Xbox Kinect, can help engage children with disabilities and improve specific social and academic skills (Bioulac et al., 2014; Blum-Dimaya et al., 2010; Ferguson et al.; Kandroudi & Bratitsis; Sheu & Chen, 2014). For example, Ferguson, Gillis, and Sevlever (2013) examined social skills with video game play (Wii Sports) for children with autism. The participants in the study demonstrated improved performances in giving compliments, taking turns, and positive comments after the play sessions. Although previous research suggested that video games could be used to train children with disabilities (Ferguson et al.), there is limited empirical evidence of the effectiveness of gesture-based gaming interventions for children with disabilities. Hence, more empirical studies are needed to support to the benefits of gesture-based gaming as a teaching and learning tool for students with disabilities.

In this regard, the current study used the XbK system for social skills intervention for young children with developmental delays. Figure 1 illustrates the logic model for this study. Proximal outcomes aimed to improve three target skills, including accurate gesture imitation, visual attention during play, and turn taking. The distal outcomes promote social skills, enabling the target students to increase engagement and interaction with peers in general settings and develop social and emotional competence.
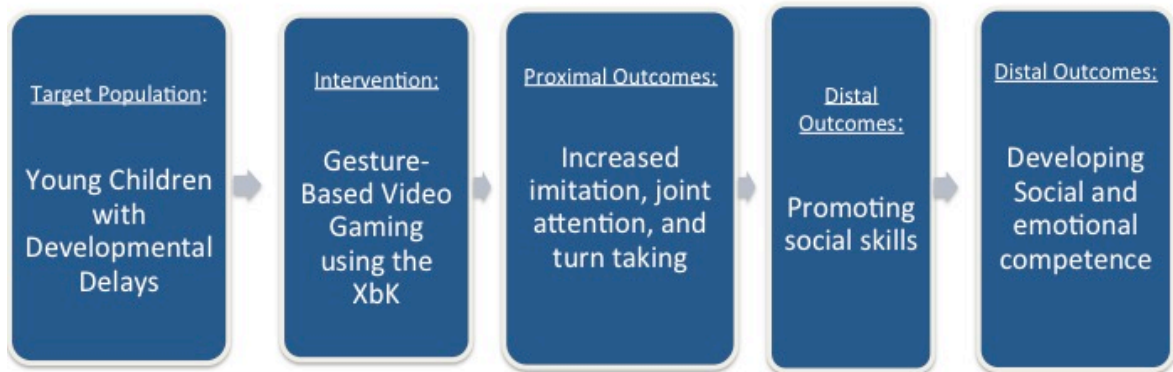
Figure 1. Logic model. The logic model describes the target population (young children with developmental delays), intervention (gesture-based video gaming using the XbK), proximal outcomes (increased accurate gesture imitation, visual attention during play, and turn taking), and distal outcomes (promoting social skills, which contribute to develop social and emotional competence) that illustrate the design of this study.

Significance of the Study

Young children with developmental delays are at higher risk of development difficulties in social, language, and cognitive growth (Emerson & Brigham, 2014; Lee & Burkam, 2002). In order to prevent negative consequences (i.e., isolation, bullying, and academic failure), appropriate early intervention is critical for them to develop social competence in preschool, thereby enhancing their school readiness. Research argued that young children with disabilities (i.e., ASD) do not obtain appropriate social skills naturally (Constantino et al., 2003; Emerson & Brigham). This means that they need to learn the appropriate behaviors. Particularly, when children with disabilities practice

social skills over time through specific training and activities, they can increase

interactions and enhance the learned skills (Jung & Sainato, 2013; Lang et al., 2009).

Various intervention strategies have examined the effects of increasing social

skills for students with disabilities, such as social stories (e.g., Delano & Snell, 2006),

video modeling (e.g., Paterson & Arco, 2007), and peer-mediated strategies (e.g.,

Laushey & Heflin, 2000). However, several meta-analysis provided a wide range of

results among these intervention types (Bellini, Peters, Benner, & Hopf, 2007; Forness,

2001; Wang & Spillane, 2009). For example, Wang and Spillane (2009) found that video

modeling based social skills interventions were effective with mean PND scores of

84.25%. However, the results of social stories and peer-mediated interventions were

questionable due to the low PND scores. Similarly, Bellini, Peters, Benner, and Hopf

(2007) found that the mean PND score of peer mediated interventions were 62%, which

highlights that the effects were questionable. Forness (2001) provided a summary of

meta-analyses for effect size of studies in special education. Overall social skills trainings

produced an *ES* of .21, which highlights that the effect was small. In the meantime,

technology-based social skills interventions have provided better outcomes, as

demonstrated by mean PND of 94% (Wehmeyer et al., 2008) and 80% (Bellini &

Akullian, 2007). This indicated that the use of technology supports positive effects to

train social skills for children with disabilities

With advances in technology, commercial technology devices have been

integrated in the educational settings to maximize the educational opportunities for all

learners (Johnson et al., 2011; Sheu & Chen, 2014). Particularly, there has been an

increase in the level of interest in gesture-based learning in special education. Specifically, research has addressed several benefits from the use of gesture-based technology in education, including enhancing motivation and engagement, increased spatial knowledge that offers opportunities for experiential learning, and easily customizable for individual needs (Johnson et al., 2011). Yet, relatively little research has examined the effectiveness of the gesture-based technology to support for teaching and learning in special education. In addition, there is a need to document how gesture-based video gaming can be utilized and implemented for teaching and learning in response to the various needs for students with disabilities.

The XbK system is a commercial ready-to-use product that is affordable and easy to manage. The features of the XbK system provide natural user interfaces, which allow users to interact with the Kinect (game console) by body movements or voice commands. Such unique features of the XbK gesture-based video gaming may provide positive effects in the learning process in educational and clinical settings for students with disabilities at low-cost (Johnson et al., 2011; Sheu & Chen, 2014). Motivation is a powerful tool to increase student engagement in the learning process (Kandroudi & Bratitsis, 2012). Prensky (2007) asserted that the visual and auditory feedback in response to body movement provides motivation for students to participate in the learning activity. In addition, Sivilotto and Pike (2007) argued that a kinesthetic learning activity is a pedagogical tool for students to actively engage in learning, thereby enhancing classroom interactions and participations. This study used the XbK gesture-based video gaming to teach social skills for preschool children with developmental delays. The

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hypothesis of this study was that the use of XbK video gaming might enable the target

children to motivate through the kinesthetic gaming activity to develop their social skills.

The intervention study employed a multiple baseline design across participants

and included three phases of baseline, intervention, and maintenance. Measured target

social skills were (a) accurate gesture imitation, (b) visual attention during play, and (c)

turn taking. To promote these target social skills, this study used the Xbox Kinect 360

gesture-based video gaming. Motivation from gesture-based video gaming provides the

participants to engage in the intervention activity, thereby increasing these target social

skills. In addition, the visual and auditory features of the XbK may support the

participants to learn appropriate imitation skills in accordance with the virtual instrument

on the screen. The results of this study provided preliminary findings whether there is a

functional relation with the use of gesture-based video gaming to increase social skills for

young children with disabilities. Furthermore, this study provided practical implications

for future research and classroom implementation.

Purpose of the Study

The aim of the present study was to examine the functional relation of gesture-

based video gaming using the XbK to teach social skills for young children with

developmental delays. Specifically, the XbK games provide visual and audio interactions

through the user's body movement (Kandroudi & Bratitsis, 2012). The features of XbK

can be a catalyst to engage users to play with limited teacher prompts. Thus, game play

using body movement in response to the audio and visual cues from the XbK may

enhance social skills for young children with developmental delays, such as joint

attention, imitation, and turn taking. In addition, young children with developmental

delays may reduce their negative behaviors and the reliance on their teachers' prompts by

following the audio and video cues from the XbK games.

Research Questions

The XbK gesture-based video gaming was integrated into this intervention study

to increase social skills for young children with developmental delays in preschool

settings. The following research questions were addressed:

1. Is there a functional relation between the use of XbK gesture-based video gaming

    and the increase in three social skills for young children with developmental

    delays?

2. Do young children with developmental delays maintain these target social skills

    two weeks after the conclusion of the intervention phase?

3.   What are the teachers' perspectives on the use of XbK video gaming to teach

    social skills for young children with developmental delays?

    Specific social skills related to first and second research questions included were:

(a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking.

Definition of Terms

Accurate gesture imitation. Appropriate play gestures in accordance with the

play material (screen) so that the play material (screen) responds to the player. For

example, while a child plays with Air Band, the Kinect sensor would capture the gestures

(imitation of play piano) of the child and if the child gestures are recognized by the

Kinect, the screen will show the virtual musical instruments (virtual piano).

Autism spectrum disorder (ASD). A group of developmental disabilities having significant social, communication and behavioral challenges. According to DSM-IV (American Psychiatric Association, 1994), autism spectrum disorders as pervasive developmental disorders was characterized by: (a) qualitative impairment in social interaction, (b) qualitative impairment in communication, and (c) restricted, repetitive and stereotypic patterns of behavior, interests and activities.

Developmental delay. Any significant delay in a child's physical, cognitive, behavioral, emotional, or social development, in comparison with a typical child. According to the IDEA, (1) Who is experiencing developmental delays as defined by the State and as measured by appropriate diagnostic instruments and procedures in one or more of the following areas: Physical development, cognitive development, communication development, social or emotional development, or adaptive development; and (2) Who, by reason thereof, needs special education and related services. [34 CFR §300.8(b)]

Gesture-based video gaming. Digital video gaming where the devices (i.e. Xbox Kinect 360) provide natural interfaces, which allow users to interact with a game console by body movements or voice commands.

Global developmental delay (GDD). A generalized intellectual disability that is usually characterized by lower than average intellectual functioning along with significant in at least two other areas of development, including poor social skills, limited reasoning and conceptual abilities, delayed acquisition of milestones.

Individualized program planning (IPP). A written commitment of intent by the learning team to ensure appropriate planning for students with special education needs in Canada. IPP is equivalent to individualized education plan (IEP) in the U.S. The *Standards for Special Education, Amended June 2004* defines an IPP as: "a concise plan of action designed to address students' special education needs, and is based on diagnostic information which provides the basis for intervention strategies" (p. 4).

Prompt. A systematic method to assist students to learn and use appropriate play skills. In order to support appropriate imitation, verbal prompt was provided. Started with independent level (no prompt), verbal, and then physical prompts were provided to the children to teach turn taking skills. Verbal prompt is a verbal instruction on what to do (i.e., move your arms side to side). Physical prompt is direct physical contact by the researcher to guide the student on what to do (i.e., holding the child's hand and guide him/her to sit on the mat). The use of prompt was aimed to increase independent turn taking and imitation skills.

Turn taking. An event involving a sequence of turns during play. The sequence of the turn taking is (a) a child patiently sits and waits for their turn to play, (b) when it is his/her turn, the child move to the play spot independently, and (c) return to the waiting area and sits on the mat after completing his/her turn independently.

Visual attention during play. Target child physically gazing at the screen or another child who is playing for 5 seconds, without shifting their eye contact somewhere else. Visual attention during play examined the children's joint attention skills, which is

defined as "gesture and eye contact to coordinate attention with another person in order to

share the experience of an interesting object or event" (Mundy, Sigman, &Kasari, 1994).

Chapter Two

This chapter provides an overview of literature on social skills and technology-based interventions for children with disabilities and consists of three sections: technology-based interventions for children with disabilities that includes literature of various technology employed in social skills intervention and gesture-based video gaming, and play and social skills for children with disabilities.

The literature search procedures were identified through computerized bibliographic searches in peer-reviewed journals from the 1970s to 2015 and from the following online database: *Education Research complete, PsycINFO, Social Sciences Citation Index,* and *Dissertation and Theses Global*. Specific keywords combinations were used for the search procedures: Technology, innovative technology, computer, video gaming, social skill*, social behavior*, social interaction, social communication, play, imitation, joint attention, turn taking, independence, and intervention*, Autism, ASD, preschoolers, and children with disabilities. A hand search was included to search additional potential studies from the commonly published journals related to studies with children with disabilities and technology, such as *Journal of Special Education Technology, Special Education Technology Practice, Journal of Positive Behavior Interventions, Journal of Autism and Developmental Disorders,* and *Research in Autism Spectrum Disorders*. The following inclusion criteria were used to find potential studies

for the literature review: (a) the participants in the study were diagnosed with disabilities, (b) the participants in the study were in school age PreK-K12, (c) a study was in peer-reviewed journal, and (d) a study employed experiment designs. However, studies were excluded if the articles were not in peer-reviewed journal nor in English.

Social Skills for Children with Disabilities

Young children with developmental delays present lack of developmental milestones in language, social, and motor skills (Petersen, Kube, & Palmer, 1998). Bowman, Donovan, and Burns (2001) argued that delays in those developmental domains significantly impact children's social-emotional competence. The lack of social and emotional competence contributes to school readiness in later years. For example, children equipped with appropriate social-emotional competence demonstrate positive attitudes about school when they enter elementary school and better success in academic achievement (Campbell, 2002). Conversely, children with deficit in social and emotional competence are exposed to the potential challenge in academic performance and social interactions with peers when they grow up (Flook, Repetti, & Ullman, 2005). Thus, research claimed that early intervention is a key factor to develop social and emotional competence for preschool children with disabilities, which contribute to their school readiness and positive social interactions in the general setting (Huffman et al., 2000). In this regard, studies asserted that social skills are foundation to develop social emotional competence in preschool settings (Flook et al.; Guglielmo & Tryon, 2001; Jordan, 2003).

Various interventions have been conducted to teach appropriate social skills for children with disabilities. However, Vaughn et al. (2003) argued that it is critical to

provide age-appropriate social skills intervention for the target students. It is because the aims for social skills vary depending on the age level. In general, social skills interventions for school age students are focused on developing peer interaction through initiating and maintaining communications, and engaging with peers in groups (Parker & Asher, 1987). Meanwhile, the goals for social skills interventions in the preschool level are mainly to increase play skills and peer interaction (Vaughan et al., 2003). Therefore, play has been actively involved in social skills interventions for preschool children with disabilities (Jung & Sainato, 2013; Lang et al., 2009). Jung and Sainato (2013) argued that engaging the appropriate play through systematic interventions provides opportunities for children with disabilities to increase social interactions, language development, and cognitive skills. Furthermore, while play helps children acquire social skills, inappropriate and negative behaviors as a collateral effect may be decrease the skill.

The nature of play includes a wide range of behaviors that are vital for the development of young children (Jung & Sainato, 2013; Lang et al. 2009). Particularly, Vygotsky addressed that play is a fundamental part for children's development:

In play a child always behaves beyond his average age, above his daily behavior; in play it is as through he were a head taller than himself. As in the focus of a magnifying glass, play contains all developmental tendencies in a condensed form and is itself a major source of development. (1978, p. 102)

Many researchers provided characteristics of play, including the followings: (a) play should be enjoyable, (b) children interact with play, play materials, and other people

through their bodies and minds, (c) children are involved in play as voluntary and spontaneous, (d) children are actively involved in their play, (e) play allows children to be sociable and interactive, (f) children can enhance play to imagine and pretend while they are playing, (g) play provides opportunities to develop knowledge, understanding, and skills, and (h) verbal and non-verbal communication can be developed (Garvey, 1977; Hughes, 2003; Roeyers & Van Berckelaer-Onnes, 1994; Rubin, Fien, & Vandenberg, 1983). Play development is strongly associated with children's development in social, cognitive, linguistic, and emotional aspects (Roeyers & Van Berckelaer-Onnes; Rubin et al.; Stagnitti, O'Connor, & Sheppard, 2012). Play can be categorized as different types, and support children to develop and learn those fundamental skills (Garvey). While children engage in simple repetitive play or constructive play with objects, cognitive development can be enhanced. The use of objects allows children to be aware of dispositional properties of the materials (i.e., toy cars). When children engage with pretend play, they use their imaginations to recognize the abstract of the attributions and functions of the pretend objects. Multiple play skills can be used while children play. For example, a child may pretend as a builder (pretend play) to build a tower or road (constructive play). The followings are various types of play (Hugh).

- Creative play: children are using their bodies and play materials to make or do things, and share their emotions, thoughts, and ideas. Children can enjoy creative play with dancing, painting, playing with materials (i.e., play-dough or clay), and their imaginations.

- Games with rules: many plays involve games with rules. For example, while babies play peek-a-boo, they explore and understand that turn taking is a rule in the game.

- Language play: language is an important part of play. Language can be involved as part of play with sounds and words that include unrehearsed and spontaneous manipulation of play.

- Physical play: children develop, practice, and control body movements through physical play. The body movements are from whole body movements to coordination and balance among body parts, such as eye-hand coordination. Physical play includes: (a) exploratory play allows children to explore their bodies and things in their environment, (b) manipulative play is to practice motor skills to increase physical movements and hand-eye coordination by manipulating objects and materials, and (c) constructive play allows children to build something with play materials.

- Pretend play: pretend play involves imagination. Children pretend in accordance with objects, actions, and situations. Pretend play involves several different events. First, play provides opportunities for children to develop early literary and numeracy skills. For example, while children play grocery shopping, they make a list of grocery to buy and pay for them. Second, children use small-scale of real world representations, such as animals and cars. Third, socio-dramatic play is often observed while children play with peers or adults. They learn how to make friends, negotiate, and communicate with others through this type of pretend play.

In typical development in early stages of young children, those various forms of play cultivate their social development. In this regard, Hughes (2003) stated that "play is the most natural of childhood activities and one of the most frequently observed " (p. 21). However, young children with disabilities, such as ASD, intellectual disabilities, or ADHD, or other developmental delays, demonstrate limited or delayed development in their social play (Jordan, 2013). As play is the primary context for preschool children to develop social skills and communication, play development is important for young children with disabilities to learn the necessary social skills as well as increasing language and cognitive growth (Jordan; Roeyers & Van Berckelaer-Onnes, 1994; Rubin et al., 1983; Stagnitti et al., 2012).

A number of intervention studies for children with disabilities in preschool have explored the use of play to teach play skills and to develop in the following areas: social skills, communication, and cognitive development (Jung & Sainato, 2013; Stagnitti et al., 2012; Stanton-Chapman & Brown, 2015; Thorp, Stahmer, & Schreibman, 1995). Stagnitti et al. (2012) argued that a play-based intervention impact not only play skills but also social competence and language skills for young children with disabilities. While children learn playful behaviors, they also learn to understand the purpose of the game, which increases their enjoyment and could result in the child playing for a longer period. Particularly, "Learn to Play" program was used to examine the relationship between play, language and social skills of 19 young children with disabilities, including intellectual disabilities, autism, developmental delay, vision and hearing impairments, and down syndrome, participated in the study (Stagnitti et al.). The study explained that Learn to

Play is an intervention program to develop self-initiated pretend play skills for children. The results showed that there are significant correlations between play scores, social competency and play. Particularly, the length of time the participants engaged in play, the use of the doll in play, and creating a narrative in the play were associated with the increased social interaction. This indicated that play abilities are related to the development of social competence. The language score at follow up was increased by 27% from baseline, indicating that symbolic play is correlated to language development.

Similarly, Thorp, Stahmer, and Schreibman (1995) used sociodramatic play with toys to increase social behavior, play, and language skills for three children with autism. In order to teach sociodramatic play skills, the study used the "Pivotal Response" with the following steps: (a) the interventionist provides each child with their preferred toys, (b) the list of toys is varied based on the interests of the child, (c) the interventionist took turns playing with each toy and modeled the appropriate social dramatic play, (d) the interventionist provides modeling of how to respond while playing with toys, and (e) the interventionist provided reinforcement. The results of the study suggested that sociodramatic play program using pivotal response may be an effective intervention strategy as all participants improved sociodramatic play, language skills, and social behavior. In addition, all participants exhibited positive change by decreasing inappropriate verbal behavior.

On the other hand, the literature emphasized that integrated play group model is an important feature in play-based intervention (Wolfberg & Schuler, 1999; Zercher, Hunt, Schuler, & Webster, 2001). Inclusive settings can provide opportunities for

children with and without disabilities to interact together (Wolfberg & Schuler). Thus, Wolfberg and Schuler (1993) claimed that integrated play group model requires several important features, including naturally inclusive settings, considerable play spaces, play materials that enable interaction, integrated play group with similar age and development status, children's competent oriented play, and full engagement in play. Zercher and colleagues (2001) conducted a study to examine whether the integrated play group model is efficient to support children with autism to increase joint attention, symbolic play, and language use. Two children with autism and three typically developing children were grouped together in the same play group. For intervention phase, typically developing children were trained to provide modeling and cues for target children to learn appropriate play behaviors, such as joint attention and symbolic play. The results of the intervention showed that joint attention increased immediately when the intervention began and remained with high scores during the maintenance phase. One of the target children immediately increased symbolic play behavior with intervention. Although the other child did not demonstrate immediate increase in symbolic play behaviors, the results showed sustained increase of symbolic play. In addition, the number of utterances of both children with autism showed an immediate and constant increase. This study highlighted that typically developing children can participate in social skills interventions for children with disabilities as they provide an effective role model to increase the quality of social behaviors.

The literature has examined the effectiveness of social skills interventions in specific social skills areas such as turn taking (Daubert, Hornstein, & Tincani, 2015;

Ferm, Clasesson, Ottesjo, & Ericsson, 2015; Stanton-Chapman & Snell, 2010), joint

attention (Murray et al., 2008; Zampini, Salvi, & D'Odorico, 2015), imitation (Cardon &

Wilcox, 2011; Garfinkle & Schwarts, 2002; Peck, Apolloni, Cooke, & Rayer, 1978;

Strid, Heimann, Smith, Gillberg, & Tjus, 2013), and independent play and task skills

(Mavropoulou, Papadopoulou, & Kakana, 2011; Stromer, Kimball, Kinney, & Taylor,

2006). Appropriate social skills are associated with social interactions and academic

performance. Hence, it is important to train young children who lack social skills to

enhance a broad range of social interactions, thereby minimizing potential negative

outcomes, such as isolation, bullying, and low academic performance.

   Joint attention. Joint attention is defined as "gesture and eye contact to

coordinate attention with another person in order to share the experience of an interesting

object or event" (Mundy & Crowson, 1997). Infants usually develop joint attention skills

in the first 2 years of life and it is a very important step in learning to interact and

communicate with others. For instance, if a mom points her index finger toward a fire

truck and a child turns his head toward it, it indicates that the child's attention is on the

fire truck and both the mom and the child are visually attending to the same object.

However, young children with a lack of social communication and attention skills, such

as autism, intellectual disabilities, developmental delays, show absence or are deficit in

joint attention skills (Charman et al., 1997; Colombi et al., 2009; Ferraioli & Harris,

2011; Kasari, Freeman, & Paparella, 2006; Loveland & Landry, 1986; Vuksanovic &

Bjekic, 2013; Zercher et al., 2001). The literature found that the lack of joint attention

skills significantly impacts the development of language, play, and social interaction

skills in later years (Charman et al.; Ferraioli & Harris; Loveland & Landry; Kasari et al.; Zercher et al.). For instance, the joint attention between a mom and her child significantly influence the child's early vocabulary development (Zampini et al., 2015). As a mom labels the name of the object in the context of joint attention, the child can acquire the vocabulary associated with the name of the object. Thus, joint attention is one of the central skills to enable positive changes in other behaviors (i.e., language and social skills). A number of studies stressed that early intervention program should focus on teaching joint attention skills to young children with developmental disabilities to improve related skills (i.e., social and language) development (Jones, Carr, & Feeley, 2006; Ferraioli & Harris; Kasari et al.; Vuksanovic & Bjekic; Zampini & D'Odorico). Therefore, a growing body of literature has focused on training joint attention along with other social abilities (i.e., social imitation, language, and play) to young children with disabilities (Ferraioli & Harris).

As the literature emphasize that joint attention skills in typical developing children are an important precursor for language development (Charman et al., 1997; Ferraioli & Harris, 2011; Loveland & Landry, 1986; Kasari et al., 2006), efforts were made to examine the relationship between joint attention behaviors and language development in children with disabilities (Murray et al., 2008; Zampini et al., 2015). Specifically, Murray et al. (2008) and Zampini, Salvi, and D'Odorico (2015) aimed to examine how joint attention skills are related to expressive and receptive language development, yet their target students were children with ASD and children with down syndrome. In order to examine the relationships between types of joint attention and

receptive language components, Murray et al. analyzed the response to and initiation of joint attention, *Mullen Scales of Early Learning* (MSEL; Mullen, 1995) the mean length of utterance (MLU), and type token ratio (TTR) scores as receptive language scores. Children with ASD having a higher response to joint attention scores showed longer MLU and higher TTR scores. The results revealed that there is a significant relationship between response to joint attention and receptive and expressive language. Similarly, Zampini et al. assessed the relationships between joint attention behaviors and receptive and productive vocabulary of 24-month-old children with down syndrome. Joint attention was observed in over 50% of intervals from the participants during interactive play with their caregivers. The results indicated that there is no relationship between the frequency of joint attention and both expressive and receptive vocabulary size. However, the total spending time in joint attention behaviors is significantly associated with children's receptive vocabulary. The study suggested that joint attention behaviors might impact the vocabulary comprehension skills of children with down syndrome.

Research addressed that some children with developmental disabilities, such as ASD, show more significant challenges with social interactions than other group of individuals with developmental disabilities, such as intellectual disabilities (Charman et al., 1997; Ferraioli & Harris, 2011). Thus, it is not surprising that young children with ASD demonstrate the absence of joint attention functions. The use of peer modeling provided positive effects to teach social skills to children with ASD (Kamps et al., 2002; Ferraioli & Harris; Garfinkle & Schwartz, 2002). Ferraioli and Harris (2011) investigated the efficacy of siblings-mediated intervention to teach joint attention to children with

autism. As Ferraioli and Harris highlighted that siblings are the most familiar peers to

children with ASD, training siblings to teach joint attention skills for children with ASD

could be an effective strategy. Hence, four typically developing siblings, as peers for four

target students with ASD, were trained to teach joint attention skills such as how to

respond to joint attention (i.e., tapping a toy and showing a toy) and initiating joint

attention (i.e., initiating distal point and a gaze shift). The expected behaviors from the

sibling-mediated intervention were the following: (a) correct responses of joint attention,

such as gazing shift to the new toy for at least 5 seconds, and (b) correct initiating joint

attention (i.e., gaze shift from toy to sibling for at least 3 seconds). As a result, all

participants demonstrated moderate to significant increase in both initiating and

responding to joint attention from their siblings. This suggested that siblings as the

interventionist can be used to teach joint attention skills for children with ASD. In

addition, increased imitation skills from three students with ASD provided additional

support to previous literature regarding the impact of joint attention to other skills (Jones

et al., 2006; Ferraioli & Harris; Kasari, Freeman, Mundy, & Sigman, 1995; Vuksanovic

& Bjekic, 2013; Zampini et al., 2015).

　　　　Research suggested that both joint attention and play skills contribute to the

developmental process for young children, which allows them to understand the mental

representation of others, thereby developing better social, cognitive, and language

abilities (Baron-Cohen, Tager-Flusberg, & Cohen, 1994; Kasari et al., 2006).

Nevertheless, difficulty with both joint attention and play skills are major aspects of

children with autism, which significantly affects language and social developments in

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later life. For this reason, Kasari, Freeman, and Paparella (2006) investigated the use of structured play and mother-child interaction to teach both joint attention and symbolic play skills for young children with autism. The study used a randomized control intervention for three different groups, including joint attention (n = 20), symbolic play (n = 21), and control (n = 17). The results of the study suggested several things. First, the improvement of target skills from both joint attention and symbolic play groups were observed. Joint attention together with play skills could be used to teach children with autism. Second, participants who learned joint attention and play skills from the trainers were able to demonstrate retaining what they learned and use of these skills while playing with their mothers. Finally, with the design of this study, the results indicated that both intervention strategies yielded positive outcomes, compared to the control group.

   Motor imitation. Infants spontaneously imitate motor and vocal actions of adults. Imitation occurs in various forms of behaviors, including imitating gross motor movement, actions with objects, fine motor movements, and oral motor movements (Quill, 2000). Typically developing children develop nonverbal social-communicative and imitation skills naturally in the first 2 years. During early childhood periods, they advance their imitation skills by expending their interaction with others (i.e., peers). Imitation is one of the fundamental developmental skills that influence social, communication, and emotional development. However, children with disabilities, such as autism spectrum disorders, intellectual disabilities, and developmental delays, often have poor imitation skills, which impact their acquisition of other important development of cognitive and social skills (Ledford & Wolery, 2011; Quill). Ledford and Wolery (2011)

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summarized three reasons to teach imitation skills for children with disabilities in a literature review. First, imitation skills correlate to the development of other skills, such as joint attention, play skills, and language acquisition. Second, imitation is a prerequisite skill to provide opportunities in instructional practices for learning. Finally, imitation enhances observational learning, which allows children to acquire new skills or behaviors by observing others. For those reasons, a number of studies were focused on enhancing imitation skills for children with disabilities (Cardon & Wilcox, 2011; Garfinkle & Schwarts, 2002; Peck et al., 1978).

Reciprocal imitation training and video modeling are common methods recognized as highly effective with teaching imitation skills for young children with disabilities (Cardon & Wilcox, 2011). Cardon and Wilcox (2011) examined those methods to teach imitation to children with autism, and compared the different effects between two strategies. The results of reciprocal imitation training indicated that all participants obtained stable increase in object imitation skills and a decline in the level of the target skills during the follow-up phase. On the other hand, the result of video modeling method enabled the participants to improve action imitations with rapid change from the baseline phase and the imitation skills were retained during the follow-up phase. Moreover, post assessment scores on the Motor Imitation Scale（MIS）from all participants were significantly gained in object imitation and body imitation compared to the pre assessment scores. Several findings were observed. First, the results indicated that both reciprocal imitation training and video modeling were effective intervention methods to improve and maintain the level of imitation skills in young children with

autism. Second, the video modeling method provided rapid increase in imitation acquisition compared to reciprocal imitation training. Third, participants' imitation skills declined at the follow up phase. However, the pre- and post-test scores of the MIS provided evidence that the participants retained some imitation skills. Finally, learning imitation skills allowed participants to be better observational learners, which are important to developing play and communication skills.

Garfinkle and Schwartz (2002) investigated the effectiveness of peer imitation intervention. The intervention involved 4 steps; (a) teacher provided instruction related to the imitation activity, (b) leader was selected to be a model for imitation, (c) teacher provided prompt to promote imitation, and (d) teacher praised imitative acts. For example, teacher provided instruction on the group activity. A leader is selected by volunteering, assigning, or asking a specific child. When a leader is chosen, the leader would play with a material and rest of kids will imitate what the leader is doing. While a leader is acting with play materials, the teacher provides physical and verbal prompts for other children to imitate the leader's action. Then, when a child imitates the leader's actions, the teacher provided verbal praise. The study employed a multiple baseline design across four students with autism to promote imitation skills either independently or with prompts using the peer imitation strategy. None of the participants demonstrate peer imitations during baseline. However, the average of peer imitations during intervention was increased to 60.8%, ranging from 41 to 81%. Two participants showed increased independent imitations of their peers and other two students tended to rely on prompts to imitate their peers. The social validity results showed that special education

teachers who observed the intervention provided positive responses related to the peer imitation intervention. Specifically, the adults who participated suggested that the intervention was easy to implement, benefitted the target children, and they were willing to use the strategy in their classrooms.

Research argued that children with disabilities might gain better imitation through peer interactions in inclusive settings (Garfinkle & Schwarts, 2002; Peck, et al., 1978). Peck and colleagues (1978) examined the effects of direct peer-imitation intervention between children with intellectual disabilities (ID) and typically developing peers (TD) during free play through two experiments; (a) imitation and social interaction between children with ID and TD during baseline and intervention phases, and (b) positive and negative social interaction between the groups. Through the first experiment, all participants showed increased peer imitation and social interaction under both training and non-training conditions. With the second experiment, children with ID increased better imitative responses to peer model as well as positive social interactions between the groups. The study supported that TD can be included in the imitation training for ID as a peer model to promote the target skill. In addition, increases in the rate of imitation of all participants under non-training conditions provided the evidence that the gained skills can be generalized.

Turn taking. Kaczmarek (2002) defined turn taking as "smooth interchanges between communicative partners" (p. 90). Children who developed turn taking skills are able to attend to the emotional and interpersonal cues of others, and engage in social interaction with them (Constantino et al., 2003). As turn taking skill is not naturally

obtained, teaching turn taking is one of the critical social skills for young children with

disabilities to enhance the quality of social interactions. Thus, several studies using

various strategies have been conducted to teach turn taking skills for children with

disabilities (Daubert et al., 2015; Harper, Symon, & Frea, 2008; Laushey & Heflin, 2000;

Stanton-Chapman & Snell, 2010; Yoder & Stone, 2006).

Daubert, Hornstein, and Tincani (2015) investigated the use of power card

strategy to engage in social games for two elementary children with autism spectrum

disorder (ASD). The power cards used special cartoon characters (i.e., Ninja Turtles^{TM}

characters) on one side and on the other side of the power cards were written instructions

of target behaviors, such as initiating a turn, relinquishing a turn, and appropriate

commenting during a game. The results showed that two children with ASD in the study

significantly improved their appropriate turn taking skills during game play. The average

percent of children who successfully initiated turn taking when the opportunity presented

itself was between 15.7 to 21.7% during baseline and 82.7 to 97% during intervention.

Visual aid based intervention (i.e., the use of Power Card) provides an effective method

for teaching social initiation such as turn taking for children with ASD.

Stanton-Chapman and Snell (2010) argued that turn taking skill is important for

children to initiate and interact with others in social communication. While four-year old

children with disabilities and children at risk of disabilities ($N = 20$) were engaged in

play, this study examined turn-taking skills using social communication intervention.

During the intervention, children with disabilities played with a particular dyad using a

storybook, having five play themes (i.e., grocery store, animal doctor, etc.). Although

some of the participants showed unstable performances, overall participants showed immediate changes in the level of turn-taking skills by initiating and responding to their peers. Turn taking while playing with a peer demanded a long sequence of interactive behavior between the children in this study. For example, the turn taking sequence during hospital play may be (a) child 1: my mom is sick (initiation), (b) child 2: is she eating? (responds), (c) child 1: no, her tummy hurts (taking another turn in the interaction), (d) child 2: let me have a look (taking another turn in the interaction), and so on. Therefore, the study discussed that children may have better improvement if they learn sophisticated play scripts to maintain the appropriate interaction with a play partner.

Similarly, Yoder and Stone (2006) asserted that appropriate turn taking skills contribute to developing communicative behaviors (e.g., initiating joint attention). A randomized group experimental study examined the efficacy of the Responsive Education and Prelinguistic Milieu Teaching (RPMT) and Picture Exchange Communication System (PECS) to develop turn taking, requesting and initiating joint attention (Yoder & Stone, 2006). While the RPMP is a method to teach turn taking directly through object exchanges, PECS is a communicative intervention to teach appropriate request minimizing adult prompts for children. 19 children received the PECS treatment and 17 children for RPMT. Particularly with turn taking, the operational definition of turn taking in this study was "voluntary extension of a hand that is holding an object toward the adult and must be extended at least half the distance between the child and adult". For example, a beanbag as an object used to exchange turns. So turn taking was observed when a child gave the beanbag to adult to exchange turns. The results indicated that

children in RPMT treatment group demonstrated increased turn taking more than the PECS, $t(34) = 2.46$, $p = .019$, $d = .97\%$. The reason of the findings was because the RMPT was directly involved in teaching the object exchange and the PECS was not. So participants in the RMPT naturally learned the context of turn taking in various routines. In addition, the RMPT had more initiating joint attention acts than the PECS. Therefore, the study argued that there was a correlation that increased turn taking from the RMPT resulted in more initiating joint attention. This supported previous research that turn taking supports increase communicative behaviors, such as initiating joint attention.

As peer mediated strategies provided positive effects to teach social skills to children with disabilities, research claimed that the use of peers to train the target students has better outcomes than peers who were simply included in the study (Odom & Strain, 1984; Roeyers, 1996). Thus, Laushey and Heflin (2000) examined the peer-initiated procedure to teach turn taking skills (i.e., waiting for turns) to kindergarten students with disabilities during the activity, called "buddy time". For example, *waiting for his turn* was defined as "the participant's ability to postpone his turn while others enjoy what he is waiting for". Students who participated as a buddy for the target students were trained on how to play with, talk to, and stay with the target students. The results showed that students with disabilities increased turn taking skills from the peer buddy approach.

Harper, Symon, and Frea (2008) also used peers of students with autism to teach social skills, such as turn taking and social initiation during recess. Two children with autism and three typically developed children as peer buddies were included in the study.

Three peers were trained on the Pivotal Response Training (PRT) strategies, such as gaining attention and turn taking. Those peers initiated and maintained play with the target students using the PRT strategies during the morning recess period. The results showed that both target children increased social play skills with the peer mediated strategies. For example, the target children did not take any turns independently across baseline probes ($M = 0$). However, both children increased the mean level of turn taking after the peer mediated intervention ($M = 12.5$). These studies stated that systemic training to the typical peer provided positive results for students with disabilities to learn appropriate social skills, including turn taking, through the social interactions with their same aged peers in natural settings (Harper, Symon, & Frea, 2008; Laushey & Heflin, 2000). Furthermore, peer meditated strategies enabled the target students to maintain and generalize learned skills more effectively than adult-mediated intervention.

Independent play. Due to the lack of appropriate functional skills (i.e., attention deficits), students with disabilities often face difficulties with engaging in social interactions in meaningful ways (Milley & Machalicek, 2012). Such deficiencies may cause them to fail to demonstrate appropriate skills, delaying them to completing a task or activity. Eventually, those students with disabilities may be unsuccessful in being independent in academic and social interactions in the general settings (Maheady, Harper, & Mallette, 2001). Therefore, schools systematically provide adult supports and prompts in order to meet the educational needs of those students with disabilities. Giangreco and Broer (2005) found that students with disabilities rely on paraprofessionals assistant over 86% of their school day to increase their academic or social engagement. However,

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prompt dependency from adults (i.e., teacher or paraprofessional) may prevent students

with disabilities to develop self-initiation skills (Giangreco, Edelman, Luiselli, &

MacFarland, 1997). As students depend on adults' prompts and assistants, the

opportunity to promote independent behaviors and skills may be less positive. This may

raise the concern that prompt dependency results in negative impact on academic and

social engagement. Furthermore, there may be the potential that these students are not

ready for post secondary school. In this matter, it is critical to support students with

disabilities to become independent learners (Giangreco & Broer, 2005). Various

instructional practices and strategies (i.e., activity schedules or peer supports) have

provided positive results to increase independent task initiation, engagement, and task

completion for students with disabilities while decreasing adult prompting or assistance.

The literature argued that independent functional play is an essential role for young

students with disabilities to increase social, linguistic, motor and emotional development

(Giangreco & Broer; Giangreco et al.; Maheady et al.; Mavropoulou et al., 2011; Milley

& Machalicek). Especially, a number of studies were focused on the use of visual or

textual cues to promote independent skills for student with disabilities (Kern, Wolery, &

Aldridge, 2007; Mavropoulou et al.; Sainato, Strain, Lefebvre, & Rapp, 1990).

     According to Mavropoulou, Papadopoulou, and Kakana (2011), students with

ASD have a tendency to demonstrate stereotypical or atypical behaviors in play, therefore

making it difficult to teach independent play skills. Thus, the study examined the

effectiveness of structured task organization using visual supports to increase

independent play skills for students with ASD (Mavropoulou et al., 2011). An ABAB

withdrawal of treatment design across participants was employed to intervene two

elementary students with ASD, Vaggelis and Yiannis, using visual instructions with a list

of play tasks: (a) manipulative play with tangrams, shape sorter, and LEGO Bricks, (b)

independent play including dressing a doll, preparing food/setting the table, and sticker

cards, and (c) games including lotto (picture-letter/word) and domino with animal picture

cards. The visual instructions included photos/picture dictionaries, colored object cards,

and printed words cards. During the intervention phase, students followed the visual

instructions to complete tasks. The researcher provided prompts to redirect students'

attention. The measured dependent variables included: on and off task behavior, teacher

prompting, task completion, and task performance. The findings from this study showed

positive changes as a result of the visual-based intervention for both students with ASD.

Specifically, Vaggelis demonstrated increase in on-task behavior from the average rate of

67% of baseline phases to 82% in intervention phases, and decreased teacher prompts

from 17.5% to 8.86%. Although he completed lower tasks during intervention phases (M

$= 2.6$) than baseline ($M = 5$), his task accuracy was increased from 30.6% in baseline to

60.7% in intervention. Another student, Yiannis, showed increased on-task behavior with

average rate of 82.4% in intervention compared to baseline average rate of 49%. Teacher

prompt was 22% in baseline and decreased to 17.6% during intervention. The mean of

completed activities was three and his average task accuracy rate was 18% during

baseline. With intervention, the mean of completed activities was 2.4, but average task

accuracy rate increased to 58%. Given the results, the study claimed students understood

the purpose of task and were able to follow the sequence of the steps properly thought the

visual instructions intervention. Furthermore, their performance became more successful and independent.

Sainato, Strain, Lefebvre, and Rapp (1990) claimed that the ability to self-evaluate provides opportunities for children to sustain the learned skills in multiple settings and allow them to be independent by becoming less reliant on adult's assist. Therefore, Sainato et al. evaluated the effects of self-evaluation to increase the attention on the tasks and decrease teachers' prompt. During the independent seatwork time, four preschool children with autism received the self-assessment package. For example, if the appropriate behavior is to work quietly, each child evaluated his own behavior by marking "yes" or "no". Teacher's verbal prompts were provided to the target children to maintain the appropriate on-task behaviors (i.e., attending to the task with pencil on paper). The results showed that the self-assessment package increased appropriate on-task behaviors and the improvement was immediate when the intervention was introduced. Moreover, teacher's verbal prompts were reduced and the target children maintained the appropriate behaviors with the self-assessment repertoire.

Young children with developmental delays often showed lack of appropriate social skills during transition in daily routines (Alger, 1984). For example, they might have difficulties in the initial transition into a classroom and demonstrate negative behaviors, such as crying or avoiding to enter the classroom. Therefore, Kern, Wolery, and Aldridge (2007) examined the use of greeting songs to teach independent greeting performance for two preschool children with autism. Songs for each child contained expected five-step morning greeting routine (i.e., say "hello" to the teacher), aimed to

teach independent greeting skills and engaging in greeting peers. During the intervention, the teacher of each child sang the song, which was designed to have the five steps of greeting, when the child entered classroom. Independent greeting occurred when the target children's independent greeting behaviors matched the song lyric. With intervention, the children showed increased independent greeting behaviors by matching their behavior with the song and demonstrated smooth transition from home to the preschool. The results indicated that the use of music was effective to support the children's transition with independent greeting skills.

Technology for Children with Disabilities

As technology advances, technology such as digital video games, virtual reality, or mobile technology, has been integral in the educational setting to support educational needs for individuals with disabilities (Goodwin, 2008). Literature has addressed several advantages associated with the use of these advanced technologies to teach individuals with disabilities to meet their needs (Khek, Lim, & Zhong, 2006; Goodwin). First, technology can prevent potential volatile situation (Khek et al.). Children with autism have difficulties interacting with their peers due to the lack of social interaction skills. Various technologies can be used to create scenarios, which enable children with autism to practice and learn specific social interaction techniques in a learning environment instead of in real life situations (Cheng & Huang, 2012). For example, virtual reality (VR) is another potential tool to teach new skills to children with disabilities with minimal negative effects (i.e., injury or fear). VR provides a simulation of the real world with high-definition graphics and design, which users can navigate the virtual

environment from the computer screen to interact with others (Parsons & Mitchell, 2002).

Thus, individuals with disabilities can practice complex concepts and functional skills

under physical and emotional safety with the VR environment.

Second, technology can enable children with disabilities to complete their tasks

independently (Stromer, Kimball, Kinney, & Taylor, 2006). One of the ongoing concerns

in special education is to enhance functional skills of individuals with disabilities (e.g.,

academic and social skills). For instance, in order to promote independence and efficient

instruction, many studies used activity schedules with multimedia technology, such as

video and audio cues (Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; McClannahan &

Krantz, 1999; Stromer et al.). The results highlight that activity schedules using

technology promote independent execution in academic and communication skills.

Third, the use of technology can reduce the cost of treatments for individuals with

disabilities (Goodwin, 2008). For example, personal mobile tools such as mobile phone

or tablet devices provide individuals with the ability to perform multiple tasks such as

organize materials, schedule management, communicate, or use as a learning tool.

Goodwin (2008) argued that the use of portable devices might replace caregivers and

reduce the expense associated with reliance on professionals.

Furthermore, the 2010 Horizon Report (Johnson, Levine, Smith, & Stone, 2010)

addressed that advance in technology has changed human lives in innovative ways during

the last decades. Obviously, innovation of technologies has brought some unique trends

in education, including the following: (a) the Internet provide abundance of resources and

accessibility, impacting teaching and learning globally, (b) the mobility features in

technology devices, allows individuals to work, learn, and study whenever and wherever, and (c) advanced digital media contribute to teaching students in multi-disciplinary approach, such as the use of mobile gaming to teach children both literacy and numeracy skills. In this regard, such innovative technologies have provided effective experiences to teach students with disabilities to develop various skills, such as academic, language, and social skills (Bellini & Akullian, 2007; Grynszpan, Weiss, Perez-Diaz, & Gal, 2014; Johnson et al.; Ke & Im, 2013; Neely, Rispoli, Camargo, Davis, & Boles, 2013; Weng, Maeda, Bouck, 2014; Wehmeyer et al., 2008).

For example, Neely, Rispoli, Camargo, Davis, and Boles (2013) argued that innovative technology has made a paradigm shift in the use of technology in education. Especially, mobile devices, such as an Apple iPad, are popular with educating individual students with disabilities. Neely et al. investigated the use of the iPad to decrease challenging behaviors and increase academic engagement for students with ASD. The target students in the study demonstrated challenged behaviors, such as verbal protesting, aggressive behaviors, and task avoidance. A reversal (A-B-A-B) design was employed, where participants received verbal direction and least-to-most prompts to complete the academic demands, such as double-digit subtraction with regrouping and matching color cards, during the entire sessions. However, during baseline, the participants used traditional materials (i.e., worksheet with a pencil and flash cards) to complete the academic demands. The iPad containing WritePad and Little Matchups applications were provided to engage in academic demand during intervention. While children demonstrated high percentage of challenged behavior during baselines (range 53 - 100%),

the use of iPad allowed them to reduce the level of challenged behaviors in intervention (range 0 - 20%). Furthermore, the result of academic engagement showed low percent of intervals (range 0 – 23%) during baselines and increase (range 60 – 93.3%) in intervention. The results suggested that the iPad motivates children and produces positive outcomes.

Technology-based social skills intervention. Many researchers have made efforts to investigate various technologies to enhance social skills for students with disabilities. Forness (2001) argued that *meta-analysis* allows the evaluation of the effectiveness of research findings in special education on specific intervention. In this regard, several meta-analyses examined the effectiveness of technology-based interventions for students with disabilities in social skills practices (Bellini & Akullian, 2007; Grynszpan et al., 2014; Weng et al., 2014; Wehmeyer et al., 2008).

Video modeling (VM) is one of the evidence-based intervention techniques used to train children with disabilities in various skills (e.g., social skills). Bellini and Akullian (2007) conducted a meta-analysis specifically of video modeling and video self-modeling interventions for individuals with ASD. As a result, the mean of PND score was 80% with a range from 29% to 100% from 22 single subject design studies. This indicates that VM intervention has moderate effects. Another meta-analysis of technology-based intervention was examined for students with intellectual disabilities. Among the various categories, social skills (i.e., self-regulation) intervention studies yielded 94% of the mean PND score, which suggested highly effective (Wehmeyer et al., 2008). Recently, a meta-analysis was conducted to review the effectiveness of the use of innovative

technology-based interventions for ASD (Grynszpan et al., 2014). The results of the meta-analysis showed moderate effect size ($d = 0.47$) from 14 controlled studies and 0.45 from 10 randomized controlled studies. The meta-analysis suggested that innovative technology-based intervention provided appreciated improvement in social skills practices for ASD. Overall, those meta-analysis established positive and promising results that technology-based interventions are effective in promoting specific skills for students with disabilities. With the positive results showing the effectiveness in technology-based social skills intervention, many studies have examined specific technology to teach social skills for children with disabilities.

As children with developmental delays (i.e., ASD) lack the ability to demonstrate facial expressions, Gordon, Pierce, and Bartlett (2014) argued that practice and training may enhance their ability to produce appropriate facial expressions. Therefore, the study examined the effectiveness of the use of computer game, called FaceMaze, to train facial expressions for children with ASD. 17 children with ASD (ASD) and 17 typically developing children (TD) were trained to produce several facial expressions, such as "happy" and "angry" with the FaceMaze. While a user produces appropriate "happy", "angry", or "surprise" facial expressions, the FaceMaze removes the face obstacles and the player can navigate a series of pac-man-type maze. The results showed that there were significant differences of quality rating in pre-training scores of happy facial expression between the ASD ($M = 2.17$, $SD = 0.06$) and TD ($M = 2.82$, $SD = 0.06$). However, there was no difference between the two groups in post-training scores, the ASD ($M = 2.80$, $SD = 0.06$) and TD ($M = 2.78$, $SD = 0.05$). While there was no

difference in pre-training scores of angry facial expressions between the ASD ($M = 1.75$, $SD = 0.07$) and TD ($M = 1.71$, $SD = 0.07$), the ASD showed higher post-training scores ($M = 2.22$, $SD = 0.07$) than TD ($M = 1.92$, $SD = 0.07$). Furthermore, there were no differences in pre-or post-training scores in quality ratings of surprise expression between ASD (pre: $M = 2.43$, $SD = 0.07$, post: $M = 2.49$, $SD = 0.08$) and TD (pre: $M = 2.58$, $SD = 0.06$, post: $M = 2.66$, $SD = 0.06$). The results indicated that the FaceMaze helped the ASD to increase the ability to understand the target facial expressions, especially for happy facial expression. As FaceMaze game provided active engagement for both groups of participants to demonstrate the quality of facial expressions, the study argued that the game was not only entertaining students, but also provided positive results as a promising intervention tool for individuals with ASD.

In addition to the lack of using appropriate facial expressions of individuals with ASD, they may have difficulty recognizing and interpreting nonverbal behaviors, such as other's body gestures or facial expressions (Hobson, 1986). Thus, while twenty five children with ASD in control group played with computer (i.e., drawing or coloring), twenty four students with ASD were trained with the FaceSays, an interactive and realistic avatar assistant, to develop emotion and facial recognition in the natural environments (Hopkins et al., 2011). The results addressed three statistical analyses. First, the results indicated that there was a significant difference in emotion recognition skills between the experiment and control groups, $F(1, 21) = 4.52$, $p < .005$. This showed that the FaceSay intervention supported children with ASD in the experiment group to increase emotion recognition skills. Second, the results indicated that there was a

statistically significant difference of post-test scores in facial recognition skills between intervention and control groups, $F(1, 21) = 10.86$, $p < .01$. The results showed that the intervention group improved their facial recognition skills more than the control group. Lastly, there was a significant difference in social interaction skills, such as assertion and cooperation, between the groups. Children with ASD in the treatment group showed higher post-test scores of social interaction skills than the control group. Overall, the results of the study yielded a promising potential for the use computer-based interactive games to increase specific social skills.

One of innovative technologies that have supported educational practices (i.e., development of social skills) is the use of virtual reality (Johnson et al., 2010). Ke and Im (2013) examined virtual-reality-based social skills intervention for children with high-functioning autism. The virtual reality (VR) system for this study used Second-Life, a virtual world, designed for children with autism to interact with virtual communication partners at a virtual social event (i.e., at a birthday party). The VR provided virtual avatars that the target children and adult facilitators interacted together to increase social communication, such as responding, maintaining, or initiating interaction, and recognizing facial and gestural expressions correctly. The results indicated that participants improved their target skills during intervention sessions and discussed several observations with the use of VR. First, the VR-based intervention is suitable for customized intervention for individual target children in various scenarios. Second, the VR-based intervention promotes the target children to be active in leading interaction. For example, the target children showed the ability to create virtual social game (i.e.,

birthday party) and enjoyed role-play as an event host. Third, VR provides observational learning for the target children in naturalistic settings. The adult communication partners role-modeled during the interaction with the target children, which enabled the participants to learn communication techniques.

Although VR showed a potential for social skills training for individuals with ASD, a study argued that there is a need to obtain knowledge regarding the use of VR for individuals with ASD, such as their understanding and interpretation (Parsons & Mitchell, 2002). Therefore, a qualitative study investigated the perspectives and experiences of the use of VR from two students with ASD. While the participants used a virtual café and bus environments, they learned specific social skills, such as finding an empty seat or asking someone to move their bag to allow them to sit down. In addition, a follow-up session was conducted to check if they maintained the gained knowledge from the VR training. The results indicated that both students with ASD were able to gain social knowledge through the use of VR and maintained the obtained knowledge. Particularly, both students with ASD showed a good understanding of the purpose of using the VR environments. The study concluded that the VR offers students with ASD the ability to practice social skills in spontaneous and realistic environments, which allow them to apply the knowledge in their real life.

As a large tabletop computer system, called Shared Active Surface (SAS), has been available, research argued that SAS may support students to collaborate and interact with each other simultaneously (Ben-Sasson, Lamash, & Gal, 2013). Therefore, Ben-Sasson and colleagues (2013) examined the SAS to improve positive social interactions

and behaviors for children with high-functioning autism spectrum disorder (HFASD). A touch-and-gesture-activated screen with puzzle games was used for the study. The puzzle game included 18 puzzle pictures that children can complete by dragging the puzzle pieces into the appropriate position. While six pairs of children with HFASD participated in the puzzle games in both free play (FP) and enforced collaboration (EC) modes, social interactions and behaviors were observed, including friendship (i.e., positive and negative social interactions), and social responsiveness, such as social cognition, social awareness, social communication, and social motivation. The results showed that participants demonstrated positive social interactions and collaborative play more frequently in EC mode than in FP mode. Specifically, high frequencies of demonstrated positive social behaviors were goal-related, sharing, pro-social, and conversational behaviors. Furthermore, the study provided evidence that enforcing strategy is effective for children with ASD to learn the positive social behaviors in collaborative play.

Video gaming-based learning. Digital video gaming has been integrated in educational settings as a means to enhance learning (Johnson, et al., 2011; Prensky, 2007; Vernadakis, Papastergiou, Zetou, & Antoniou, 2015; Wuang, Chiang, Su, & Wang, 2011). Prensky (2007) referred to several reasons as to why digital game-based learning (DGL) works; (a) games containing the learning context enhance engagement, (b) the DGL enables individuals to actively interact in the learning process, (c) the DGL include learning games which is highly contextual for learners. Particularly, the advance gesture-based gaming devices (i.e., Microsoft Kinect, Nintendo Wii, and Apple iPhone/iPad) have provided positive potential for students learning through the use their intuitions

while interacting with the devices (Johnson, et al., 2011; Vernadakis et al.; Wuang et al.). Thus, a growing body of literature has examined the effectiveness of gesture-based video gaming using various commercial game consoles (i.e., Wii or Xbox Kinect) to enhance various areas (i.e., academic or clinical therapy) for students with and without disabilities (Sheu & Chen, 2014; Vernadakis et al.; Wuang et al.).

While the development of gesture-based technology applications has expanded from gaming to education and training purposes, the evaluation of the innovative teaching using these technologies also has been growing in various areas, such as special education, mathematics, literacy, and physical therapy (Sheu & Chen, 2014). Particularly, Sheu and Chen (2014) reported that 59 studies regarding gesture-based learning were published between 2001 and 2013. The trend showed that there were a small number of studies, ranging from zero to two each year prior to 2010. There has been an increase in the number of studies ($n = 49$) during the three years between 2011 and 2013. Among 59 studies, 43 studies (72.9%) employed an experimental research design, which investigated the effect of gesture-based technology in individuals' learning (i.e., academic content). The three most employed gesture-based technologies were Wii ($n = 26$), Kinect ($n = 9$), and own system ($n = 8$). The systemic review analyzed how gesture-based technology devices were used for supporting teaching and learning with different educational domains, such as special education ($n = 25$), science and math education ($n = 14$), education in general ($n = 10$), physical education ($n = 7$), and other education related field ($n = 6$). The instructional goals in each domain varied. For examples, in special education, gesture-based technology was mainly used to support learners with functional

skills, including physical, cognitive, daily life skills, and job training. Physical training (i.e., visual-motor integration) aimed to use gesture-based technology in physical education. This study argued that gesture-based technology has been integrated in various educational domains, such as low level of learning by repeat motor skills through to more complex learning (i.e., problem-solving). Overall, findings from the systemic review suggested that applications and implementations of gesture-based technology are affordable in supporting teaching and learning in education.

One of the educational domains that gesture-based video gaming was used for was physical education, such as motor skills learning (Sheu & Chen, 2014). A quasi-experiment study was conducted to assess virtual reality using Wii gaming to enhance sensorimotor functions for children with down syndrome (Wuang et al., 2011). The randomly assigned two groups were; virtual reality using Wii gaming technology (VRWii) and standard occupational therapy (SOT). In addition, participants who could not attend to the treatment sessions were assigned to the control group. The VRWii group used Nintendo Wii with Wii Sports and the Wii game controller, which interacted with the participants by detecting their body movements. The pre-intervention test scores did not show any significant differences among the three groups. However, the post-test scores of VRWii group were significantly different from children with down syndrome in two other groups. The VRWii group demonstrated increased motor proficiency, visual-integrative abilities, and sensory integrative functions. As the features of Wii gaming provide real-time interactive simulated feedbacks to the children's performance, the study argued that the virtual reality gaming encourages students to explore their sensory

organization and enhance their motor ability. Moreover, while children are playing the

Wii game, they are required to grasp the Wii handle. This allows them to coordinate

visual and multisensory control, thereby improving visual motor integration.

Similarly, Vernadakis, Papastergiou, Zetou, and Antoniou (2015) examined the

short-term and long-term effectiveness of the gesture-based gaming using Microsoft

Xbox Kinect 360 (XbK) to develop fundamental motor skills (FMS) for early elementary

school children. While children in the control group engaged in traditional FMS training

program to develop object control skills (i.e., catching, kicking, or throwing), the XbK

group played NBA Baller Beats and Kinect Sports for the same target skills using the

XbK console. As both groups performed similar object control (OC) skills in the pretest,

the posttest scores between the control and XbK groups showed significant differences.

The XbK group performance, which had a larger improvement in their score, was better

able to maintain the OC skills compared to the control group. In addition, the XbK group

had higher scores for enjoyment with the XbK games than the control group. Therefore,

as the game console is not expensive and children enjoy playing on them, the study

asserted that the XbK games have the potential to be used in various educational

practices, such as physical education.

Sheu and Chen (2014) highlighted that the majority of the topics in gesture-based

technology focused supporting individuals with disabilities in the area of functional

skills, such as physical and daily life skills. Bioulac et al. (2014) conducted a group

comparison study between children with ADHD and typical children on the continuous

performance test with video gaming. The study hypothesized that video gaming may

increase capturing and maintaining attention for children with ADHD. The study used three video games: PlayStation with Secret Agent, Bubble Pop, and Kung2. The objective of the Secret Agent game is to catch objects, such as ropes, saws, or keys, without being spotted. The game Bubble Pop requires the player to burst blue bubbles and to avoid red bubbles. During Kung 2 game, participants fight against enemies or monsters. The study showed that there is no significant difference between the groups on the video gaming performance. Although the experiment group of children with ADHD showed lower scores in inhibition skills (i.e., catching objects without being spotted by a target) in pre test, the post test results of children with ADHD in inhibition skills increased compared to the results of the pretest. The study argued that video games provided stimulation for children with ADHD to learn adequate functioning skills.

Shih, Yeh, Shih, and Chang (2011) used Wii remote controller to reduce limb hyperactive behaviors of children with ADHD. An ABAB design was employed to provide intervention for two children with ADHD. A Wii remote controllers was attached to one participant' left hand and the other participant's left foot to detect their body movements. During baseline, each student was asked to perform the desire static posture (i.e., maintaining static limb posture). While each student performed prompted posture every 1 minute during the three minutes in each session, the Wii remote controller sensed the limb action of the participant and sent the signal to the software on the computer, which connected to the Wii via Bluetooth. During intervention the same procedure was provided. However, when the participant maintained the static limb posture, the control system activated to show the children's favorite cartoon video on the computer screen.

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Then when the participant exhibited limb hyperactivity, the cartoon video was turned off. The results showed that both children with ADHD presented short duration of maintaining static limb posture during baseline phases ($M = 40.5$s). Then both children increased the duration ($M = 156.25$s). With positive results, this study stated that commercial gesture-based technology might be beneficial to assist individuals with disabilities to learn and develop functional skills, such as reducing hyperactive behaviors.

Mombarg, Jelsma, and Hartman (2013) also used the Wii system to train balance-related skills for children with developmental delays. While 15 children received the intervention using the Wii balance board, which is an accessory of Wii video game consoles, 14 students in control group did not receive intervention. Students in the Wii intervention group played several games on the Wii balance board, such as ski-jump, Segway circuit, and skate boarding. In order to compare the difference between the groups, pre- and post-test of two motor development tests were conducted: (a) the Movement-Assessment Battery for children-2 (M-ABC-2) to evaluate the amount of motor coordination deficits, and (b) Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) to assess balance and balance related skills (e.g., standing on one leg on a balance beam). Pre-test results indicated that there was no statistical difference in the two test scores between the groups. With post-test results, while there was no significant progress on the balance-related skills for the control group, experimental group showed significant improvements: M-ABC2 Balance $F(1, 28) = 22.09$, $p = .00$, $\eta^2 = .45$ and BOT-2 balance $F(1, 28) = 5.34$, $p = .03$, $\eta^2 = .47$. This study found that immediate visual feedback on the video screen benefits the children because it

provided implicit learning, which means that students gained the proper motor movements naturally while they were playing and watching themselves simultaneously.

On the other hands, few studies have been conducted to examine the use of gesture-based video gaming in social skills intervention for students with disabilities (Blum-Dimaya et al., 2010; Ferguson, et al., 2013). However, for those studies that have examined gesture-based video gaming interventions the results have highlighted several positive indications such as promoting motivation and engagement, and increasing feasibility due to ease of use and maintain the device. Ferguson, Gillis, and Sevlever (2013) conducted a study using a multiple baseline design across participants to examine Wii Sports gaming to teach sportsmanship skills for children with ASD. The defined target skills were giving compliment, taking turns, and making positive postgame comment. The operational definition of giving compliment was described as (a) face to the person, (b) use the person's name, (c) give a complement (i.e., "that was a great hit"), and (d) use a friendly voice. Taking turns is defined as (a) wait patiently in the seat when not playing, (b) ask nicely for the remote, (c) hand the remote to peer in a gentle way, and (d) return to seat when turn is over. Finally, the operation definition of making a positive postgame comment was referred as (a) face the person and make eye contact, (b) give a general comment (i.e., "good game"), (c) give a specific comment (i.e., "I had a lot of fun playing with you."), and (d) say comment with a friendly voice. As the results showed increase in those target skills across all participants, the study indicated that the use of video games enabled the target participants to master sportsmanship skills in a short time period (10 week sessions). In addition, due to the portability and accessibility of the Wii

console, the study discussed that video gaming-based social skills intervention with a small group of participants can be easily implemented to clinical and classroom settings.

Due to the lack of social skills, children with autism may have difficulties to independently participate in social activities (Blum-Dimaya et al., 2010). Thus, Blum-Dimaya et al. (2010) conducted a study to examine developing leisure skill using a video game for children with autism. In order to teach four children with autism how to play the video game, Guitar Hero II using the Play Station II, the study provided two different methods: activity schedule and video modeling. The study employed a multiple-probe across participants. During baseline written instruction was provided to the participants to follow the steps to set up the game system, play Guitar Hero, and turn off when the game was finished. During intervention photographic activity schedules contained the same instructions that were used in the baseline. Also, simultaneous video modeling was embedded to teach the children to use fingers to press and play the notes. Additionally, faded prompts were delivered until the participants completed over 70% of tasks. All participants demonstrated increase performance in activity completion independently with activity schedules and maintained the obtained skills during maintenance sessions. In addition, the participants with ASD were able to rapidly learn how to play each song accurately with Guitar Hero.

The findings from these limited studies indicated that the application of gesture-based video gaming provided positive outcomes for students with disabilities. Furthermore, gesture-based video gaming as a means of assistive technology is cost effective to adapt, customize, and maintain for educational practices. Despite the growth

over recent years in gesture-based technology intervention in special education, there is limited evidence to support how gesture-based video gaming can be used in intervention practices in special education (Sheu & Chen, 2014). This indicates that more empirical studies are required to examine the evidence of effective gesture-based video gaming in educational settings.

Summary

The current chapter provided the literature review of existing research to support the current study. Young children with developmental delays tend to show lack of developmental milestones in language, social, and motor skills, which impact their ability to grow as individuals. Social skill is a foundation for young children to develop their social and emotional competence in preschool settings. Research argued that it is important to provide age-appropriate social skills intervention based on their age and developmental levels. In general, play and peer interactions are the main goals of social skills interventions for preschool children with disabilities. Previous research provided evidence that appropriate social skills are associated with increased social interaction and the foundation for success in learning in the future. Particularly, while young children demonstrate appropriate joint attention and imitation skills, they are able to develop language, play and social interaction skills. Turn taking skills allow children to attend to the emotional and interpersonal cues of others and to engage in social interaction with others. In addition, independent play skills is essential because children can be independent in social interaction and academic learning and rely less on adult's assistant.

As technology has been integrated in special education as a teaching and learning tool, a body of literature provided several benefits with the use of technology for students with disabilities: (a) prevent potential dangerous situation, (b) support children with disabilities to complete their tasks independently, and (c) reduce the cost of treatments. Particularly, a number of researches provided positive effects on the use of technology in social skills training for children with disabilities. As technology advances day-by-day, gesture-based video gaming has been introduced to the educational settings, which has been known for entertainment. However, limited body of literature has shown the effectiveness of the use of gesture-based video gaming to teach social skills for children with disabilities. Thus, more evidence-based interventions are required to ensure the meaningful and appropriate use of the video gaming to enhance social skills for children with disabilities.

Chapter Three

This chapter covers the methodology and procedures for this intervention study, which examined the functional relation between gesture-based video gaming using the Xbox Kinect and increase social skills for young children with developmental delays in the preschool setting. This section includes descriptions of the research design, participants, setting, materials, dependent variables and measures, procedures for each phase of the study, reliability and validity, and data analysis.

Research Design

The present study employed a multiple baseline design across participants to evaluate the effects of XbK video games as a means to teach social skills for young children with developmental delays. The three phases of baseline, intervention, and maintenance were included. Direct and systematic replication across the participants was used to establish experiment effects resulting from the intervention.

Single-subject research investigates the functional relation between independent and dependent variables by repeated measurement of the individual participants or cases throughout the study (Horner et al., 2005; Kratochwill & Levin, 2014; Tankersley, Harjusola-Webb, & Landrum, 2008). As the individual participants serve as their own control, the measurement of single-subject research is to compare each participant's performance before, during, and after intervention (Horner et al). This differs from the

experiment group research, which measures the average or mean level of performance between experiment and control group, or compares the change in the group's performance between pre and post-test (Kratochwill & Levin). In the field of special education, each student with disabilities is provided specialized and/or individualized educational services to meet their individual needs (Tankersley et al.). Hence, single-subject research designs have been part of evidence-based practices in special education. The research methods in single subject research are: (a) repeated measurement of individuals' behavior or performance, and (b) assessing the effectiveness of educational practices.

Gast and Ledford (2014) addressed that among single-subject research designs, multiple-baseline designs are the most appropriate for educators and clinicians to conduct a study in educational or clinical settings for the following reasons: (a) allowing them to measure the efficacy of the intervention, (b) not requiring the withdrawal of intervention, and (c) easy to design and implement. Specifically, a multiple-baseline design across participants can be used if all participants are under similar learning histories and/or under similar environmental conditions.

Therefore, the use of single-subject methodology is suitable for the current study, aimed at finding the functional relation between gesture-based gaming and teaching appropriate social skills for young children with disabilities. Furthermore, a multiple-baseline design across the participants provides the effectiveness and efficacy of gesture-based gaming by repeated measurement across the individual student's performance.

Standards and criteria with design. The design of this study followed the standards for single-subject designs and applied the required criteria to meet evidence standards. Kratochwill et al. (2010) provided the criteria that needed to be present in order to meet evidence standards for studies employing a single-subject research design. This study employed a multiple-baseline design across participants and applied the following criteria to meet evidence standards:

(a) "The independent variable (i.e., the intervention) must be systematically manipulated, with the researcher determining when and how the independent variable conditions change." (p. 14)

Student participants were randomly assigned to three tiers for Experiment 1 and 2, and each tier was randomly assigned the intervention start point. Therefore, intervention was introduced in a staggered format to each group in the three tiers.

(b) "Each outcome variable must be measured systematically over time by more than one assessor, and the study needs to collect inter-assessor agreement in each phase and on at least twenty percent of the data points in each condition (e.g., baseline, intervention) and the inter-assessor agreement must meet minimal thresholds." (p. 15)

Interobserver agreement (IOA) checks were conducted for at least 33% of all participants across all phases. The IOA for all three dependent variables ranged between 80% and 100% across all participants, which met the IOA minimum acceptable value of at least 80%. In addition, procedural reliability

was conducted for at least 33% of all tiers across all phases.

(c) "The study must include at least three attempts to demonstrate an intervention effect at three different points in time or with three different phase repetitions." (p. 15)

This study demonstrated an intervention effect for three baseline conditions based on three tiers in Experiment 1 and 2. In addition, each tier received the intervention in three phases, including baseline, intervention, and maintenance.

(c) "For a phase to qualify as an attempt to demonstrate an effect, the phase must have a minimum of three data points." (p. 15)

Each tier across all students received between 5 to 10 baseline sessions, 7 to 12 intervention sessions, and 3 maintenance sessions. Therefore, all phases had at least three data points.

As these design criteria were presented, the design of this study meets evidence standards (Kratochwill et al., 2010).

Participants

Students and professional participants were recruited through an email advertisement to local agencies (i.e., pre-K schools) for children with special needs. A site manager of the preschool contacted the researcher and confirmed that their teachers and students were interested in participating. Therefore, the researcher visited the potential site and evaluated whether the potential site serves young children with

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developmental delays and the classroom was suitable to conduct this study (i.e., technology equipment and space).

Protection of participants and informed consent. Through the Institutional Review Board (IRB) at George Mason University, the procedures and methods of this study was reviewed and approved to protect the rights and welfare of the study participants (see Appendix A for IRB approval letter). After the IRB approval of the study, permission was obtained from the director of the private preschool agency. The site manager of the preschool nominated potential student participants, then parents and/or guardians of participants with developmental delays were informed of the study and how their child would be involved. An introduction letter and consent forms were provided to grant permission for their child to participant in the study (see Appendices B and C for informed consent and introduction letter). Professionals, including teachers, instructional assistance, therapist, site managers, who work directly with student participants also provided their consent forms to complete a social validity interview about the study (see Appendix D for professional participant consent form).

Student participants with developmental delays were assigned a pseudonym to maintain individual confidentiality. All information related to the individual identification was deleted to protect their identification. Thus, no one including the individual students or their family would be identifiable from the study. Professional participants completed the social validity interview anonymously and no personal information in relation to each of the professional participants was retained thereby ensuring that their identity remained

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undisclosed. The details relating to the preschool where the study was conducted is not revealed.

Selection of student participants. The student participants met the following criteria: (a) between 3 to 5 years old and attending preschool, (b) a clinical diagnosis of developmental disabilities (i.e., ASD or GDD), or suspected of development delay by the school authorities (i.e., clinical team); (c) having social skills goals on their Individualized Program Plan (IPP); and (d) able to understand basic spoken English. Potential student candidates were excluded from this study if the student (a) had prior experiences in playing Xbox games, (b) did not give permission to the researcher for video recording of all sessions, and (c) could not see or hear the games on the screen with either aided (i.e., hearing aid or glasses) or unaided. Those criteria for selecting the student participants can be found in Appendix E.

Potential student participants were included either if the student had a clinical diagnosis of a specific disability (i.e., ASD or GDD) or an indication of developmental delay by the school clinic team. In the later case, although a student has not been evaluated and diagnosed with a specific disability, the preschool provides special education services which is based on formal and informal assessments and observations when a student is suspected to have a developmental delay. Therefore, this study included students at risk for developmental delays by the school agency.

Selection of professional participants. Professional participants were selected from teachers, therapists, and instructional assistants who directly work with student participants in the same preschool. Before starting the intervention, they were asked to

provide their consent to complete the social validity interview. At the end of the

intervention, these professionals shared their opinions regarding the use of gesture-based

video gaming as an intervention for their children with developmental delays.

Student participants. Eight preschool children with developmental delays were

originally selected to participate in this study. Only seven children met the selection

criteria (see Appendix E for candidacy checklist). This is because the parent of one of the

student did not grant permission to record her child on video. A second student was

absence for multiple intervention sessions and was excluded from the data collection.

Therefore, a total six children participated in the study. Three children were diagnosed

with Autism Spectrum Disorder (ASD) or Global Developmental Delay (GDD) by

independent agencies. Three children were at-risk for developmental delays by the school

agency. All children had limited social skills, and had aims to improve specific social

skills (i.e., turn taking) in their IPP. Participants were divided into two groups for the

purpose of data analysis. Experiment 1 included students with diagnosis of specific

disabilities and Experiment 2 for students who were at-risk for developmental delays.

Experiment 1. The following section provides demographic and developmental

descriptions of each participant in Experiment 1. Students were included in Experiment 1

if they had a clinical diagnosis of specific developmental disabilities, such as ASD or

GDD. Therefore, three students, Danny, Fran, and James, were included in Experiment 1.

The following describes each participant, including demographic information (i.e.,

gender, age by month, ethnicity, and diagnosed disabilities), areas of current IPP related

to social skills, and current level of language and physical development.

Danny. Danny was an Asian boy who was 48-month-old at the start of this research study. He was diagnosis with Global Developmental Delay (GDD). According to the medical report by the local physician, Danny demonstrated severe communication, fine motor, and gross motor delays, as well as sensory processing difficulties.

Danny's Individualized Program Plan (IPP) provided information on the present levels of speech, language, play, and social skills development. Due to the delay of his expressive and receptive language skills, he has been learning how to express his feelings or request a preferred toy or activity. The occupational and speech therapists focused on teaching him to express his feelings in an appropriate manner to peers when he does not like their behaviors. For example, he would say, "stop please" when his peer is touching his toy. He had a tendency to be unwilling to share a toy or perform an activity with peers. This resulted in frequent refusal to participating in group activities or peer interactions, accompanying with emotional distress, such as crying or hitting himself. His teacher worked with him to increase joint attention for sharing space and activity with peers, reducing his emotional distress. His attention was not consistent, especially when there was another child playing around him, he easily got distracted and was not able to complete his task.

Fran. Fran was an Asian boy who was 48-month-old at the start of this research study. He had a medical diagnosis of ASD. He showed moderate delay (4th percentile) in gross motor skills. According to the medical report by the private physician, he demonstrated severe delays in expressive and receptive language skills and difficulty with social interaction.

He had difficulty with joining group activities such as circle time. During circle time, he would join the group for less than one minute. Then he stayed away from the group during most of the circle time and walked around the classroom or played with toys or objects by himself. He became calm when he was holding his preferred toy or object (i.e., stuffed toy). However, he had a difficult time transitioning from his preferred activity to non-preferred ones. He often showed negative behaviors when he was playing an activity he was not interested (i.e., whining or crying). When he was disrupted by his peers or his preferred toys were removed, he got easily upset and threw tantrums, including anger ranting. While he played with toys or objects, he demonstrated difficulty with following verbal directions and combining two objects (i.e., choose two red blocks and put together). Therefore, Fran's IPP focused on improving his language and social skills. The main goals for his social skills were to increase the amount of time he joined in the circle time and group activities and be more accepting of his peers in his play space. In trying to reduce his negative behaviors, the speech therapist was teaching him how to request or deny what he wants or does not want, such as "I want" or "I don't want".

James. James was a Caucasian boy who was 56-month-old in the beginning of this study. He was diagnosed with ASD by the local private agency. His medical reports showed severe delays in fine motor and gross motor skills. His language and communication reports indicated that he had severe delay in expressive language skills and moderate delay in receptive language skills.

James had lack of social and motor imitation skills. During circle time, he often tried to avoid the group activity by demonstrating negative behaviors, such as crying. Then, he tended to stay away from the group and preferred sitting alone to play by himself. Although he showed better understanding towards verbal instructions from adults compared to his peers with developmental delays, he had difficulty to express or describe his feeling or emotions when he faced challenges in completing a task. He also had difficulty with participating in physical activity due to his limited motor skills. Therefore, James' IPP focused on improving his language, social and motor skills. His main IPP goals were to identify and describe his emotions to teachers, such as his feeling "I am angry". He would increase his attention during circle time and interact with peers. Also, his physical therapist was focusing on teaching him gross motor movement with appropriate hand and body movements.

Summary of student participants in Experiment 1. Table 1 summarizes the characteristics of student participants in Experiment 1. The detail includes each participant's gender, age by month, diagnostic/suspected category of disabilities, and clinical report.

Table 1

Summary of Characteristics of Student Participants in Experiment 1

Participant	Gender	Age (in months)	Diagnostic Disabilities	Clinical Report
Danny	Boy	48	GDD	Severe delays in communication, fine motor, gross motor skills Severe sensory processing difficulties
Fran	Boy	48	ASD	Moderate delay in gross motor skills, Severe expressive/receptive delays
James	Boy	56	ASD	Severe delays in fine more, gross motor, and expressive language skills Moderate in receptive language skills

Experiment 2. Students were included in Experiment 2 if they were at-risk for developmental delays by the school clinical team. Therefore, three students, John, Eric, and Carl, were included in Experiment 2. The following describes each participant, including demographic information (i.e., gender, age by month, ethnicity, and suspected disabilities), areas of current IPP related to social skills, and current level of language and physical development.

John. John was an Asian boy who was 41-month-old at the start of this study. He was suspected of ASD by the school clinic team. According to the local medical assessment report, he showed severe delay in receptive and expressive language skills.

John showed severe lack of social and communication skills. He had limited verbal language and only used a few single words. He was unable to follow one-step

verbal directions. Therefore, his teachers used visual cues for communication and instructions, which helped him follow the instruction using these familiar signs (i.e., stop). He had difficulty with transitioning between indoor and outdoor activities. He had limited eye contacts with adults and did not make eye contact with his same age peers at all. During regular classroom routine, he tended not to engage or participate in the activity and did not let peers within his space. Further, he showed no interest in the group activity, so he usually isolated himself from the group. Hence, his IPP goals indicated the need to increase his social and communication skills. His speech therapist was training him on how to express what he wants in the appropriate manners, such as "more". He would participate during circle time and allow peers into the play area with him.

Eric. Eric was a Middle Eastern boy who was 42-month-old when this study started. He was suspected ASD by the school clinic team. According to the Receptive-Expressive Emergent Language Test, Third Edition (REEL-3), his receptive language skills was below 1-percentile, 2-percentile for expressive language skills, and below 1 percentile in language ability, which showed severe delay in language and communication skills.

Due to his severe language and communication skills, he did not make verbal requests independently. Although he participated in group activities without inappropriate behaviors, he had difficulty with following one-step functional direction (i.e., sit on the mat). He mainly relied on the instructional assistant, such as visual signs, to follow the directions of the class activities. Therefore, he had difficulty to complete tasks independently and did not always respond to his name. Due to his poor language and

communication skills, he did not interact with peers. Instead, he had a tendency to repeat one-word which was his favorite toy (i.e., Spiderman) while adults tried to communicate with him. During circle time, he was unable to take turns, and had difficulty with imitating verbal and motor actions. Therefore, his IPP indicated improvement in his communication and social skills. He would follow one-step functional directions and make independent verbal requests. Also he would understand taking turns in classroom activity and increase attention toward his peers and the activity.

Carl. Carl was a Caucasian boy who was 55-month-old at the start of this study. He was suspected GDD by the school clinic team. The local medical agency reported that he demonstrated severe delay in expressive, receptive language and communication skills. In addition, he had pragmatic language deficits.

Due to his lack of communication and social skills, he had difficulty with interacting with a communication partner. Although Carl produced and imitated various single words, he was unable to use two-word sentence to communicate. Therefore, he had difficulty with following directions from peers and two-step simple directions from adults. In addition, he was not able to take turns in communication and play activity. This resulted in his inability to maintain play with peers for more than 5 minutes. Also, Carl had difficulty with change in his routine, such as transition between playground and indoor. He had auditory sensitivity and was easily disturbed by loud sound. In this regards, the IPP team focused on increasing his joint attention, using two-word sentence for communication, and increasing turn taking for communication and play.

Summary of student participants in Experiment 2. Table 2 summarizes the

characteristics of student participants with developmental delays in each group. The

detail includes each participant's gender, age by month, diagnostic/suspected category of

disabilities, and clinical report.

Table 2

Summary of Characteristics of Student Participants in Experiment 2

Participant	Gender	Age (in months)	Suspected Disabilities	Clinical Report
John	Boy	41	ASD	Severe delays in expressive and receptive language skills
Eric	Boy	42	ASD	Severe delays in expressive and receptive language skills
Carl	Boy	55	GDD	Severe delays in expressive and receptive language skills, Pragmatic language delays

Professional participants. Three professional participants were recruited and

they were all teachers who directly educated the student participants in this study. Those

professional participants had opportunities to observe this intervention study. Thus, they

participated in the social validity interviews at the end of the intervention and provided

their opinions related to the XBK gesture-based video gaming as a social skills

intervention. Three professionals were all female, between 30 to 32 years old and had 2.5

to 5 years of teaching experiences in the preschool settings.

Setting

This study was conducted in a preschool in an urban city in North America. The preschool is a private agency for three to five years old children with special needs. All children in the program are from backgrounds of poverty, abuse, trauma, or neglect. Particularly, many children in this preschool are at-risk for developmental disabilities, such as ASD or GDD. Therefore, the agency focuses on providing daily socialization, therapies in development, speech and language, gross and fine motor, and psychology, and nutritional needs to the children.

This study was conducted in the sensory room in the preschool agency, where it is suitable for the XbK game activity. The room has sufficient space for unhampered interaction with the XbK interface and appropriate technical infrastructure including TV screen and secured Wi-Fi Internet access, are available to support the use of the XbK. The room is an open space with all materials removed to avoid all distractions.

Through the entire sessions, two placemats were placed in the left side of the room. The placemats were used to mark the seating spots for the participants while waiting for their turns and watching their peers play. Then a play spot was marked using a color tape 6 feet from the front of the room. In addition, the TV screen with the XbK system was placed at the front of the room during the intervention and maintenance phases.

Independent Variable

The Xbox Kinect 360 (XbK) was the independent variable for this investigation. XbK includes Xbox 360 console and Kinect sensor (see Figure 2). Xbox 360 is a video

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game console. The Kinect sensor device is a controller, which senses the player's motion. The Kinect sensor enables users to control and interact with the game console (Xbox 360), through a natural user interface using gestures and spoken commands.

Figure 2. Image of Xbox 360 with kinect sensor

The Kinect system with Xbox 360 tracks users' motion by face recognition, clothes color tracking, and height estimation from the existing profile database in the system. The profile includes an avatar representing the user on the Xbox games. Users are able to customize his or her own avatars, representing individual characteristics by body shape, gender, facial features, hairstyle, and clothing. When the personal profile is matched to the user identification, the user can control the Kinect system by using simple body movements and the avatar on the screen would perform the action by imitating the user's movements.

Materials

During the baseline, intervention, and maintenance phases, visual color signs and placemats were used to support the student participants for the game activities. Visual color signs (red and green) were used to assist with signaling when it was each player's turn. Two paper plates having a solid red or green color were placed at the front of the room for each session. Each student was assigned a different color, when a sign with their color was placed at the front of the room this would signal the child's turn. Two placemats were used to provide seated area for each participant. Each student was assigned to a placemat to sit while waiting for his turn.

Two iPad minis were used to record each session across all phases. The video mode on the Camera app on the iPad mini was setup to record the entire session. One iPad was placed at the front right corner and the other was at the back right corner. The videos were angled to capture the students' performances and the screen to enable the review of their performances. The video recorded sessions were used for the independent observers to collect the data on the three dependent variables for each participant and check the procedural reliability.

The Timer app on the iPhone was set to ensure that each child's turn to play was for 30 seconds with a total of six alerts during each 5 seconds interval. When the researcher put a visual sign at the front of the room, she pressed the start button on the timer, then every 5 seconds the timer vibrated. While each student played the game, verbal or physical prompts were provided if he did not demonstrate the appropriate play behaviors for turn taking for 5 seconds. Also, verbal prompt was provided for accurate

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gesture imitation when he did not imitate properly for 5 seconds. Therefore, vibration during every 5 seconds interval provided a signal for the researcher to provide prompt if necessary.

Two different games were used in the current study. During baseline phase, Sue Says game was introduced to measure the baseline data of the three dependent variables from the student participants. Then, the XbK with Air Band game was introduced to enhance the target behaviors during the intervention phase and continued to use it for the maintenance phase.

Baseline game material. During baseline, the Sue Says game was used. Sue Says game was adapted from the Simon says game for this study. Specifically, the researcher introduced herself as Sue to the participants and asked each student to imitate playing with a specific musical instrument (i.e., "Sue says, play the guitar").

Intervention and maintenance game material. Kinect Fun Labs is a downloadable application from the Microsoft Xbox Kinect 360 Marketplace and includes over fifteen gadgets, which could be used to play with XbK. Air Band game is part of Kinect Fun Labs gadgets and was used with XbK during the intervention and maintenance phases. Once the Air Band game was loaded, the user would be required to select the music genres (i.e., pop, dance, country, or rock). Then, the introduction screen appears to show how to play the musical instruments (see Figure 3 for introduction screenshot of Air Band game).
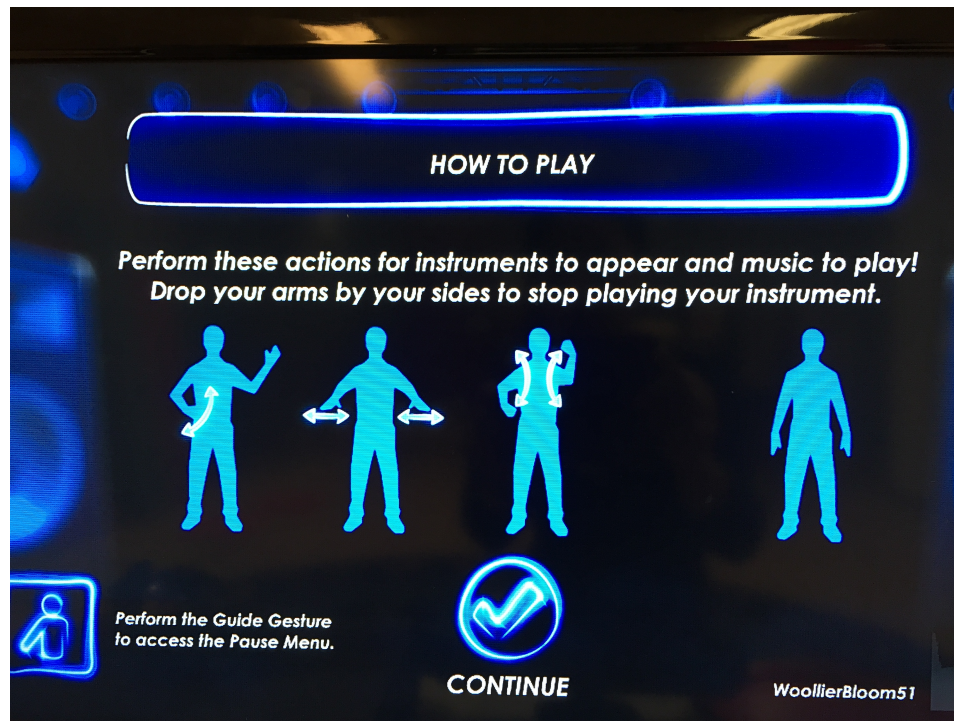
Figure 3. Screenshot of the introduction of Air Band game

Air Band provides three different musical instruments (piano, drum, and guitar) and one or two players can play at a time with their preferred instruments by body motions. Figure 4 shows two children playing the piano and drum with the Air Band game. While playing with Air Band, the Kinect sensor would capture the gestures of the child' movement and if the child gestures are recognized by the Kinect, the screen shows the virtual musical instruments. Therefore, the child plays with the virtual musical instrument based on the appropriate body gestures. For example, in order to play the piano, a child holds both hands and moves their hands up and down while at the same time moving their arms left to right as if the child was selecting a different key. In order

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to play the drum, a child moves their hands up and down or alternating with one hand up and the other hand down. With playing the guitar, a child put one hand to the side like holding the guitar and the other hand is moving up and down as if to motion striking the guitar strings. In addition, when a child wants to change the musical instrument, a child would need to remain still by putting both arms down until the current virtual instrument disappears.

Figure 4. Screenshot of students playing Air Band game

Dependent Variables and Measurement

The dependent variables of this investigation were (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking. All dependent variables were related to specific social skills observed during play and across all phases and recorded using the data collection sheet (see Appendix F).

Accurate gesture imitation. The operational definition of accurate gesture imitation was defined as body actions by a child that accurately imitated playing a musical instrument. During the Sue Says baseline sessions, the researcher instructed the students to play certain musical instruments (i.e., piano, drum, and guitar) and the students tried to imitate playing the musical instrument. While a child played the Air Band game, the Kinect sensor captured the gestures of the child and if the child's gestures were recognized by the Kinect, the screen showed the virtual musical instruments. Therefore, the child played with the virtual musical instrument based on the appropriate body gestures. For example, appropriate gesture imitation with playing the piano occurred when a child holds both hands and moves their hands up and down while at the same time moving their arms left and right as if the child was selecting a different key. In order to play the drum, a child moved both hands up and down, or alternating one hand up and the other hand down. With playing the guitar, a child put one hand to the side like holding the guitar and the other hand would move up and down as if to motion striking the guitar strings. In addition, when a child changes the musical instrument, they need to remain still by putting both arms down until the current virtual instrument disappeared.

Verbal prompt assisted the participants to learn and use appropriate play skills independently across all phases. When a child did not demonstrate appropriate gesture imitation for more than 5 seconds, the researcher provided one verbal prompt. Verbal prompt was verbal instructions on what to do (i.e., "John, move your arms side to side").

The data collection sheet (see Appendix F) was used to collect data for accurate gesture imitation. All virtual instruments appearing on the screen in accordance with the child's gestural imitations were recorded. When a child independently demonstrated accurate gesture, the initial for independent "I" was recorded and the occurred imitation was noted on the occurred imitation section (i.e., piano). If a child demonstrated accurate gesture imitation after the verbal prompt, the initial for verbal prompt "V" was recorded and the occurred imitation was noted on the occurred imitation section (i.e., piano). For each turn, a child played only one musical instrument. In this case, the accurate gesture imitation behavior occurs only once. For example, if a child imitated playing the piano with verbal prompt and the virtual piano appeared, "V" was recorded and "piano" was noted. For another example, if a child imitated playing the guitar independently and the virtual guitar appeared, "I" was recorded and guitar was noted. However, a child might play several instruments during the turn. In order to change the instrument, the child needed to be still for a moment until the virtual instrument disappeared. Then he/she would motion the appropriate body imitation for playing the musical instrument. For instance, during a turn, a child started to play the drum independently with accurate gesture of drumming, and remained still until the current visual instrument disappeared, then played the piano. In this case, two occurrences of "I" were recorded and drum and

piano were noted in order. Thus, the frequency of accurate gesture imitation was collected based on the total score of the occurrences, 1 point for independent and 0.5 for verbal, in each session.

Visual attention during play. Visual attention during play was defined as a child's visual attention that was orientated toward the screen, or other players without shifting his/her eye gaze. During the baseline game, a child would visually attend to the game facilitator (instead of a screen) or other player. While a child played on the XbK, he would visually attend to the screen. While waiting for their turn, a child would visually engage in play by looking at the screen or their peer's playing. Visual attention during play applied the concept of joint attention to measure the frequency of intervals with their visual attention toward the XbK gesture-based video gaming.

The visual attention was recorded if the student was staring at the screen (game facilitator during baseline) or the other player for the entire 5 seconds. As the interval was 5 seconds, each child was required to eye gaze for the entire 5 seconds to be scored as an occurrence of visual attention during play. If a child stared towards the screen for 4 seconds and shifted eye gaze for 1 second, the occurrence was not scored. Although a child was staring at the screen or other player for the entire 5 seconds, visual attention was not observed for the following; (a) if the child showed negative behaviors (i.e., making noise), and (b) if the child interrupted other students while they were playing. Visual attention during play was recorded using the data collection sheet (see Appendix F). If visual attention occurred toward the screen (game facilitator during baseline) for the 5 seconds, "S" for screen was noted on the occurrence section. When visual attention was

toward the other's playing for the 5 seconds, "O" for other's play was recorded on the occurrence section. Then, the independent observer noted whether the visual attention had occurred while playing ("P") or while waiting ("W") in the note section. In addition, observed time was noted on each occurrence. With the total number of occurrences, the frequency of intervals with visual attention during play was collected and recorded.

Turn taking. The operational definition of turn taking referred to an event involving a sequence of turns during play. The sequence of the turn taking are (a) a child patiently sat and waited for their turn to play, (b) when it was his turn, the child moved to the play spot, and (c) returned to the waiting area and sat on the mat after completing his turn. In order to assist children to demonstrate appropriate turn taking behaviors, verbal and physical prompts were provided. If a child did not demonstrate the appropriate behaviors for turn taking for over 5 seconds, verbal prompt was provided. For example, if a child started walking around the room for more than 5 seconds while waiting, the researcher provided verbal prompt, "sit and wait". If a child did not correct the behavior in over 5 seconds after the verbal prompt, physical prompt was provided (i.e., holding the child's hand and guide him/her to sit on the mat). The sequence of turn taking behaviors was recorded using the data collection sheet (see Appendix F). The prompt initials (I, V, and P) for the occurred event of the each step of turn taking were recorded. After the physical prompt, if the child repeated the inappropriate behaviors (i.e., leaving from the seating), then "N" was recorded to represent that the event has not occurred.

For example, if the child was not sitting on the seat patiently while waiting his turn after the physical prompt (i.e., walking around the room), the sequence of the first

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step of turn taking was not present. In addition, although the child was sitting on the mat and waiting for his turn, appropriate turn taking had not occurred if the child demonstrated negative behaviors (i.e., making noise) or interrupted other's playing. Therefore, the turn was considered completed if the child finished the three step turn taking sequence independently. Each participant was provided 5 turns per session. The frequency of turn taking was collected based on the total number of prompts during the 5 turns in each session. The three steps in each turn taking were recorded as 2 points for independent occurrence, 1 points after verbal prompt, 0.5 point after physical prompt, and zero point if not occurred. Then, the frequency of turn taking was calculated and the maximum score per session was 30 points (2 points x 3 steps x 5 turns).

Procedures

This research study followed the order to conduct this intervention study. Prior to the study, the researcher assigned the six students into three groups to receive the intervention. During the study, three phases were conducted including baseline, intervention, and maintenance. Then, the social validity interviews with students and professional participants were conducted at the end.

Random assignments. With a total six student participants, this intervention study formed groups of two participants in each playgroup. Fran and Eric attended the morning program so they were grouped together. The other four students, two from Experiment 1 and the other two from Experiment 2 attended the afternoon program. The researcher wrote each of the four students name on a piece of papers and folded them into halves. Then, the researcher put them into two small baskets, one basket for Experiment 1

and other for Experiment 2, and mixed the papers. In order to divide the four students into two groups, the researcher closed her eyes and picked the one papers from each basket, which were John and Danny, who formed as one group. Then the remaining two students, James and Carl, were in the other group. Therefore, six students were divided into three groups.

The next step was to assign the orders of the group, which determined the treatment starting point. Using three pieces of paper, the researcher wrote down the names of the students in one group on one piece of paper, then repeated for the remaining two groups and folded the three pieces of papers into halves. The folded papers were placed in a small basket and mixed. The researcher closed her eyes and picked the first paper, which contained the names, John and Danny. They were in the group 1, which was the first tier to receive the intervention after the 5th baseline session. The second paper drawn contained the names of Fran and Eric. They were in the second tier and received the intervention after 8th baseline session and after the first group had shown stable data points in intervention. The last piece of paper contained the names, James and Carl, who were assigned to the third group and were the last to receive intervention. They received the intervention after 10th baseline session.

Baseline. Prior to the start of all baseline sessions, two iPad minis were set up at two different angels, one toward the play spot and the other toward the seated area. The video started recording before the participants entered the room. The researcher marked a play spot using a colored tape 6-feet from the front of the room. Then, two placemats were placed in the left side towards the front of the room. Two different colored (green

and red) visual signs were used to assist with signaling when each participant's turn, by placing the applicable colored sign in front of the room.

The researcher facilitated the Sue Says game during the baseline phase (see Appendix G for baseline game script). When the teacher brought each group of participants into the room, the researcher guided each child to sit on a placemat and mentioned they will play a game. The researcher said, "It's time to play the Sue says game. My name is Sue. When I ask you something, you will play what Sue says". The researcher showed the color signs and assigned each color to each student (i.e., "John, green sign"). Then, explained how to take a turn, "When you see your color, come and play. When I remove your color, return to your seat and wait". After the introduction, the researcher said, "Let's start!" Then, the researcher placed the color sign in front and pressed the start button on the timer. The order of the color signs was alternated for each session. The researcher said, "Sue says, play the _____(drum, guitar, or piano)". When the timer vibrated after 30 seconds, the researcher pressed the timer and took away the color sign. This was repeated until each participant had 5 turns to play. To end a session, the researcher announced, "It is time to finish the game. Well done!" Then, the participants' teacher brought the students back to their class and researcher turned off all video recording devices. This procedure was repeated for each group of participants. During baseline phases, several prompts supported each participant to complete their turn. While taking turns, verbal and physical prompts were provided if a child did not demonstrate appropriate behaviors within 5 seconds. For example, verbal prompts provided verbal instruction to the child on what do to (i.e., "come to the play spot"). If

the child did not correct the anticipated behavior 5 seconds after the verbal prompt was provided, physical prompt was given to help the child with the appropriate turn taking (i.e., holding the child's hand and moving to the play spot). While a child was playing the Sue says game (i.e., Sue says, play the drum), verbal prompt was provided. If a child did not play the appropriate imitation of what Sue says, the researcher provided the verbal direction of how to play the musical instruments (i.e., "move your hands up and down").

Baseline sessions conducted between 2 to 4 times per week for approximately 10 minutes and each child had 5 turns per session. All three tiers had at least 5 baseline sessions. Each tier had the following number of baseline sessions; the first tier had 5 sessions, the second tier with 8 sessions, and the third tier with 10 sessions. All video recorded baseline sessions were reviewed to score the dependent variables by the researcher and a trained observer.

XbK video gaming intervention. Prior to the start of each intervention session, the researcher set up the XbK system in the front of the TV screen and both the TV and XbK were turned on. The game profile was logged in and the Air Band game for the session was ready and displayed the introduction screen. The researcher marked the play spot using a colored tape 6-feet from the XbK system. Then, two placemats were placed in the left side angling 45-degree toward the play screen (see Figure 5 for XbK intervention game setup). Two different colored (green and red) visual signs were used to assist with signaling when each participant's turn, by placing the applicable colored sign in front of the room. The two iPad minis were set up in the room, angling towards the

play spot and the seating area. The video started recording before the children entered the room.

Figure 5. Screenshot of XbK intervention game setup

The researcher facilitated the XbK with Air Band game during the intervention phase (see Appendix G for intervention game script). When the teacher brought each group of participants into the room, the researcher guided each child to sit on a placemat and mentioned they will play a game. The researcher said, "It's time to play the Air Band game. Look at the screen". The researcher pointed to the screen and modeled what movement was required for each musical instrument. The researcher said, "Piano", and

moved her hands side to side to play the piano. "Drum" and moved her hands up and down to play the drum. Then, she said "Guitar" and straightened one hand to the side and moved her other hand up and down to play the guitar. The researcher showed the color signs and assigned a color to each student (i.e., "John, green sign"). Then, explained how to take turn, "When you see your color, come and play. When I remove your color, return to your seat and wait". After the introduction, the researcher said, "Let's start!" Then, the researcher placed the color sign in front and pressed the start button on the timer. The order of the color signs was alternated for each session. When the timer vibrated after 30 seconds, the researcher pressed the timer and took away the color sign. This was repeated until each participant had 5 turns to play. To end a session, the researcher announced, "It is time to finish the game. Well done!" Then, the participants' teacher brought them back to their class and the researcher turned off all video recording devices. This procedure was repeated for each group of participants.

During intervention phase, the same verbal and physical prompts from the baseline phase supported each participant to complete the game. While taking turns, verbal and physical prompts were provided if a child did not demonstrate appropriate behaviors within 5 seconds. For example, verbal prompts provided verbal instruction to the child on what to do (i.e., "come to the play spot"). If the child did not correct the anticipated behavior after providing the verbal prompt for 5 seconds, physical prompt was given to help the child with the appropriate turn taking (i.e., holding the child's hand and moving to the play spot). While a child played the Air Band game, verbal prompt was provided. If a child did not play the appropriate imitation, the researcher provided the

verbal direction of how to play the musical instruments (i.e., "move your hands up and down").

The total intervention sessions were 7 to 12 sessions depending on the tier and each group of students received approximately 10 minutes of 2 to 4 sessions per week. All video recorded intervention sessions were reviewed to score the dependent variables by the researcher and a trained observer.

Maintenance. Three maintenance sessions were conducted for all groups of participants two weeks after the completion of the intervention phase. During maintenance each group played the XbK with Air Band game but without showing the introduction screen on how to play each instrument.

Prior to the start of the maintenance sessions, the researcher set up the XbK system in the front of the TV screen and both the TV and XbK were turned on. The profile was logged in and the Air Band game was running. However, the researcher skipped the introduction screen, therefore the participants was able to play immediately without watching the introduction on how to play. The researcher marked the play spot using a colored tape 6-feet from the XbK system. Then, two or three placemats were placed in the left side angling 45-degree toward the play screen. The two iPad minis were set up in the room, angling toward the play spot and the seating area. The video started recording before the children entered the room.

The researcher facilitated the XbK with Air Band game during the maintenance phase (see Appendix G for maintenance game script). When the teacher brought each group of participants into the room, the researcher guided each child to sit on a placemat

and mentioned that they will play a game. The researcher said, "It's time to play the Air Band game". The researcher showed the color signs and assigned each color to each student (i.e., "John, green sign"). After assigning the color for each child, the researcher said, "Let's start!" Then, the researcher placed the color sign in front and pressed the start button on the timer. The order of the color signs was alternated for each session. When the timer vibrated after 30 seconds, the researcher pressed the timer and took away the color sign. This was repeated until each participant had 5 turns to play. To end a session, the researcher announced, "It is time to finish the game. Well done!" Then, the teacher brought the students back to their class and the researcher turned off all video recording devices. This procedure was repeated for each group of participants.

During maintenance phase, the same verbal and physical prompts from the baseline and intervention phases supported the participants with completing the game. While taking turns, verbal and physical prompts were provided if a child did not demonstrate appropriate behaviors within 5 seconds. For example, verbal prompts provided direct verbal instruction to the child on what to do (i.e., "come to the play spot"). If the child did not correct the anticipated behavior after 5 seconds, physical prompt was given to help the child with the appropriate turn taking (i.e., holding the child's hand and moving to the play spot). While a child played the Air Band game, verbal prompt was provided. If a child did not show the appropriate imitation, the researcher provided the verbal direction on how to play the musical instruments (i.e., "move your hands up and down").

Maintenance phase had 3 sessions each approximately 10 minutes long and each child had 5 turns per session. All video recorded maintenance sessions were reviewed to score the dependent variables by the researcher and a trained observer.

Reliability and Validity

While reliability of measurement provides consistency as to what the study measured, validity refers to the degree of what the study is intended to measure (Gast & Ledford, 2014). Reliability of measurement refers to both accuracy and consistency of the data, which is commonly documented as the agreement between two independent observers who observe the behaviors and is called interobserver agreement (IOA). Procedural reliability is related to procedural fidelity to document whether the procedures for each phase were implemented as planned. In SSRD, social validity is included to provide evidence on how the study is socially valid and important. Social validity data can be obtained by surveys, questionnaires, or interviews that determine whether the participants were satisfied with the intervention.

This section provides reliability of data collection on research procedures and dependent measures. The reliability for the three dependent measures was assessed, including (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking. Procedural reliability was also assessed across baseline, intervention, and maintenance sessions. In addition, social validity was conducted by interviewing the student and professional participants.

Independent observer's training. Prior to the reliability checks for dependent measures and procedures, the researcher trained an independent observer on how to

record the observation. The independent observer was a 25-year old college student studying electronic engineering in a local university where the research was conducted. Although he had no experience with working in the educational field, he had a 5-year old nephew who was diagnosed with developmental delay. Therefore, he showed high interest in being an observer to collect data on the performance of children with developmental delays. The training session took place in a quiet lounge room in the researcher's condo. The researcher explained the game materials (Sue says and XbK with Air Band games) and the three dependent variables. Then, the researcher showed how to use the data recording systems (see Appendix F for data collection sheet). The researcher and the independent observer practiced collecting data using the data recording system. Two pilot sessions of recorded videos, one baseline and one intervention session, were used to train the independent observer. The children in the pilot sessions did not participate in this study.

While the researcher provided training to the independent observer for the dependent measures, they watched the baseline pilot videos together and collected data using the data collection sheet. The researcher explained how to collect data for each student on the three dependent variables, watching the recorded videos from two different angles. Then, the researcher demonstrated how to record the three dependent variables on the data collection sheet. When the researcher and the independent observer completed recording the data on the data collection sheet using the recording of one pilot baseline session (front and side angled video recordings), they discussed how the recording process went and any questions or learning related to analyzing the data. Then, the

researcher and the independent observer watched the intervention pilot session of the recorded videos and collected the data separately. This provided an opportunity for the independent observer to practice data collection before starting the study. After completing the recording of the data with the second set of videos, the researcher compared the data sheet to check the percentage of data recorded was agreeable between the researcher and the independent observer. IOA of accurate gesture imitation was 100%, 100% of visual attention during play, and 97% of the turn taking data. As the results were over 80% of IOA, this was an acceptable level of the reliability (Gast & Ledford, 2014). The training session was completed with higher percentage of IOA for the dependent measures.

Interobserver agreement for dependent measures. The three dependent variables, including accurate gesture imitation, visual attention during play, and turn taking, were recorded using two iPad minis from two different angles, front right side and back right side, to capture the participants' performances and the TV screen. In order to assess the reliability of the dependent measures, the researcher and a trained observer independently scored the three dependent variables using the data collection sheet. Event recording was used to record the occurrence of each independent variable base on the event-by event agreement. The interobserver agreement (IOA) was calculated by the number of agreements divided by the sum of the number of agreements and disagreements, then multiplying by 100.

In order to evaluate the reliability of the observed scores for the dependent variables, the IOA analysis was completed from randomly selected 33.33% to 42.86% of

the observations for three dependent variables, (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking, across all phases and participants. The mean IOA was 97.25% ($SD = 6.08$), ranging from 80% to 100% for all participants for accurate gesture imitation: Danny ($M = 97.14\%$, $SD = 7.56$), Fran ($M = 100\%$, $SD = 0$), James ($M = 100\%$, $SD = 0$), John ($M = 97.14\%$, $SD = 7.56$), Eric ($M = 97.62\%$, $SD = 6.30$), and Carl ($M = 97.05\%$, $SD = 5.48$). Table 3 provides a summary of the IOA for accurate gesture imitation. For visual attention during play, the mean IOA was 94.45% ($SD = 4.45$), ranging from 96.15% to 100%: Danny ($M = 98.49\%$, $SD = 2.64$), Fran ($M = 100\%$, $SD = 0$), James ($M = 98.90\%$, $SD = 3.12$), John ($M = 97.80\%$, $SD = 5.81$), Eric ($M = 100\%$, $SD = 0$), and Carl ($M = 99.49\%$, $SD = 1.44$). Table 4 provides a summary of the IOA for visual attention during play. For turn taking, the mean IOA was 99.40% ($SD = 1.23$), ranging from 86.67% to 100%: Danny ($M = 92.83\%$, $SD = 4.60$), Fran ($M = 94.29\%$, $SD = 4.60$), James ($M = 95.24\%$, $SD = 5.04$), John ($M = 91.43\%$, $SD = 6.34$), Eric ($M = 93.33$, $SD = 5.44$), and Carl ($M = 95.00\%$, $SD = 4.71$). Table 5 provides a summary of the IOA for Turn taking.

Overall, the IOA scores of all three dependent variables across all participants and phases fell within the acceptable limits, which is a minimum of 80% agreement (Gast & Ledford, 2014). The results achieved was more than 80% of IOA for all three dependent variables for one-third of the sessions (33%) across participants and phases which meet the evidence standards (Kratochwill et al., 2010).

Table 3

Interobserver Agreement (IOA) in Percentage for Accurate Gesture Imitation

Phase	IOA	Experiment 1			Experiment 2		
		Danny	Fran	James	John	Eric	Carl
B	% of S	40	37.50	40	40	37.50	40
	M	100	100	100	100	100	100
	SD	0	0	0	0	0	0
	Range	100-100	100-100	100-100	100-100	100-100	100-100
I	% of S	33.33	33.33	42.86	33.33	33.33	42.86
	M	100	100	100	95	100	92.13
	SD	0	0	0	10.00	0	6.85
	Range	100-100	100-100	100-100	80-100	100-100	87.50-100
M	% of S	33.33	33.33	33.33	33.33	33.33	33.33
	M	80	100	100	100	83.33	100
	SD	.00	.00	.00	.00	.00	.00
	Range	80-80	100-100	100-100	100-100	83.33-83.33	100-100

Note. Phase: B = Baseline, I = Intervention, and M = Maintenance. S = Sessions.

Table 4

Interobserver Agreement (IOA) in Percentage for Visual Attention during Play

Phase	IOA	Experiment 1			Experiment 2		
		Danny	Fran	James	John	Eric	Carl
B	% of S	40	37.50	40	40	37.50	40
	M	100	100	100	100	100	100
	SD	0	0	0	0	0	0
	Range	100-100	100-100	100-100	100-100	100-100	100-100
I	% of S	33.33	33.33	42.86	33.33	33.33	42.86
	M	97.35	100	97.06	96.15	100	98.64
	SD	3.16	0	5.09	7.69	0	2.36
	Range	93.75-100	100-100	91.18-100	84.62-100	100-100	95.92-100
M	% of S	33.33	33.33	33.33	33.33	33.33	33.33
	M	100	100	100	100	100	100
	SD	0	0	0	0	0	0
	Range	100-100	100-100	100-100	100-100	100-100	100-100

Note. Phase: B = Baseline, I = Intervention, and M = Maintenance. S = Sessions.

Table 5

Interobserver Agreement (IOA) in Percentage for Turn Taking

Phase	IOA	Experiment 1			Experiment 2		
		Danny	Fran	James	John	Eric	Carl
B	% of S	40	37.50	40	40	37.70	40
	M	90	93.33	91.67	100	91.11	91.67
	SD	4.71	6.67	3.33	0	7.70	3.33
	Range	86.67-93.33	86.67-100	86.67-93.33	100-100	86.67-100	86.67-93.33
I	% of S	33.33	33.33	42.86	33.33	33.33	42.86
	M	91.67	93.33	100	88.33	95.56	100
	SD	3.33	0	0	3.33	3.85	0
	Range	86.67-93.33	93.33-93.33	100-100	86.67-93.33	93.33-100	100-100
M	% of S	33.33	33.33	33.33	33.33	33.33	33.33
	M	100	100	100	86.67	93.33	93.33
	SD	0	0	0	0	0	0
	Range	100-100	100-100	100-100	86.67-86.67	93.33-93.33	93.33-93.33

Note. Phase: B = Baseline, I = Intervention, and M = Maintenance. S = Sessions.

Procedural reliability. The researcher trained the independent observer in the procedural reliability checking. The researcher showed the procedural reliability checklist and explained how to record the data (see Appendices H and J). Same pilot videos were

used to train the independent observer to score the procedural reliability checklist. Using the baseline session of the pilot video, the researcher and independent observer watched and checked each step on the procedural checklist. Also, the researcher showed and explained the intervention scripts that demonstrate how the researcher intends to facilitate each session across the phases. When the researcher and the independent observer completed recording the data on the data collection sheet with the first pilot baseline session videos (front and side angled videos), they discussed questions related to analyzing the data. Then, the independent observer scored the procedural reliability alone using the intervention video of the second pilot session. After the independent observer completed the procedural reliability checklist, the researcher discussed the checklist and the data analysis process. When the independent observer expressed a degree of confident with the data collection, the training session was ended.

The procedural reliability checklist contained the appropriate procedures of experiment conditions for each phase, baseline, intervention, and maintenance. In order to obtain the procedural reliability for this study, a trained observer watched the video recordings and checked the procedural checklist across all tiers and phases. Appendices H and I presented the list of intended steps and evaluate if each session proceeded as intended for each condition (baseline, intervention, and maintenance). Procedural reliability was calculated by randomly selecting at least 33% of all of three tiers across all phases. The reliability checklist for baseline condition contained eight-steps of instructional procedures and ten-steps for intervention and maintenance conditions. The procedural reliability calculation was the number of steps completed dividing by the

number of steps planned, and multiplying by 100. This calculation provided a percentage to evaluate whether the researcher consistently followed the procedures in an appropriate manner.

For the procedural reliability, the independent observer completed the procedural reliability checklist for 33% to 40% of sessions for three tiers and across all phases. Procedural reliability was calculated to be 100% for all participants in three tiers and across all phases (baseline, intervention, and maintenance).

Social validity. It is critical for young children with disabilities to develop appropriate social skills in preschool. In order to measure the impact of the intervention in this study, student and professional participants completed interviews at the end of the study. In order to conduct the social validity survey with student participants, the social validity questionnaire for student participants were used (see Appendix J for student participant social validity survey). The questionnaire included two questions related to the intervention and procedures to gather student participants' thoughts. The researcher verbally asked the questions, including "Did you like playing the Xbox games?" and "Did you like playing the game with your friends", and provided the visual rating scale to assist the student to answer questions. The visual rating showed three different faces to represent three different feelings (really like, like, and don't like). The Boardmaker with SD Pro software was used to create the three pictures of the visual ratings, (a) big smiley face for "Really like", (b) flat mouth with smile for "ok", and (c) frowning mouth for "Don't like". When the researcher asked the two questions, students answered by pointing to a face on the visual rating or verbally responded to the researcher. Student

participants completed the questionnaire at the last session of the maintenance session. A mean score was calculated for each question on the questionnaire.

In addition, professional social validity interview questions were used to interview three professional participants. Social validity interview from professional participants provided their perspectives and opinions regarding the XbK gesture-based video gaming as an intervention to teach social skills for young children with developmental delays. At the end of the study, the researcher conducted an interview with three professional participants individually and examined the social validity in response to the third research question of the study (see Appendix K). Social validity interview provided seven interview questions, asking their opinions of the use of XbK games for their students, (i.e., did the XBOX Kinect benefit your students?). Each interview took approximately 25 minutes and was conducted in their classrooms. Audio was recorded for the data analysis during the interview for each professional participant. The interview data was reported in Chapter Four. In addition, demographic information, including age, gender, educational background, and years of teaching were collected using the demographic questionnaire (see Appendix M).

Data Analysis

The three dependent variables of this intervention study were accurate gesture imitation, visual attention during play, and turn taking, which are related to social skills. Those dependent variables were assessed by the direct observation of all video recorded sessions and recorded the occurrences of the target behaviors during each session using the data collection sheet. After each session the researcher reviewed the video and scored

the target participants' play behaviors on the each data collection sheet. Then, the researcher transferred the data of three dependent variables into Microsoft Excel sheets to provide the visual analysis of graphic data across all participants and phases.

Qualitative descriptive analysis was conducted to provide a comprehensive summary of the social validity interview results from professional participants. In addition, descriptive data analysis provided the results of the social validity survey from student participants.

Visual analysis. Visual analysis of graphic data is commonly used to interpret the results of a study employed with SSRD (Gast & Ledford, 2014). Visual analysis allows the researcher to assert the effectiveness of the intervention and provides the visual graphic data pattern (Horner et al., 2005). This study conducted visual analysis to examine the functional relation of the XbK video gaming intervention and the targeted social skills within and between participants and phases.

A visual analysis examined the data from the three dependent variables, accurate gesture imitation, visual attention during play, and turn taking. The visual analysis involved an interpretation of the level, trend, variability, overlap, immediacy, and consistency of data points within and between phases (Kratochwill et al., 2010). Those six features of the graphic data can be used to assess the effect of the intervention. The mean score for each phase provides an average of the level of performance. Trend shows the increase or decrease in performance within a phase. Variability shows the degree of fluctuations in the performance within a phase. Immediacy is the magnitude of change when the intervention is introduced or removed. Consistency shows whether each phase

has similar data patterns. Finally, overlap is the percentage of data points in the intervention phase that are not overlapped from the baseline phase. The interpretation of those features from the graphic data enables the determination as to whether there is a functional relation between the independent and dependent variables.

Percent of non-overlapping data. Visual inspection of graphed data was interpreted through the calculation of the percentage of non-overlapping data (PND). The PND between baseline and treatment phases has been suggested as an alternative to analyze the effectiveness of intervention in SSRD (Scruggs, Mastropieri, & Casto, 1987). The calculation of the PND involves the division of the total number of treatment data points by the number of treatment data points that exceed the highest or lowest baseline data point, depending on the target treatment effect, then multiplying by 100 (Scruggs et al.).

PND scores were calculated for all dependent variables across all participants. The interpretation of PND score are as follows; over 90 is very effective, scores between 70 to 90 is effective, scores between 50 to 70 is questionable, and below 50 is ineffective treatment (Scruggs & Mastropieri, 1998). The calculation of the PND scores was used in this study to describe the overlapping data points between the phases (i.e., baseline vs. intervention).

Qualitative data analysis. In order to describe the results of social Validity interviews from professional participants, a comprehensive descriptive data analysis was conducted. The interviews were recorded using Quick Note app on the iPad mini and transcribed. For the qualitative data analysis, deductive approach was used. The

researcher used the each interview question to group the data from each professional participant and looked for similarities and differences. The interview data from three professional participants produced the following results: (a) how teachers viewed the XbK intervention to teach social skills for the target children, (b) the teachers' experienced with the XbK intervention, and (c) the teachers' opinions on the XbK intervention in classroom implementation.

Summary

This chapter addresses the detail methods on how this study was conducted, including the following: (a) research design, (b) participants, (c) setting and materials, (d) dependent variables and measurements, (e) procedures, (f) reliability and validity, and (g) data analysis. The methodology matrix in Table 6 provides a summary of details on how the collected data was used to analyze the responses to the research questions.

Table 6

Methodology Matrix

Research Question	Type of Data Collection	Data Analysis
1. Is there a functional relation between the use of gesture-based XbK video game and the increase in three social skills* for young children with developmental delays?	Frequency of accurate gesture imitation, frequency of intervals with visual attention during play, and frequency of turn taking	Visual Analysis and PND
2. Do young children with developmental delays maintain these targeted social skills* two weeks after the conclusion of the intervention phase?	Frequency of accurate gesture imitation, frequency of intervals with visual attention during play, and frequency of turn taking	Visual Analysis and PND
3. What are the teachers' perspectives on the use of XbK video gaming to teach social skills for young children with developmental delays?	Social validity interview data from professional participants	Qualitative description

Note. * The social skills include (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking. PND = Percentage of Non Overlapping Data.

Chapter Four

This chapter covers the results of the use of XbK gesture-based video gaming to teach social skills for young children with developmental delays in preschool settings. This study employed a multiple-baseline design across participants in the SSRD to examine the XbK commercial gaming system as an intervention tool to increase social skills. This chapter reports the effects of the XbK gesture-based video gaming on the three dependent variables, including accurate gesture imitation, visual attention during play, and turn taking.

Six students in a preschool setting participated in this intervention study. As described in the previous chapter, participants were assigned into three groups and each group was randomly assigned to three tiers and staggered the start of the intervention for each group. During the baseline phase, the Sue Says game was used to collect the target social skills data and there were 5 turns for each participant per session. In the intervention phase, the XbK with the Air Band game was introduced to the participants and the data for the target social skills was collected while the participants were playing each session. During the maintenance phase, which occurred two weeks after the completion of the intervention, data was collected on the target social skills. The maintenance phase did not show the introduction screen to remind them how to play the XbK Air Band game.

The visual analysis of the three dependent variables (i.e., accurate gesture imitation, visual attention during play, and turn taking) addresses the two main research questions for this study. The first research question examined the functional relation between the XbK gesture-based video gaming and the three target social skills. The second question examined whether the participants maintain the target social skills two weeks after the conclusion of the intervention phase. Participants were divided into two separate groups and participated in two concurrent Experiments. Experiment 1 included students with identified disabilities (i.e., ASD or GDD) and students in Experiment 2 were at-risk for developmental delays. The results for the first and second research questions are presented below by Experiment. The social validity interviews with the professional participants provided results to the third research question for this study. The third research question examined teachers' opinions on the XbK gesture-based video gaming as an intervention tool to teach social skills for young children with developmental delays. The social validity findings for both student and professional participants are presented later in this chapter.

Results of Experiment 1

Visual analysis was conducted for the three target dependent variables; (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking, and provided the results in response to the first and second research questions.

Accurate gesture imitation. Accurate gesture imitation was measured using event recording while participants were playing. When a participant performed the accurate gesture imitation independently, the occurrence was scored as 1 point. With

verbal prompt, the occurrence was scored as 0.5 point. Figure 6 shows the frequency of accurate gesture imitation. Table 7 shows the mean and the standard deviation for accurate gesture imitation for the three participants in Experiment group 1.

Overall, the results indicate that all participants in Experiment 1 showed a low level and flat trend in baseline. Then, the results increased with an immediate effect of accurate gesture imitations after receiving the XbK intervention. Across participants, different trend was observed, such as variability from Danny's data points, a stable trend from Fran, and an upward trend from James. While the mean frequency of the accurate gesture imitation of three students during baseline was 0.21 (SD = 0.26), the mean frequency in intervention was 5.80 (SD = 1.78). In addition, all participants maintained their accurate gesture imitation skills during maintenance (M = 5.33, SD = 1.42), staying at a high level and stable trend. The calculated mean Percent of Non-Overlapping Data (PND) was 98.81 across the participants for accurate gesture imitation. Results for each individual participant in Experiment 1 are presented next.

Table 7

Means and Standard Deviations for Accurate Gesture Imitation in Experiment 1

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
Danny	0	0	3.75	1.69	4.00	0.50
Fran	0.13	0.35	6.94	0.77	5.17	0.29
James	0.50	0.71	6.71	1.52	6.83	1.04
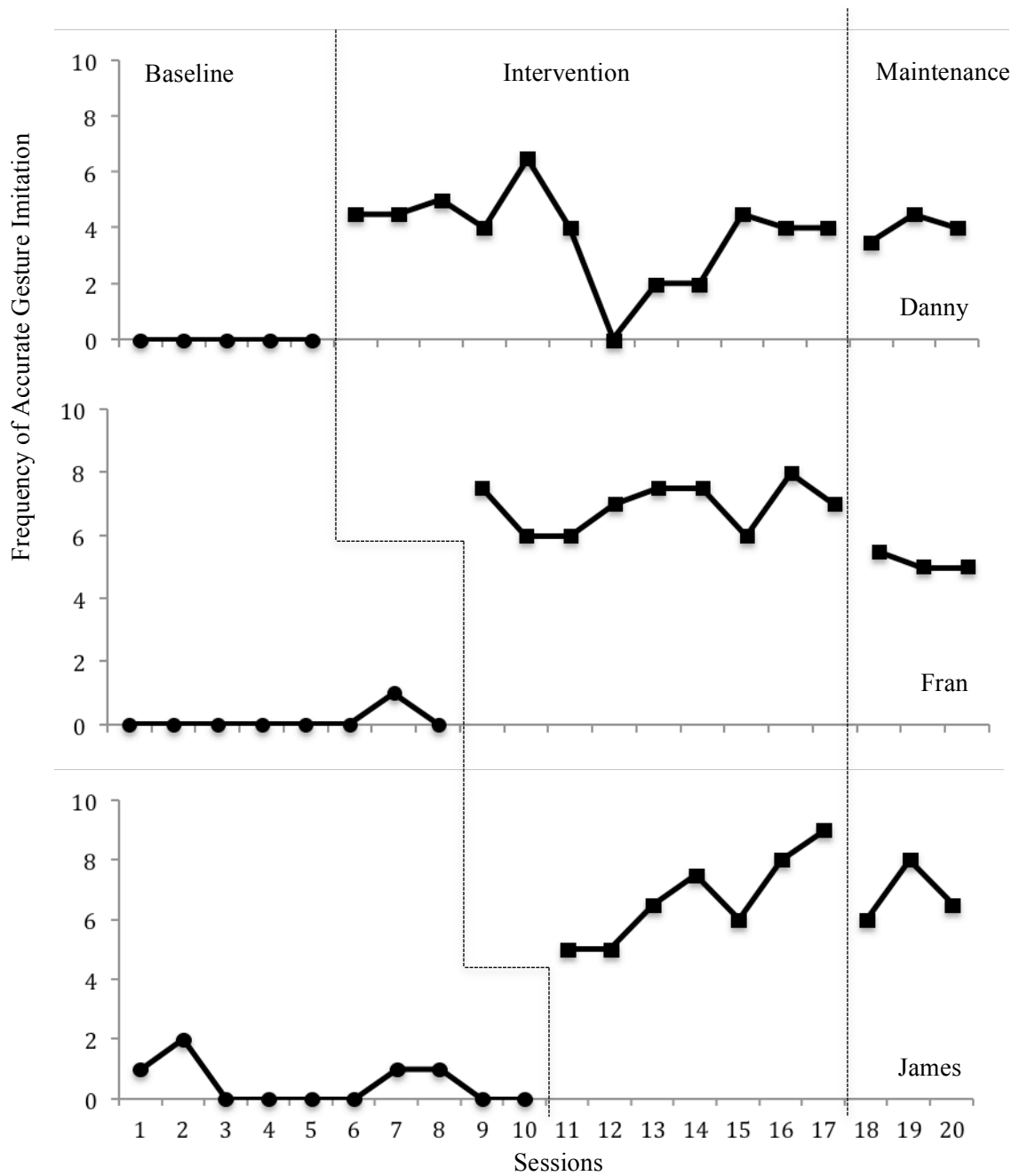
Figure 6. Frequency of acccurate gesture imitation across baseline, intervention, and maintenance for three participants in Experiment 1.

Danny. Tier 1 of Figure 6 shows the results of Danny's accurate gesture imitation in response to the first research question. Throughout the entire baseline sessions, he was not able to imitate the action of playing a musical instrument properly ($M = 0$, $SD = 0$). Therefore, the data from five baseline sessions were all zero, which showed zero level and a stable trend. No variability was observed.

With the XbK intervention, Danny had increased the level of his accurate gesture imitation ($M = 3.75$, $SD = 1.69$). When the intervention started in session 6, he showed an immediate improvement in imitating the motion of playing a musical instrument from zero to 4.5. Danny demonstrated a relatively consistent result of imitation in the first half of the intervention sessions. However, there was some variability with a decrease in the middle of intervention phase, but he was able to gradually increase and maintain a consistent level during the last three intervention sessions. The reason Danny had zero point in session 12 was because he refused to play. The PND from baseline to intervention was 91.67%, with one data point that was overlapping out of 12. Overall, Danny was able to increase his imitation skills with the XbK intervention.

As shown in tier 1 of Figure 6 (research question two), Danny showed slightly higher level of accurate gesture imitation during maintenance ($M = 4.00$, $SD = 0.50$) than the level during intervention. There was no significant change between the last session of the intervention ($n = 4$) and the first session of the maintenance ($n = 3.5$). The calculated PND was 100% from baseline to maintenance. Overall, the data during the maintenance phase showed a consistently similar level and stable trend without variability.

Fran. Tier 2 of Figure 6 shows the results of Fran's accurate gesture imitation in response to the first research question. Across eight baseline sessions, Fran had a low level of data points ($M = 0.13$, $SD = 0.35$). Most of the baseline sessions he had zero points except session seven with one occurrence of accurate gesture imitation. The data in the baseline sessions showed a low level and stable trend with no variability.

With the XbK intervention, Fran had a significant increase level of accurate gesture imitation ($M = 6.94$, $SD = 0.77$). The data showed an immediate increase in accurate gesture imitation when the XbK intervention was introduced, 7.5 data point in session nine compared to zero in session eight. Fran was able to show consistent data patterns during intervention, with data points between 6 and 8. No variability was observed. The PND was calculated as 100% from baseline to intervention. Thus, the data during the intervention phase was consistently higher than baseline with a stable trend.

In response to the second research question, Fran showed slightly lower level of data patterns during maintenance ($M = 5.17$, $SD = 0.29$) compared to the intervention sessions, yet he still performed at a higher level of accurate gesture imitation compared to baseline. The data pattern was stable, ranging from 5 to 5.5. The calculated PND was 100% from baseline to maintenance. Thus, the data during the maintenance phase showed a high level with stable trend.

James. Tier 3 of Figure 6 shows the results of James's accurate gesture imitation in response to the first research question. Across 10 baseline sessions, James had a low level of data points ($M = 0.50$, $SD = 0.71$) with mostly zero data points except for 1 or 2

data points. Overall, the data during baseline showed a low level, stable trend, and no variability.

With the XbK intervention, James had a higher level of accurate gesture imitation (M = 6.71, SD = 1.52). The graph showed an immediate improvement when the intervention was introduced. Although the data showed moderate variability with a slight decrease in session 15, overall the data points during intervention had an upward trend. The PND was 100% from baseline to intervention.

As seen in tier 3 of Figure 6 (research question two), James had a slightly higher level of accurate gesture imitation during maintenance than intervention (M = 6.83, SD = 1.04). The PND was 100% from baseline to maintenance. Overall, the data of the maintenance phase showed consistently similar level.

Visual attention during play. Visual attention during play was measured using a whole interval recording for each participant throughout each session. The frequency of intervals with visual attention during play was recorded when a participant oriented his attention toward the screen (game facilitator during baseline) or other players for entire 5 seconds. Figure 7 shows the visual analysis for the frequency of intervals with visual attention during play. Table 8 shows the mean and the standard deviation for the visual attention during play for the three participants in Experiment 1.

While the mean frequency of intervals with visual attention during play for the three students during baseline was 0.17 (SD = 0.37), the mean frequency of intervals during intervention was 27.20 (SD = 7.04). Overall, the results indicate that all participants in Experiment 1 showed a stable trend at a low level in baseline. However,

all participants increased the frequency of intervals with visual attention during play after

receiving the XbK intervention. Overall, the data during intervention showed an

increased level, immediate effects, and variability. In addition, all participants maintained

their visual attention during play in the maintenance phase ($M = 24.33$, $SD = 1.93$). The

calculated mean PND was 98.61% for all three participants for visual attention during

play.

Table 8

Means and Standard Deviations for Visual Attention during Play in Experiment 1

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
Danny	0.20	0.45	19.00	6.69	24.00	1.73
Fran	0	0	25.44	8.62	23.33	2.52
James	0.30	0.67	37.17	5.81	25.67	1.53
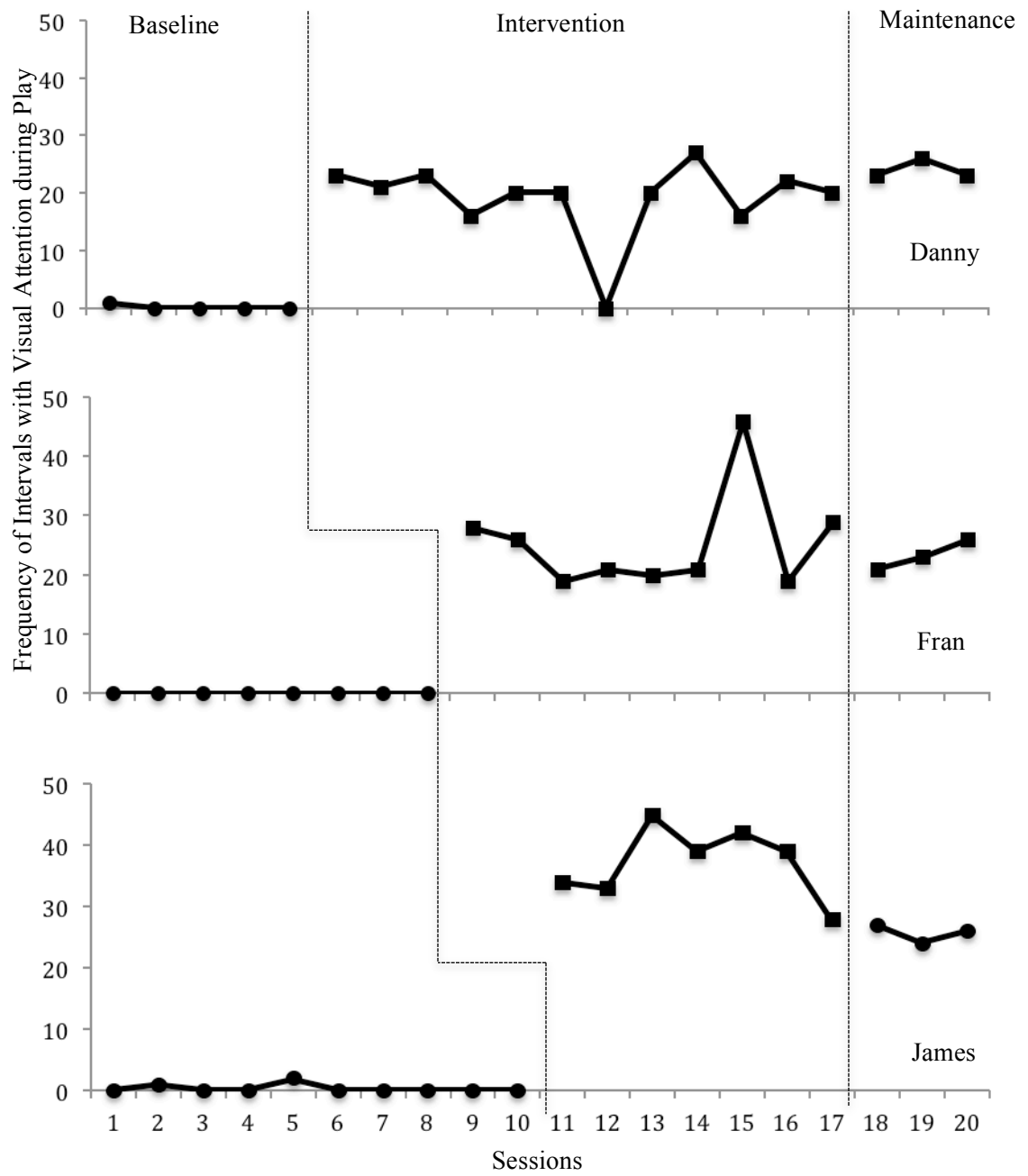
Figure 7. Frequency of intervals with visual attention during play across baseline, intervention, and maintenance for three participants in Experiment 1.

With the overall results, visual attention during play was analyzed further by breaking down and examining the distribution of visual attention during play between waiting and playing. All participants in Experiment 1 showed visual attention toward the screen with no occurrence towards the other players. For all participants in Experiment 1, the mean frequency of intervals with visual attention was 0.03 *(SD* = 0.18) while waiting and 0.13 (*SD* = 0.25) while playing in the baseline phase. During intervention, the mean frequency of intervals was 8.93 (*SD* = 1.04) while waiting and 18.26 (*SD* = 1.47) while playing. The mean frequency of intervals in maintenance while waiting was 5.13 (*SD* = 1.24) and while playing was 16.02 (*SD* = 1.51). Table 9 shows the frequency of intervals for two types with visual attention during play (waiting and playing) for all three participants. Overall, visual attention during play was rarely observed in baseline. With significant increase of visual attention during intervention, all participants showed visual attention toward their own play more than watching other's play. They showed a similar level of visual attention distribution in the intervention and maintenance phase. It is important to note that Table 9 shows the mean frequency of intervals for each type of visual attention (waiting or playing) from the total intervals of visual attention that occurred for each session.

Table 9

Mean Frequency of Intervals for the Types of Visual Attention during Play in Experiment 1

Participant		Baseline		Intervention		Maintenance	
		Waiting	Playing	Waiting	Playing	Waiting	Playing
Danny	*M*	0	0.20	7.08	11.92	5.67	18.33
	(*SD*)	(0)	(0.45)	(4.08)	(5.30)	(2.08)	(0.58)
Fran	*M*	0	0	8.00	17.44	4.67	18.67
	(*SD*)	(0)	(0)	(5.94)	(3.00)	(1.15)	(3.51)
James	*M*	0.10	0.20	11.71	25.43	5.00	21.00
	(*SD*)	(0.32)	(0.42)	(5.79)	(5.74)	(3.61)	(2.65)

Danny. Tier 1 of Figure 7 shows the results of Danny's visual attention during play in response to the first research question. Throughout the entire baseline sessions, he had zero data points for four sessions and only in the first session he had one instance of visual attention (*M* = 0.20, *SD* = 0.45). The data points in baseline were consistently flat at a low level, thereby showing a stable trend with no variability.

With the XbK intervention, Danny had a significantly increased level of his visual attention during play (*M* = 19.00, *SD* = 6.69). The graph shows an immediate increase of visual attention from zero to over 20 occurrences when the intervention started. The stable level and trend of data pattern became variable, dropping to zero point in the middle of intervention phase, then increased with moderate variable trend toward to the

end of intervention. The zero point in session 12 contributed the overlapped data between baseline and intervention. Therefore, the PND from baseline to intervention was 91.67%, with 1 data point that was overlapping out of 12. Although the graph showed a change of level between baseline and intervention, a variable trend was shown in intervention.

In response to the second research question (tier 1 of Figure 7), Danny maintained a higher level of visual attention while playing during maintenance ($M = 24.00$, $SD = 1.73$) compared to intervention ($M = 19.00$, $SD = 6.69$). There was no significant change between the last session of the intervention ($n = 20$) and the first session of the maintenance ($n = 23$). The calculated PND was 100% from baseline to maintenance. Overall, the data showed consistently similar level and stable trend in maintenance.

To specify the types of visual attention during play, Table 9 shows the mean frequency of intervals for two types of visual attention during play that Danny demonstrated (waiting and playing). During baseline, Danny did not show any visual attention while waiting but had very low mean frequency of intervals while playing ($M = 0.20$, $SD = 0.45$). During the intervention phase, he showed higher mean frequency of visual attention while playing ($M = 11.92$, $SD = 5.30$) than waiting ($M = 7.08$, $SD = 4.08$). During maintenance, he showed increased mean frequency of visual attention while playing ($M = 18.33$, $SD = 0.58$). However, he had slightly decreased mean frequency of intervals while waiting ($M = 5.67$, $SD = 2.08$) compared to the intervention. Overall, Danny showed visual attention toward his own play rather than watching other's play.

Fran. Tier 2 of Figure 7 shows the results of Fran's visual attention during play in response to the first research question. Throughout the entire baseline sessions, Fran was not able to demonstrate visual attention ($M = 0$, $SD = 0$). This indicates that the baseline data were consistently flat at zero level with no variable trend.

With the XbK intervention, Fran showed a significant improvement in the level of visual attention ($M = 25.44$, $SD = 8.62$). The graph shows an immediate increase in visual attention during play when the XbK intervention was introduced, having 28 occurrences with visual attention in session nine compared to zero in session eight. However, the data points showed a downward trend for the two sessions after the first intervention session but stabilized over the next four sessions. Then, an extreme deviation from the level and trend of data pattern was shown in session 15 with 46 occurrences of visual attention. The PND was calculated as 100% from baseline to intervention. Overall, the data in intervention showed fluctuation with a significant improvement.

As seen in tier 2 of Figure 7 in respond to the second research question, Fran retained the level of visual attention during play in the maintenance phase ($M = 23.33$, $SD = 2.52$). The data pattern was consistent with an upward trend with improvement of visual attention. The calculated PND was 100% from baseline to maintenance. Thus, the data during the maintenance phase stayed at a high level with an upward trend.

To specify the types of visual attention during play, Table 9 shows the mean frequency of intervals for the types of visual attention during play that Fran demonstrated (waiting and playing). As Fran showed zero level of visual attention during baseline, he had zero mean frequency. He increased the level of visual attention during intervention,

while waiting ($M = 8.00$, $SD = 5.94$) and playing ($M = 17.44$, $SD = 3.00$). In the maintenance phase, he continued to show the high level of visual attention, while waiting ($M = 4.67$, $SD = 1.15$) and playing ($M = 18.67$, $SD = 3.51$). Throughout intervention and maintenance sessions, Fran showed higher mean frequency of intervals with visual attention while playing compared to waiting, which indicated that he watched his own play more than watching others.

James. Tier 3 of Figure 7 shows the results of James's visual attention during play in response to the first research question. Across ten baseline sessions, James had a low level of data points ($M = 0.30$, $SD = 0.67$). Although two sessions had one or two data points throughout the baseline phase, the overall data was at a consistently low level with a stable trend and no variability.

With the XbK intervention, James had a significantly higher level of visual attention during play ($M = 37.14$, $SD = 5.81$). The graph shows an immediate increase at the start of the intervention phase. The first two sessions had similar level of data points. Then the data was abruptly higher and became stable for four sessions. However, the data decreased at the end of the intervention sessions. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase was significantly higher than baseline but variability was observed.

In response to the second research question (tier 3 of Figure 7), James maintained visual attention during play ($M = 25.67$, $SD = 1.53$) in the maintenance sessions. The graph shows that the data points in the maintenance sessions were a stable trend. No

variability was observed. The PND was 100% from baseline to maintenance. Overall, the data of the maintenance phase showed consistently similar level.

To specify the types of visual attention, Table 9 shows the mean frequency of intervals for the types of visual attention during play that James demonstrated (waiting and playing). As James showed his visual attention several times during the baseline phase, distributed mean frequency of intervals was for waiting ($M = 0.10$, $SD = 0.32$) and for playing ($M = 0.20$, $SD = 0.42$). During the intervention phase, he demonstrated increased frequency of intervals with visual attention: while waiting ($M = 11.71$, $SD = 5.79$), and playing ($M = 25.43$, $SD = 5.74$). Then, he had decreased mean frequency for while waiting ($M = 5.00$, $SD = 3.61$) and playing ($M = 21.00$, $SD = 2.65$). Overall, James showed that visual attention occurred toward his own play more than for watching others.

Turn taking. Turn taking was measured using event recording for each participant throughout each session. The three steps in each turn taking were recorded as 2 points for independent occurrence, 1 points after verbal prompt, 0.5 point after physical prompt, and zero point if not occurred. Then, the frequency of turn taking was calculated and the maximum score per session was 30 points. Figure 8 shows the visual analysis for the frequency of turn taking. Table 10 shows the mean and the standard deviation for turn taking for three participants in Experiment 1.

While the mean frequency of turn taking for three students during baseline was 12.48 ($SD = 6.34$), the mean frequency of intervention was 22 ($SD = 6.50$). Overall, the results indicate that all participants in Experiment 1 had variability in the data points with the low mean level during the baseline sessions. When the XbK intervention was

introduced, all participants showed increased levels with immediate effects. While data points of Fran and James showed a stable trend, Danny had variability during intervention. In addition, the mean frequency of turn taking during the maintenance phase was slightly higher (M = 23.44, SD = 3.94) than the intervention phase. This indicated that participants retained turn taking skills at a higher level with stable trend during maintenance. The calculated mean PND was 91.67% for the three participants for turn taking.

Table 10

Means and Standard Deviations for Turn Taking in Experiment 1

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
Danny	16.20	2.25	18.25	6.83	21.67	1.89
Fran	5.38	2.40	21.00	1.90	20.30	1.04
James	16.30	4.76	29.70	0.76	28.30	1.53
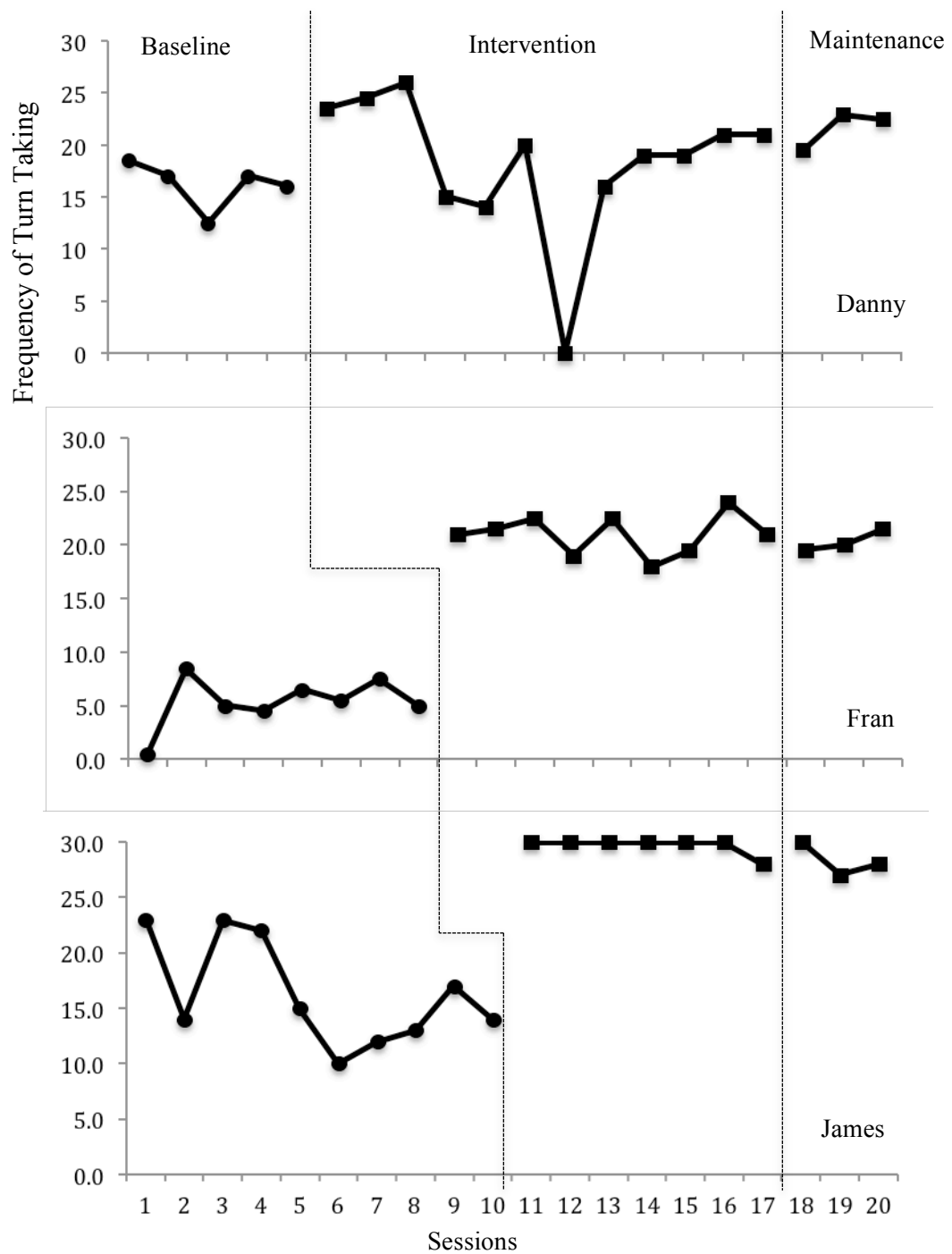
Figure 8. Frequency of turn taking across baseline, intervnetion, and maintenance for three participants in Experiment 1.

Table 11

Total Number of Turn Taking by Prompts for All Participants Across Phases in Experiment 1

Prompt	Danny			Fran			James		
	B	I	M	B	I	M	B	I	M
I	26 (34.67%)	85 (47%)	23 (51%)	4 (3.33%)	76 (56.30%)	26 (57.78%)	58 (38.67%)	103 (98.10%)	40 (88.89%)
V	27 (36.00%)	45 (25.00%)	18 (40.00%)	30 (25.00%)	22 (16.30%)	3 (6.67%)	45 (30.00%)	2 (1.90%)	5 (11.11%)
P	4 (5.33%)	8 (4.44%)	2 (4.44%)	20 (8.33%)	30 (22.22%)	7 (26.67%)	4 (2.67%)	0 (0%)	0 (0%)
N	18 (24.00%)	42 (23.33%)	2 (4.44%)	76 (63.33%)	7 (5.19%)	4 (8.89%)	43 (28.67%)	0 (0%)	0 (0%)
Total	75 (100%)	180 (100%)	45 (100%)	120 (100%)	135 (100%)	45 (100%)	150 (100%)	105 (100%)	45 (100%)

Note. B= Baseline, I=Intervention, and *M* = Maintenance. Prompt: I = Independent, V = Verbal, P = Physical, and N = Not Occurred.

Turn taking was analyzed further by breaking down the types of prompt (independent, verbal, physical, or not occurred) that each participant followed to complete their turn, examining how many times each type of prompts were provided to the participants across all phases. The total number of turn taking was 15 per session (5 turns x 3 steps each turn). The mean percentage for each prompt was provided for each student for each phase. During the baseline, the mean percentage for turn taking for all

participants in Experiment 1 was 25.56% (range 3.33 – 34.67) by independent, 30.33%

(range 25.00 – 36.00) by verbal, 5.44% (range 2.67 – 8.33) by physical, and 38.67%

(range 24.00 – 63.33) for not occurred. The mean percentage for turn taking in

intervention sessions was 67.20% (range 47.00 – 98.10) by independent, 14.40% (range

1.90 – 25.00) by verbal, 8.89% (range 0.00 – 22.22) by physical, and 10.37% (range 0.00

– 23.33) for not occurred. Then, during maintenance, the mean percentage for all students

for turn taking was by independent (M = 65.93%, range 51.00 – 88.89), by verbal (M =

19.26%, range 6.67 – 40.00), by physical (M = 10.37%, range 0.00 – 26.67), and for not

occurred (M = 4.44%, range 0.00 – 8.89). Table 11 shows the total number of turn taking

by prompts for three participants across all phases in Experiment 1. Overall, the results

indicated that all participants showed increased independent turn taking during the

intervention phase and maintained their independent turn taking in maintenance. In

addition, all participants showed decreased not occurred turn taking during intervention

and maintenance.

  Danny. Tier 1 of Figure 8 shows the results of Danny's turn taking in response to

the first research question. During baseline, the graph shows a variable trend, ranging

from 12.5 to 18.5 (M = 16.20, SD = 2.25). The graph shows that the first two sessions

were stable but the data decreased to 12.5 in the third sessions, then became stable for the

last two sessions. Overall, the data for turn taking was at a low level with variable trend

during baseline.

  With the XbK intervention, Danny had an increased level of his turn taking (M =

18.25, SD = 6.83). The graph shows an immediate increase in frequency of turn taking

from 16 to 23.5 when the intervention started. The stable trend of data pattern became variable, dropping to zero point in session 12, then accelerated with a stable upward trend toward to the end of the intervention. The PND from baseline to intervention was 66.67%, which 4 data points overlapping out of 12 between baseline and intervention. Although the graph showed a change in the level between baseline and intervention, variability was shown in intervention.

In response to the second research question (tier 1 of Figure 8), Danny showed a higher level of turn taking during play (M = 21.67, SD = 1.89) in maintenance than in intervention. There was no significant change between the last session of the intervention (n = 21.00) and the first session of the maintenance (n = 19.50). The calculated PND was 100% from baseline to maintenance. Overall, the data showed a consistent level with a stable trend and no variability in maintenance.

In order to see how Danny completed his turn taking, Table 11 shows the total number of turn taking and the percentage for each prompt that Danny followed to complete his turns across all phases. The total number of turn taking Danny had during baseline was 75 (3 steps x 5 turns x 5 sessions) and he completed 26 by independent, 27 by verbal, 4 by physical, and 18 for not occurred. During the intervention phase, his independent turn taking increased to 85 out of 180 (3 steps x 5 turns x 12 sessions), followed by 45 for verbal, 8 for physical, and 42 for not occurred. Then, he completed his turn taking 23 out of 45 by independent, 18 by verbal, 2 by physical, and 2 for not occurred in the maintenance phase. Overall, Danny increased his independent turn taking skills during intervention and maintenance. There was no significance difference in the

percentage of not occurred turn taking between baseline and intervention (24% and 23.33% respectively). He had dramatically decreased not occurred turn taking during maintenance (4.44%).

Fran. Tier 2 of Figure 8 shows the results of Fran's turn taking in response to the first research question. During the baseline phase, Fran had a low level of data points ($M = 5.38$, $SD = 2.40$). In the first two baseline sessions, the data was inconsistent. Then, the data became stable and consistent at a low level. Overall, the data during baseline was a variable trend at a low level.

With the XbK intervention, Fran showed a significant change in the level of turn taking ($M = 21.00$, $SD = 1.90$). The graph shows an immediate increase in turn taking when the XbK intervention was introduced, having the frequency of 21 in session nine compared to 5 in session eight. Throughout intervention, data points were stable and consistent at a higher level with no variability. The PND was calculated as 100% from baseline to intervention.

In response to research question two (tier 2 of Figure 8), Fran maintained the level of turn taking during the maintenance phase ($M = 20.33$, $SD = 1.04$). The data pattern was consistent with an upward trend showing improvement in turn taking. The calculated PND was 100% from baseline to maintenance.

Table 11 shows the total number and the percentage of turn taking with each prompt that Fran followed to complete his turns across all phases. The total number of turn taking during baseline was 120 (3 steps x 5 turns x 8 sessions) and the number of turn taking was 4 by independent, 30 by verbal, 10 by physical, and 76 for not occurred.

While his independent turn taking increased to 76 out of 135 during intervention, he completed his turn taking with 22 by verbal, 30 by physical, and 7 for not occurred. In addition, he showed similar patterns of turn taking during maintenance over a total 45 turns: 26 by independent, 3 by verbal, 12 by physical, and 4 for not occurred. Overall, Fran completed his turn taking, with over 55% by himself during intervention, and not occurred turn taking significantly decreased from 63.33% to 5.19%. In addition, he continued to increase his independent turn taking during the maintenance phase.

James. Tier 3 of Figure 8 shows the results of James's turn taking in response to the first research question. Across ten baseline sessions, the graph shows variability, ranging from 10 to 23. James had the highest score of turn taking among the participants ($M = 16.39$, $SD = 4.76$) in baseline. He started with high scores ($n = 23$), but gradually decreased his turn taking to 14 in the last baseline session. Overall, the data in baseline was inconstant with a declining trend. Variability was observed.

With the XbK intervention, James had a higher level of turn taking ($M = 29.71$, $SD = 0.76$). The graph shows an immediate increase at the start of intervention, having 30 out of 30 scores in the first intervention session compared to 14.0 for the last baseline session. The graph shows that James took turns independently throughout intervention ($n = 30$) except in the last intervention session ($n = 28$). This indicated that the data points were consistent and stable at a higher level during intervention with no variability. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase was at a higher level with a stable and consistent trend.

As seen in tier 3 of Figure 8 in response to research question two, James maintained turn taking during the maintenance phase ($M = 28.33$, $SD = 1.53$). The graph shows that the data points for the maintenance sessions were slightly lower but a stable trend. The PND was 100% from baseline to maintenance. Overall, the data for the maintenance phase showed consistently similar level with intervention.

Table 11 shows the total number and percentage of turn taking with each prompt that James followed to complete his turns across all phases. The total number of turn taking with each prompt during baseline was 150 turns with 58 by independent, 45 by verbal, 4 by physical, and 43 for not occurred. However, he increased his independent turn taking to 103 out of 105 during intervention, which showed 2 turns by verbal and zero instances by physical and for not occurred turn taking. Over 45 turns during maintenance, James showed similar results of turn taking, 40 by independent, 5 by verbal, and zero by physical and for not occurred. Overall, James showed significant increase in his independent turn taking and there was zero instance of not occurred turn taking with the XbK intervention.

Results of Experiment 2

Visual analysis was conducted for the three target dependent variables; (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking, and provided the results in response to the first and second research questions.

Accurate gesture imitation. As described above in the results of Experiment 1, accurate gesture imitation was measured using event recording while participants were playing. When a participant performed accurate gesture imitation independently, the

occurrence was scored as 1 point. With verbal prompt, the occurrence was scored as 0.5 point. Figure 9 shows the frequency of accurate gesture imitation across the participants. Table 12 shows the mean and the standard deviation for accurate gesture imitation for the three participants in Experiment 2.

Overall, the results indicate that all participants in Experiment 2 showed a low level with a flat trend in baseline ($M = 0.10$, $SD = 0.18$). Then all participants showed increase in accurate gesture imitation after receiving the XbK intervention ($M = 4.44$, $SD = 0.23$), but variability was observed. While John showed gradual improvement, the other two students, Eric and Carl, showed immediate improvements from the XbK intervention. In addition, all participants maintained higher level of accurate gesture imitation skills during maintenance ($M = 4.83$, $SD = 0.43$). The data points during maintenance for all participants were stable and consistent with no variability. The calculated mean PND was 98.61 across all participants for accurate gesture imitation.
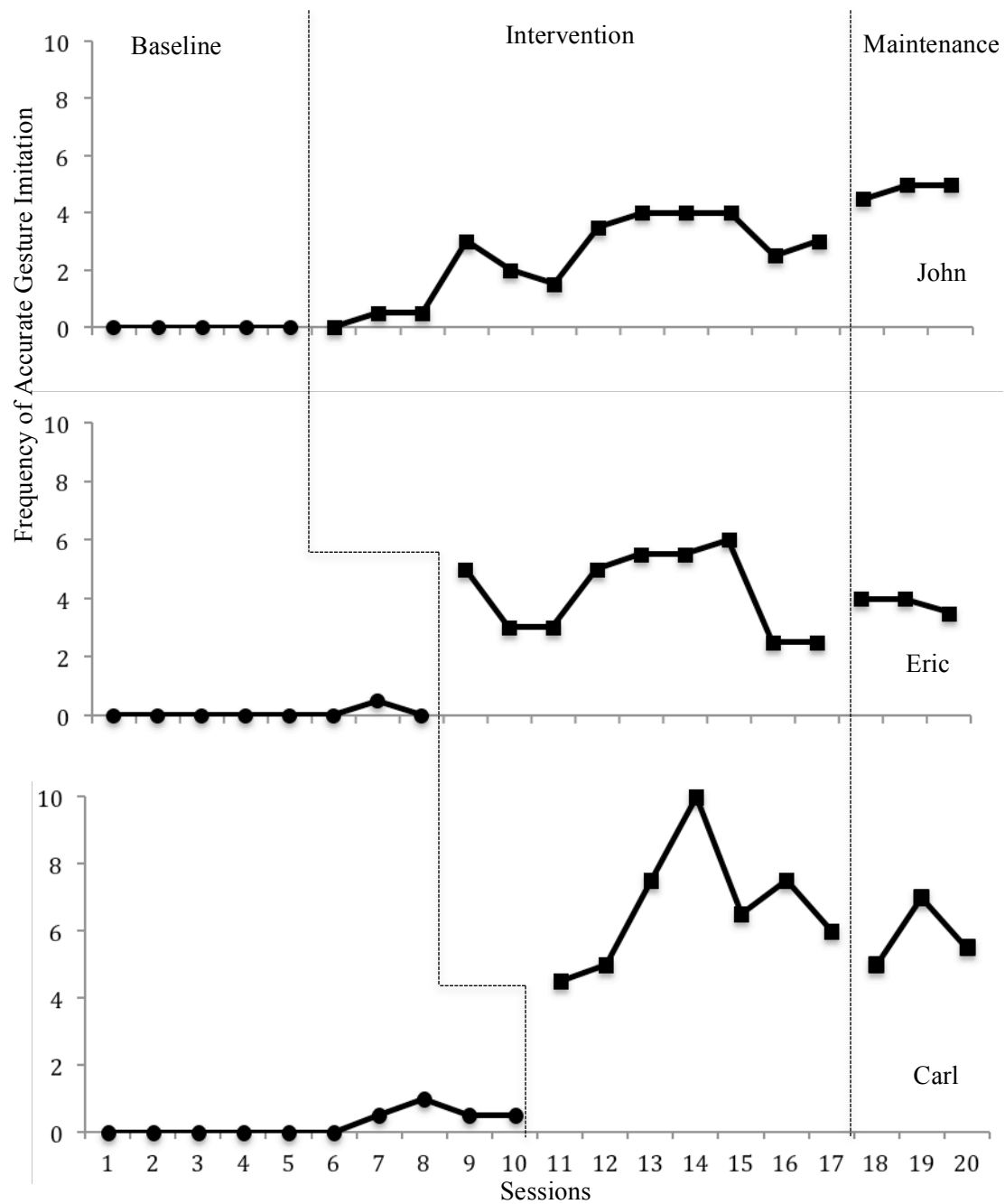
Figure 9. Frequency of accurate gesture imitation across baseline, XbK intervention, and maintenance for three participants in Experiment 2.

Table 12

Means and Standard Deviations for Accurate Gesture Imitation in Experiment 2

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
John	0	0	2.38	1.46	4.83	0.29
Eric	0.06	0.18	4.22	1.44	3.83	0.29
Carl	0.25	0.35	6.71	1.85	5.83	1.04

John. In response to the first research question, tier 1 of Figure 9 shows the results of John's accurate gesture imitation. Throughout the entire five baseline sessions, John had zero data point (*M* = 0, *SD* = 0). The data points in baseline were consistently flat at zero level with a stable trend. No variability was observed.

During the intervention phase, John had an improved level of accurate gesture imitation (*M* = 2.38, *SD* = 1.46). The graph shows a gradual increase rather than immediate during intervention. The data points during the intervention showed moderate variability. At the beginning of the intervention phase, John had no change in accurate gesture imitation and showed abrupt increase (*n* = 3) in session nine. Then the frequency of accurate gesture imitation decreased during the next two sessions. However, the data points for the second half of the intervention were stable and consistent. The PND was 91.67% from baseline to intervention. Overall, the data in the intervention phase showed

a higher result with moderate variability at the first half of the intervention. However, during the second half, the data was stable and consistent at a higher level.

As shown in tier 1 of Figure 9 in response to the second research question, John had a higher mean level during maintenance ($M = 4.83$, $SD = 0.29$) compared to intervention ($M = 2.38$, $SD = 1.46$). The graph shows that the data point for the first maintenance session was higher ($n = 4.5$) than the last intervention session ($n = 3$). For the remainder of the maintenance sessions, the data was stable. The PND was 100% from baseline to maintenance. Overall, the data during the maintenance phase showed a consistent and stable trend but at a higher level of accurate gesture imitation compared to intervention.

Eric. In response to the first research question, tier 2 of Figure 9 shows the results of Eric's accurate gesture imitation. Throughout the entire baseline sessions, Eric had zero data point with the exception of one session, which was 0.5 data point ($M = 0.06$, $SD = 0.18$). The data points in baseline for Eric were consistent at a low level and stable trend with no variability.

During the intervention phase, Eric had an improvement in the level of accurate gesture imitation ($M = 4.22$, $SD = 1.44$). The graph shows an immediate effect from the XbK intervention, resulting in a higher data point when the intervention was introduced ($n = 5$). However, following the first intervention session, the two preceding sessions showed a decline but turned around during the middle sessions with a steady improvement. However, the last two sessions were the lowest level during the intervention ($n = 2.5$). The PND was 100% from baseline to intervention. Overall, the

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data in the intervention phase shows an improvement but there was variability in the trend with decline during the early stage and at the end.

In response to the second research question (tier 2 of Figure 9), Eric maintained accurate gesture imitation with a slightly lower mean level during maintenance ($M = 3.83$, $SD = 0.29$). However, the data during the maintenance sessions showed higher points than the last two intervention sessions. The graph shows that the data points in maintenance stayed at a high level with a stable trend and no variability. The PND was 100% from baseline to maintenance.

Carl. In response to the first research question, tier 3 of Figure 9 shows the results of Carl's accurate gesture imitation. Until session six, Carl had zero data point, then the graph shows insignificant increase ($M = 0.25$, $SD = 0.35$). The data points in baseline for Carl were consistent and stable at a low level. No variability was observed.

During the intervention phase, Carl had a significant improvement in the level of accurate gesture imitation ($M = 6.71$, $SD = 1.85$). The graph shows an immediate effect from the XbK intervention, having a higher data point when the intervention was introduced ($n = 4.5$). The data points show accelerated trend until session 14. Although the data of the last intervention session ($n = 6$) was higher than the first session ($n = 4.5$), the data points became variable with a declining trend toward the end of intervention. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase was at a higher level but showed variability in the trend.

As seen in tier 3 of Figure 9 (research question two), Carl maintained accurate gesture imitation at a slightly lower level during maintenance ($M = 5.83$, $SD = 1.04$)

compared to intervention (M = 6.71, SD = 1.85). The data point of the first maintenance session was slightly lower (n = 5) than the last intervention session (n = 6). Then, the data became variable with higher data points. The PND was 100% from baseline to maintenance. Overall, the data during maintenance stayed at a high level but variability was observed.

   Visual attention during play. Visual attention during play was measured using whole interval recording for each participant throughout each session. The frequency of intervals with visual attention during play was recorded when a participant oriented his/her attention toward the screen (game facilitator during baseline) or towards the other players for 5 seconds. Figure 10 shows the visual analysis for the frequency of intervals with visual attention during play. Table 13 shows the mean and the standard deviation for visual attention during play for the three participants in Experiment 2.

   Overall, the results indicate that all participants in Experiment 2 significantly increased the frequency of intervals with visual attention during play after receiving the XbK intervention. While the mean frequency of intervals with visual attention during baseline was 0.03 (SD = 0.11), the mean during intervention was 28.43 (SD = 7.38). All three participants showed an improvement in visual attention during play in intervention and the improvement was immediate. However, across all participants, variability was observed. In addition, all participants maintained their visual attention during play in maintenance (M = 22.78, SD = 1.36). The data during maintenance phase across all participants were stable and consistent with no variability. The calculated mean PND was 100% across the participants for visual attention during play.
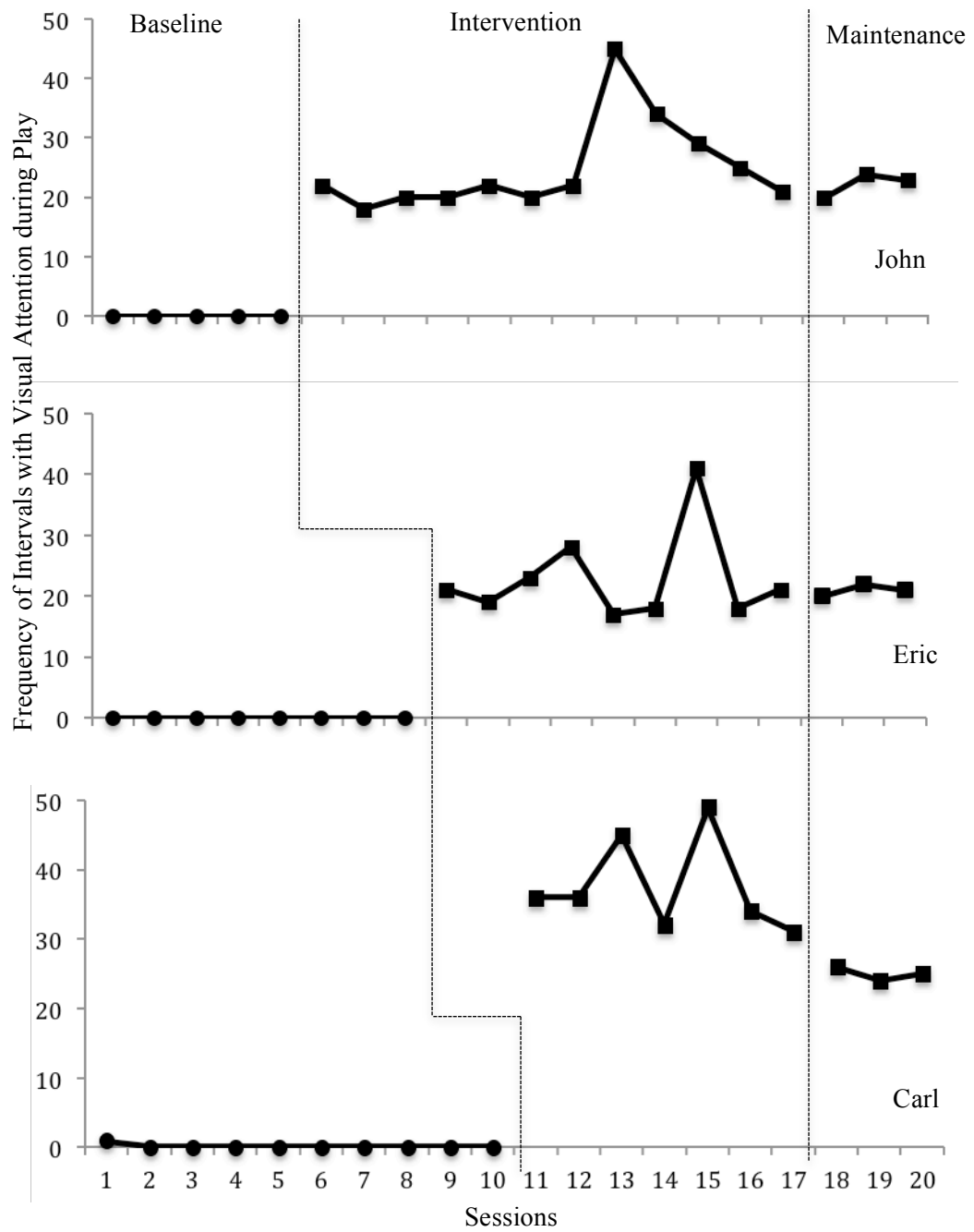
Figure 10. Frequency of intervals with visual attention during play across baseline, XbK, and maintenance for three participants in Experiment 2.

Table 13

Means and Standard Deviations for Visual Attention during Play in Experiment 2

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
John	0	0	24.83	7.77	22.33	2.08
Eric	0	0	22.89	7.57	21.00	1.00
Carl	0.10	0.32	37.57	6.80	25.00	1.00

Visual attention during play was analyzed further by breaking down and examining the frequency of intervals for the types of visual attention between waiting and playing. All participants in Experiment 2 showed their visual attention toward the screen with no occurrence of attention towards the other players. For all participants in Experiment 2, the mean frequency of intervals with visual attention was 0 ($SD = 0$) while waiting and 0.04 ($SD = 0.21$) while playing in baseline. During intervention, the mean frequency of intervals with visual attention was 10.64 ($SD = 5.61$) while waiting and 16.57 ($SD = 6.83$) while playing. The mean frequency of intervals in maintenance was 7.67 ($SD = 2.12$) while waiting and 15.00 ($SD = 3.77$) while playing. Table 14 shows the frequency of intervals of two types with visual attention during play (waiting and playing) for all three participants in Experiment 2. Overall, all participants showed their visual attention toward their own play more frequently than watching other's play during

the intervention phase. In maintenance, they showed a similar level of visual attention

distribution as during the intervention phase. It is important to note that Table 14 shows

the mean frequency of intervals for each type of visual attention (waiting or playing)

from the total intervals of visual attention that occurred for each session.

Table 14

Mean Frequency of Intervals for the Types of Visual Attention during Play in Experiment 2

Participant		Baseline		Intervention		Maintenance	
		Waiting	Playing	Waiting	Playing	Waiting	Playing
John	*M*	0	0	9.50	14.92	6.00	16.00
	(*SD*)	(0)	(0)	(6.80)	(3.45)	(0)	(0.42)
Eric	*M*	0	0	11.44	11.44	10.33	10.67
	(*SD*)	(0)	(0)	(5.46)	(2.65)	(0.58)	(1.53)
Carl	*M*	0	0.10	11.57	26.00	6.67	18.33
	(*SD*)	(0)	(0.32)	(3.51)	(5.48)	(1.15)	(2.08)

John. In response to the first research question, tier 1 of Figure 10 shows the

results of John's visual attention during play. Throughout the entire five baseline

sessions, John had zero data point (*M* = 0, *SD* = 0). The data points in baseline were

consistently flat at zero level, thereby showing a stable trend with no variability.

During the intervention phase John had an improvement in the level of visual

attention during play (*M* = 24.83, *SD* = 7.77). The graph shows an immediate effect from

the XbK intervention when the intervention was introduced. During the first half of the intervention session, John had a stable and consistent trend in the data points. The frequency of visual attention during play increased abruptly in session 13 ($n = 45$). Then the data points had a declining trend during the second half and ended with the last intervention session with 21 points. The PND was 100% from baseline to intervention. During the first half, the data was consistent and stable, however, the second half showed variability with an increase and then a gradual decline for the remainder of the sessions.

In response to the second research question (tier 1 of Figure 10), John had a slightly lower level of visual attention during play ($M = 22.33$, $SD = 2.08$) compared to intervention ($M = 24.83$, $SD = 7.77$). The data point of the first maintenance session was slightly lower ($n = 20$) than the last intervention session ($n = 21$). There was a slight improvement during the second session and then stable at the same level during the last session. The PND was 100% from baseline to maintenance. Overall, the data in the maintenance phase showed a consistent and stable trend of visual attention during play.

To specify the types of visual attention during play, Table 14 shows the mean frequency of intervals of the distribution that John demonstrated (waiting and playing). During baseline, John did not show any visual attention while waiting and playing ($M = 0$, $SD = 0$). However, he increased his visual attention while waiting ($M = 9.50$, $SD = 6.08$) and playing ($M = 14.92$, $SD = 3.45$) during intervention. While he showed lower mean frequency of intervals with visual attention while waiting ($M = 6.00$, $SD = 0$) during maintenance compared to intervention, his visual attention while playing had higher mean frequency ($M = 16.00$, $SD = 2.00$). Overall, John demonstrated his visual

attention toward his own play rather than watching other's play. In addition, the frequency of intervals with visual attention while playing continued to increase over the maintenance.

Eric. In response to the first research question, tier 2 of Figure 10 shows the results of Eric's visual attention during play. Throughout the entire baseline sessions, Eric had zero data point ($M = 0$, $SD = 0$). Therefore, the data points in baseline were consistently flat at zero level with no variability.

During the intervention phase, Eric had an improvement in the level of visual attention during play ($M = 22.89$, $SD = 7.57$). The graph shows an immediate effect from the XbK intervention, with a higher data point ($n = 21$) when the intervention was introduced. However, the data points fluctuated over time. During the first four intervention sessions, the data showed an increasing trend but declined in session 13 ($n = 17$) and was lower than the first intervention session ($n = 21$). In session 15, there was an abrupt improvement to 41 and dropped to a lower data point ($n = 18$) in the following session. The data of the last intervention session was the same as the first intervention session ($n = 21$). The PND was 100% from baseline to intervention. Overall, the data in intervention showed an improvement but variability was observed.

As seen in tier 2 of Figure 10 in respond to the second research question, Eric maintained visual attention during play at slightly lower level during the maintenance phase ($M = 21.00$, $SD = 1.00$). The graph shows that the data points in maintenance were stable with a consistent trend and no variability was observed. The PND was 100% from baseline to maintenance.

To specify the types of visual attention during play, Table 14 shows the frequency of intervals of distribution that Eric demonstrated (waiting and playing). As Eric showed zero level of visual attention during baseline, he had zero mean frequency while waiting and playing. Unlike to the other participants, Eric showed equal distribution of visual attention while waiting ($M = 11.44$, $SD = 5.46$) and playing ($M = 11.44$, $SD = 2.65$) during the intervention phase. Then, he had similar mean frequency of visual attention while waiting ($M = 10.33$, $SD = 0.58$) and playing ($M = 10.67$, $SD = 1.53$) in the maintenance phase. This indicates that Eric distributed his visual attention equally for watching his own play and watching others.

Carl. In response to the first research question, tier 3 of Figure 10 shows the results of Carl's visual attention during play. Carl had one occurrence of visual attention, then had zero point for the rest of the baseline sessions ($M = 0.10$, $SD = 0.32$). The data points in baseline for Carl were consistent and stable at a low level with no variability.

During the intervention phase, Carl had a significant change in the level of visual attention during play ($M = 37.57$, $SD = 6.80$). The graph shows an immediate effect from the XbK intervention, having a higher data point when the intervention was introduced ($n = 36$). However, the data points between sessions 13 to 15 showed fluctuated trend, ranging from 32 to 45. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase showed a higher level, an immediate improvement, and variability in the trend.

In response to the second research question (tier 3 of Figure 10), Carl maintained visual attention skills at a lower level during maintenance ($M = 25.00$, $SD = 1.00$)

compared to intervention ($M = 37.57$, $SD = 6.80$). The data point for the first

maintenance session was lower ($n = 26$) than the last intervention session ($n = 31$) but the

overall data was stable and consistent. No variability was observed. The PND was 100%

from baseline to maintenance.

To specify the types of visual attention during play, Table 14 shows the mean

frequency of distribution for visual attention that Carl demonstrated (waiting and

playing). Throughout the baseline session, visual attention occurred once while playing

($M = 0.10$, $SD = 0.32$) and zero while waiting ($M = 0$, $SD = 0$). Carl's visual attention was

predominately higher while playing ($M = 26.00$, $SD = 5.38$) compared to waiting ($M =$

11.57, $SD = 3.51$) during the intervention phase. Similarly, the mean frequency of visual

attention was higher while playing ($M = 18.33$, $SD = 2.08$) compared to waiting ($M =$

6.77, $SD = 1.15$). Carl presented much higher frequency of intervals for watching his own

play than watching others.

Turn taking. Turn taking was measured using event recording for each

participant throughout each session. The three steps of each turn taking were recorded as

2 point for independent occurrence, 1 point after verbal prompt, 0.5 point after physical

prompt, and zero point if not occurred. Then, the frequency of turn taking was calculated

and the maximum score per session was 30 points. Figure 11 shows the visual analysis

for the frequency of turn taking for three participants in Experiment 2. Table 15 shows

the mean and standard deviation for turn taking for three participants.

While the mean frequency of turn taking for the three students during baseline

was 9.48 ($SD = 5.34$), the mean frequency during intervention was 16.91 ($SD = 7.53$).

Overall, the results indicate that all student participants in Experiment 2 had variability in the data points at a low mean level during the baseline sessions. When the XbK intervention was introduced, all participants increased the mean frequency of turn taking. All three participants showed an improvement in turn taking during the intervention phase and the intervention effect was immediate. Eric's data points showed a stable trend but the data for John and Carl showed variability. In addition, the mean frequency of turn taking during the maintenance phase was a higher level ($M = 21.78$, $SD = 3.71$) compared to the intervention phase. This indicated that all participants retained turn taking skills at a higher level with a stable trend and no variability during maintenance. The calculated mean PND was 100% across the participants for turn taking.

Table 15

Means and Standard Deviations for Turn Taking in Experiment 2

Participant	Baseline		Intervention		Maintenance	
	M	*SD*	*M*	*SD*	*M*	*SD*
John	0.90	1.24	9.54	3.43	19.50	2.60
Eric	11.18	2.64	19.28	1.20	19.50	1.00
Carl	11.90	3.38	26.50	2.69	26.33	1.15
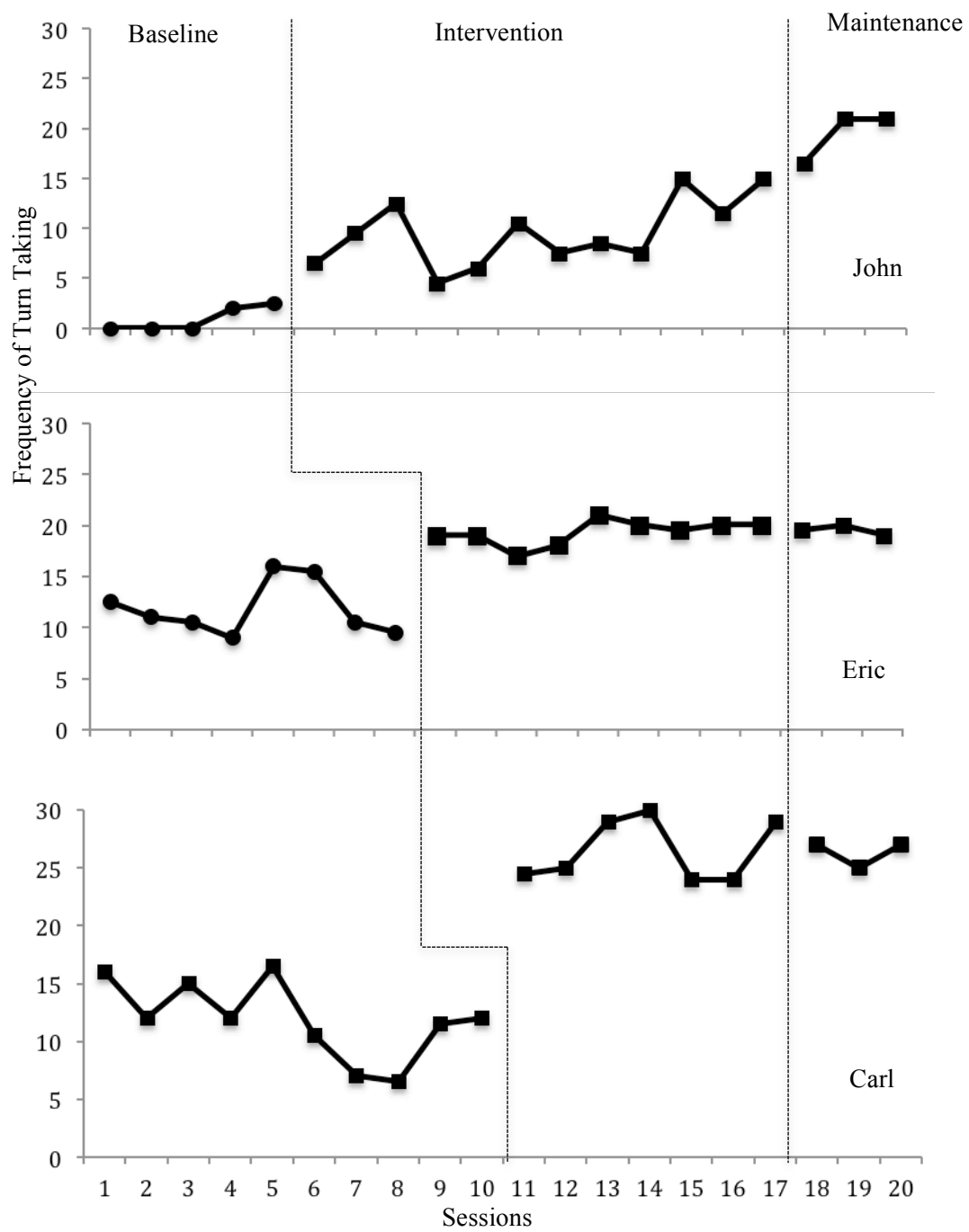
Figure 11. Frequency of turn taking across baseline, XbK intervention, and maintenance for three participants in Experiment 2.

Turn taking was analyzed further by breaking down the types of prompt

(independent, verbal, physical, or not occurred) that each participant followed to

complete their turn across all phases. The total number of turn taking was 15 per session

(5 turns x 3 steps each turn). The mean percentage of turn taking by each prompt was

provided for each student for each phase. During the baseline, the mean percentage of

turn taking for all participants in Experiment 2 was 16.17% (range 0 – 25.83) by

independent, 17.28% (range 0 – 36.00) by verbal, 10.17% (range 2.67 – 15.83) by

physical, and 56.39% (range 39.17 – 88.00) for not occurred. The mean percentage of

turn taking by prompts in intervention sessions was 43.51% (range 16.67 – 79.05) by

independent, 27.39% (range 10.00 – 54.07) by verbal, 17.05% (range 0.95 – 40.56) by

physical, and 12.05% (range 1.48 – 32.78) for not occurred. Then, during maintenance,

all students showed the mean percentage of turn taking by independent ($M = 54.81\%$,

range 33.33 – 77.78), by verbal ($M = 31.11\%$, range 13.33 – 60.00), by physical ($M =$

8.89%, range 0 – 20.00), and for not occurred ($M = 5.19\%$, range 0 – 13.33). Table 16

shows the total number of turn taking by prompts for three participants across all phases

in Experiment 2. Overall, the results indicated that all participants showed increased

independent turn taking during the intervention phase and continued to increase their

independent turn taking during the maintenance phase. In addition, all participants

showed decreased frequency of not occurred turn taking throughout intervention and

maintenance.

Table 16

Total Number of Turn Taking by Prompts for All Participants Across Phases in Experiment 2

Prompt	John			Eric			Carl		
	B	I	M	B	I	M	B	I	M
I	0 (0%)	30 (16.67%)	24 (53.33%)	31 (25.83%)	47 (34.81%)	15 (33.33%)	34 (22.67%)	83 (79.05%)	35 (77.78%)
V	0 (0%)	18 (10%)	6 (13.33%)	23 (19.17%)	73 (54.07%)	27 (60%)	49 (32.67%)	19 (18.10%)	9 (20%)
P	9 (12%)	73 (40.56%)	9 (20%)	19 (15.83%)	13 (9.63%)	3 (6.67%)	4 (2.67%)	1 (0.95%)	0 (0%)
N	66 (88%)	59 (32.78%)	6 (13.33%)	47 (39.17%)	2 (1.48%)	0 (0%)	63 (42%)	2 (1.90%)	1 (2.22%)
Total	75 (100%)	180 (100%)	45 (100%)	120 (100%)	135 (100%)	45 (100%)	150 (100%)	105 (100%)	45 (100%)

Note. B=baseline, I=Intervention, and *M* = Maintenance. Prompt: I = Independent, V = Verbal, P = Physical, and N = Not Occurred.

John. In response to the first research question, tier 1 of Figure 11 shows the results of John's turn taking. In the first three baseline sessions, John had zero data point and slightly improved his turn taking in session four and five (*M* = 0.90, *SD* = 1.24). The data in baseline was consistent at a low level and no variability was observed.

During intervention phase John had improved level of turn taking (*M* = 9.54, *SD* = 3.43). During the first three intervention sessions, John showed an upward trend in turn taking but decreased his turn taking for the next two sessions. The fluctuated pattern was

repeated, then the data points increased toward the end of intervention. The PND was 100% from baseline to intervention. Overall, the data points in intervention were at a higher level than data in baseline, and showed an upward trend with variability.

In response to the second research question (tier 1 of Figure 11), John showed a higher level of turn taking during maintenance ($M = 19.50$, $SD = 2.60$) compared to intervention ($M = 9.54$, $SD = 3.43$). The data point for the first maintenance session was slightly higher ($n = 18$) than the last intervention session ($n = 17$). Then the data points showed an increase trend. The PND was 100% from baseline to maintenance. Overall, the data in the maintenance phase had an increasing trend at a higher level than intervention and no variability was observed.

Table 16 shows the total number of turn taking with each prompt that John followed to complete his turns across all phases. The total number of turn taking John had during baseline was 75 (3 steps x 5 turns x 5 sessions) and he completed zero by independent, zero by verbal, 9 by physical, and 66 for not occurred. During the intervention phase, his independent turn taking increased to 30 out of 180 (3 steps x 5 turns x 12 sessions), followed by 18 for verbal, 73 for physical, and 59 for not occurred. Then, he completed his turn taking 24 out of 45 by independent, 6 by verbal, 9 by physical, and 6 for not occurred in the maintenance phase. Overall, John showed an increase in his independent turn taking during intervention and continued to increase the independency in maintenance. Furthermore, he showed significant decrease in not occurred turn taking with the XbK intervention.

Eric. In response to the first research question, tier 2 of Figure 11 shows the results of Eric's turn taking. During the baseline sessions, Eric had 11.90 (*SD* = 3.38) mean frequency of turn taking. The data points showed a decreasing trend at the beginning of baseline, then a rapid upward trend in session five. However, the data showed a declining trend again toward the end of baseline. The data of the last baseline session was lower (*n* = 9.5) than the first baseline session (*n* = 12.5). Eric's turn taking data showed a declining trend at a low level and variability was observed.

During the intervention phase, Eric had an improved level of turn taking (*M* = 19.28, *SD* = 1.20). The graph shows an immediate effect from the XbK intervention, with a high data point (*n* = 19) when the intervention was introduced. The data points throughout intervention were consistent with a stable trend, ranging from 17 to 21. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase was stable and consistent at a higher level with no variability.

In response to research question two (tier 2 of Figure 11), Eric showed a slightly higher level of turn taking (*M* = 19.50, *SD* = 1.00) compared to intervention, which indicated that he maintained the high level of turn taking throughout maintenance. The graph shows the data points in maintenance were a stable and consistent trend at a high level and no variability was observed. The PND was 100% from baseline to maintenance.

Table 16 shows the total number and the percentage of turn taking with each prompt that Eric followed to complete his turns across all phases. The total number of turn taking during baseline was 120 (3 steps x 5 turns x 8 sessions) and the number of turn taking was 31 by independent, 23 by verbal, 19 by physical, and 46 for not occurred.

While his independent turn taking increase to 47 out of 135 during intervention, he completed his turn taking 73 by verbal, 13 by physical, and 2 for not occurred. In addition, he showed similar patterns of turn taking during maintenance over a total of 45 turns: 15 by independent, 27 by verbal, 3 by physical, and zero for not occurred. Although he showed increased independent turn taking with the XbK intervention, Eric completed his turn taking over 54% by verbal prompt. Furthermore, he showed significant decrease of not occurred turn taking during intervention and maintenance.

Carl. In response to the first research question, tier 3 of Figure 11 shows the results of Carl's turn taking. During the baseline sessions, Carl had 11.90 (SD = 3.38) of mean frequency of turn taking. During the first few baseline sessions, the data was variable, ranging from 12 to 16.5, then the data points declined to 7 for the next few sessions. Therefore, Carl had lower mean baseline data points (M = 11.90) compared to the first baseline session (n = 16). The data points in baseline showed inconsistent at a low level and variability was observed.

During the intervention phase, Carl had a significant improvement in the level of turn taking (M = 26.50, SD = 2.69). The graph shows an immediate effect from the XbK intervention, having a higher data point when the intervention was introduced (n = 24.5). The data points showed an upward trend for the first four intervention sessions. Then the data decreased slightly for the next two sessions. At the end of intervention, he had increased the mean frequency of turn taking to 29. The PND was 100% from baseline to intervention. Overall, the data in the intervention phase showed an increase in the level of turn taking with an immediate intervention effect. However, variability was observed.

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As seen in tier 3 of Figure 11 in response to research question two, Carl maintained turn taking at a similar level during maintenance ($M = 26.33$, $SD = 1.15$) as the intervention. The data point of the first maintenance session was slightly lower ($n = 27$) than the last intervention session ($n = 29$) but the overall data was stable and consistent throughout maintenance. No variability was observed. The PND was 100% from baseline to maintenance.

Table 16 shows the total number and percentage of turn taking with each prompt that Carl followed to complete his turns across all phases. The total number of turn taking with each prompt during baseline over 150 turns was 34 by independent, 49 by verbal, 4 by physical, and 63 for not occurred. However, he increased his independent turn taking to 83 out of 105 during intervention, which showed 19 by verbal, 1 by physical, and 2 for not occurred. Over 45 turns during maintenance, Carl showed similar results of turn taking 35 by independent, 9 by verbal, zero by physical, and 1 for not occurred. Overall, Carl showed significant increase in independent turn taking and decrease not occurred turn taking with the XbK intervention.

Social Validity

At the end of the study, the social validity questionnaire was asked to student participants. In addition, social validity interview was conducted for professional participants. The purpose of the social validity questionnaire and interview were to assess whether the XbK intervention, procedures, and the outcomes of this study were socially important and acceptable. The interview for professional participants included teachers' opinions and experiences related to the XbK gesture-based video gaming intervention

(see Appendices K). The questionnaire for student participants collected their preferences regarding the XbK intervention and the procedures (see Appendices J). Moreover, the results from professional participants' social validity interview were directly related to the third research question in this study.

Social validity from student participants. For student participants, the social validity questions were asked after the last session of the maintenance and the researcher asked the questions verbally (see Appendix J). The social validity questionnaire for the student participants included two questions. The responses were collected using three Likert-scale items, including 3 (really liked), 2 (okay), and 1 (did not like). Each rating scales contained picture-based faces describing three different feelings, a big smiley face, a plain smiley face, and a face with a frowning mouth. Those visual cues were used in the regular classroom routine to communicate with participants. Each participant responded by either pointing to the visual rating scale or verbally for each question.

The first question was about student participants' opinions related to the XbK video gaming. The mean response for the question was 2.83 ($SD = 0.41$) out of 3. Five students responded that they really liked the XbK gaming. One student responded as "okay". Second question was related to playing with a friend. The mean response for the second question was 2.83 ($SD = 0.41$) out of 3 points. Five participants responded as "really like" playing with a friend. One student responded as "Okay" playing with a friend. Overall, the results of social validity survey for student participants were positive with the XbK intervention and the procedures.

Social validity from professional participants. In response to the third research question, three teachers shared their perspectives and opinions related to the XbK gesture-based video gaming to teach social skills for young children with developmental delays. Social validity interview contained seven questions (see Appendix K). The interviews were conducted with each professional participant in their classroom at the end of the study and took approximately 20 to 25 minutes.

First, the three professional participants showed positive attitudes toward the use of XbK with the Air Band game. For the interview questions one and two, they believed that the XbK with Air Band game was beneficial for their students to learn the target social goals. All professional participants said that they were able to see some degree of improvements from the XbK intervention study. Professional participant A stated that the game setting helped their students learn to sit and wait for their turns for a longer period, compared to the usual challenges the teachers faced during classroom activity. She, also, found that kids improved their attention skills while they were playing the XbK in comparison to the baseline game. Professional participant B expressed appreciation about the XbK intervention. She said that Eric was not good at understanding or being aware of what is going on in the class. Although it took a while for him to be aware of the game, Eric was watching friends and was able to copy and imitate the play. She stressed that it was great to see that he was getting into the game. In addition, she explained the improvement of John's social skills in the regular classroom routine activity. She said, " During the typical classroom routine, John usually took his toys and played by himself. He did not go near anyone but isolated himself. Now he does. He is letting people around

him. I believe that this study really helped him learn play and social skills". Professional participants C said that James, particularly, is better able to wait for his turn. During classroom activities, usually he was not interested in others at all but she found that he is watching his peers' play.

In addition, all professional participants provided positive feedback to the Air Band game chosen for the XbK intervention. Professional participants A said that the Air Band game definitely entertained the students and motivated them. Professional participants B and C expressed that the screen displaying the students while playing enabled the students to improve attention and imitation skills. Professional participant B added that Eric did not have any play skills before. Although Eric did not interact with other kids, he increased his attention by watching others' play with the Air Band game. She stated that the Air Band game helped Eric learn play skills, such as copying by watching others, which eventually helped him developing the target social skills. Professional participant C stated similar opinions. She recalled James' imitation at the beginning of the study and said that he only moved his arms side to side with little movement. While he was playing the Air Band, he looked at himself on the screen and made bigger motions to imitate playing the virtual instruments.

Second, in response to the interview question four, all professional participants showed the willingness to use the XbK as their instructional strategies and practices. All teachers mentioned that they see the use of XbK in a small group activity or during center time. Professional participant C said, "Oh definitely I can see myself using this (XbK) with small group of students. I have seen that my students were so into the game and

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showed a lot of improvements in waiting and attention. I love to use this game with my students". However, all of them agreed that the XbK gaming is not appropriate to use in a larger group activity because most of their students are not good at waiting for long periods of time.

Third, as all of the professionals were positive with the use the XbK as their instructional practices, they shared their ideas regarding additional instructional areas they would apply. All of the professionals addressed various social skills, which were extended from the target social skills of this study. Professional participant B and C said that they found a great deal of listening skills. While students were playing the Air Band game, they listened to the verbal prompts and figured out what to do. They thought that the reason was because the XbK provides motivation for them to be more engaged. Professional participant B added independent skills along with listening skills for the same reason. Based on the idea of Air Band game, professional participant A mentioned that she would teach motor movements and pretend play skills.

Fourth, in response to the interview questions three and six, professional participants provided opinions and suggestions for better outcomes from the XbK intervention. They provided positive responses with the intervention procedures. Professional participant B said that she appreciated marking the play spot on the carpet. The marked spot helped kids become aware of the play spot. However, the professional participants suggested several modifications to the procedures in order to implement the XbK intervention directly in their classroom. Professional participant A addressed some difficulty with the group setting. Since most of students in the study had lack of waiting

skills, sitting and waiting for play was not easy. Particularly, she thought the morning group with three kids was the most challenging setting because they had to wait longer. She suggested having group of two students. Another suggestion was that the use of 5 turns format was too long for their students. They mentioned that kids were getting tired and losing attention toward to the end of a session. So they suggested that "3 to 4 turns" would be ideal for this population when they use the XbK. In addition, professional participants A and C suggested a short introduction prior to the intervention. While the researcher provided verbal instruction, explaining how to play and how to take turns, they thought that the introduction was too long and contained too much information, and made it difficult for the students to follow or retain the details and would impact their ability to follow instructions. Regarding the visual signs for taking turns, they all liked the use of visual signs. They said eventually all of the students recognized their color signs. However, professional participants A and B suggested that the use of their own face image instead of color might be a better option, so they immediately recognize what to do.

On the other hand, professional participant C pointed out the limitation of the XbK, especially with the sensor. She found out that several times the sensor captured the gestures differently. For example, a kid intended to play the guitar but the sensor recognized a different instrument and displayed the piano instead. Some kids, like James, were able to correct themselves and some kids, like Carl, just continued to play with the unintended instruments. So she thought that it was hard for kids when the XbK displayed the unintended instruments.

Finally, they provided additional comments in response to the survey question seven. A and B expressed excitement related to improved social skills for their kids. For example, Fran was very interested in the XbK gaming and his waiting skill improved. John now accepts his peers playing near or around him. Professional participant C commented the positive social interactions and verbal praises that some kids demonstrated during the XbK intervention. She said, "The most excited moments was when the kids were interacting with each other while they were playing. I know those spontaneous play behaviors were not your research intention. But I wanted to mention that I was really amazed when I saw them doing that…". For social interactions, she described that James and Carl exchanged their attention by verbal prompting to each other, like Carl called out "James' turn" or James said "Carl's turn". All professional participants added that they liked the XbK intervention and learned a lot from this study.

Overall, the three professional participants suggested that the XbK intervention is socially acceptable and valid. They found that all student participants showed some degree of improvement in the target social skills.

Summary

This study used the XbK, gesture-based video gaming system, to teach social skills for six young children with developmental delays. Specifically, this intervention study sought to promote three social skills, (a) accurate gesture imitation, (b) visual attention during play, and (c) turn taking. All participants showed increase in these three social skills. According to the evidence of effectiveness criteria (Kratochwill et al., 2010), the results from this study provided strong evidence that the functional relation exists

between the use of XbK gesture based video gaming and increase of social skills for the target students. Social validity interviews with the student and professional participants provided positive support toward the social significance of the study. In addition, social validity interviews with the professional participants provided useful insights and opinions about the use of XbK as an intervention tool.

Chapter Five

The purpose of this study was to explore the XbK gesture-based video gaming as a social skills intervention for young children with developmental delays in preschool settings. There were limited empirical studies on gesture-based video gaming as a means for social skills intervention. The study examined the use of XbK to determine the effectiveness of teaching three social skills, including accurate gesture imitation, visual attention during play, and turn taking.

This study was conducted using the multiple-baseline design across participants to examine the three research questions. Kratochwill et al. (2010) provided criteria to demonstrate evidence of a relation between an independent and the outcome variables. This study documented the following demonstrations of the XbK intervention effect: (a) the level, trend, and variability within each phase and across all participants, (b) immediate effects and the overlapping data points across phases and participants, and (c) the outlier data points within a phase. Therefore, the findings of this study provide strong evidence of the functional relation between the XbK intervention and the increase of social skills.

This chapter addresses the followings: a summary of findings in response to the research questions and anecdotal findings from this study; implications for practices; future research; and limitations of the study.

Summary of Findings

The purpose of the Experiment investigation was to examine a functional relation between the XbK intervention and the increase of the target social skills for young students with developmental delays. The target social skills were accurate gesture imitation, visual attention during play, and turn taking. Previous research showed that gesture-based video gaming enables students to learn the target skills in a short time period (Blum-Dimaya, Reeve, Reeve, & Hoch, 2010; Ferguson, Gillis, & Sevlever, 2014). The majority of student participants demonstrated poor performance of the target skills during the baseline phase. The results of this study indicated that six student participants demonstrated improved performance in the target social skills during the intervention phase and retained the learned skills during the maintenance phase. The findings support the limited body of literature on the effects of gesture-based video gaming to teach various skills (i.e., social skills) for children with disabilities. The findings discussed the three target skills and addressed the three research questions including the results from the social validity interviews.

Accurate gesture imitation. Imitation is a fundamental developmental skill to contribute to social, communication, and emotional development (Quill, 2000). According to Ledford and Wolery (2011), imitation skills are correlated with the development of joint attention, play skills and language acquisition. The Air Band game allows the players to imitate playing a musical instrument, watching himself on the screen playing the virtual musical instrument. While each student participant played the Sue says in baseline and Air Band games in intervention and maintenance, accurate

gesture imitation was measured using event recording. While all six participants in Experiment 1 and 2 showed poor imitation skills in the baseline phase, five students demonstrated an increase in the level of imitation with an immediate improvement when the intervention was introduced. However, variability of data points was found from several students. During maintenance, all six participants retained the imitation skills at a similar level as intervention, and showed a stable trend with a consistent pattern.

The first research question explored the functional relation between the XbK gesture-based video gaming intervention and the increase in accurate gesture imitation for the student participants. The calculated mean PND was 98.81% in Experiment 1 and 100% in Experiment 2, which indicates that the XbK intervention was very effective in improving accurate gesture imitation for the target participants (Scruggs & Mastropieri, 1998). The improved level and the immediate improvement support the effects of accurate gesture imitation from the XbK intervention. Although the variability of the data points was found from several student participants (i.e., Danny, James, and John), a possible justification for the variability was dependent on whether the students continued playing the same musical instrument or changed to different instrument during each turn, playing the Air Band game. The Air Band game allows players to change the musical instrument while playing. If a student changed the musical instrument during a turn (i.e., started with the piano and changed to the drum), the event recording counted the number of different instruments the student imitated (2 occurrences with piano and drum). For example, during session 11, over 5 turns James imitated only one musical instrument during each turn and 5 occurrences was observed. In session 13, for the first and second

turns he only imitated one instrument during each turn, but during the third to fifth turns he played two different instruments, which recorded as a total of 8 occurrences. If the occurrence of accurate gesture imitation was counted as 1 per turn regardless of number of musical instruments imitated, the visual analysis of accurate gesture imitation may show a more consistent pattern with stable trend. For Danny, in session 12, he had an outlier data point because he refused to play and did not imitate any musical instrument ($n = 0$). This resulted in a sudden change in the data point during the intervention phase.

The second research question examined whether the student participants maintain accurate gesture imitation skills two weeks after the conclusion of the intervention phase. All six student participants had consistent and stable data points. This indicated that they maintained the accurate gesture imitation skills after the intervention. Moreover, three student participants, Danny, James, and John, had a slightly higher level of accurate gesture imitation skills during maintenance, compared to the intervention sessions. The possible explanations with the slightly higher level of accurate gesture imitation from those students are as follows; for Danny, due to the zero point in session 12, the mean level in intervention was effected by this outlier resulting in a slightly higher mean level in maintenance. John had a gradual increased trend of accurate gesture imitation throughout intervention and maintenance sessions. The improvement over time resulted in a higher mean score in maintenance.

Comparing the results of accurate gesture imitation between Experiment 1 and 2, students in both Experiment 1 and 2 showed similar patterns during baseline and intervention. Both groups had very low level of data points during baseline and increased

the level with immediate effects during intervention. However, the difference was observed during maintenance. Experiment 1 maintained the imitation skills at a slightly lower level than intervention, while Experiment 2 continued to increase the level. Overall, the results indicated that both groups of students increased accurate gesture imitation through the XbK intervention.

Regarding the significant increase in the level and immediate effect of accurate gesture imitation, one possible explanation is due to their young age and their severe delay in language skills. Most of the student participants may not be familiar with the musical instruments names (i.e., piano, drum, and guitar). Thus, the student participants were not able to imitate the musical instruments properly during baseline. However, when they were introduced to the XbK with Air Band game, the display of the virtual musical instruments on the screen may have assisted the students with recognizing each musical instrument and resulting in their ability to imitate each of them. Research claimed that the use of visual or textual support enhance on-task behaviors for children with disabilities (Mavropoulou, Papadopoulou, & Kakana, 2011; Stromer, Kimball, Kinney, & Taylor, 2006). The use of XbK with the virtual display of the student playing the musical instrument may have contributed to the immediate improvement in imitation skills of playing the musical instrument.

Video modeling has been introduced as an effective intervention tools to teach various skills for children with disabilities (Ayres & Langone, 2005; Bellini & Akullian, 2007; Cardon & Wilcox, 2011). The similarity between gesture-based video gaming and video modeling is that the participants are provided a screen to watch and learn the target

skill. However, the feature of gesture-based video gaming is quite different from the video modeling. While the video modeling provides pre-made or pre-existing videos that include the appropriate behaviors or functional skills for the target students, gesture-based video gaming provides a screen that displays them playing. Several researches argued that video gaming assists students with self-regulated learning, which promote motivation, goal achievement, engagement and emotions while playing games (Ferguson et al., 2013; Prensky, 2007; Wuang et al., 2011). The participants' performances and the results support the previous literature regarding self-regulated learning. When student participants were playing the Air Band game, they watched themselves imitating a musical instrument, which provided an opportunity to self-correct or self-regulated their imitation. It was obvious that the students participants were engaged in the Air Band game as most of the time they showed their excitement while playing the game, with either facial expressions, such as smiling and laughing out loud, or vocal utterances, such as "wow".

Cardon and Wilcox (2011) designed the video modeling imitation training to teach object and gestural imitations for children with autism. The study argued that video modeling has not been evaluated as an imitation teaching strategy. The results were promising where the participants showed gained imitation skills through the use of video modeling. To date, gesture-based video gaming has not been used to teach imitation skills for children with disabilities. The results of accurate gesture imitation from six participants may provide promising results to support gesture-based video gaming allows the target students to self-regulate and learn the appropriate imitation skills. Hence,

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additional research is needed to provide empirical evidence of the effect of gesture-based video gaming on imitation skills.

Visual attention during play. The literature argued that lack of joint attention skills adversely impacts and significantly challenges young children with disabilities in social interactions (Charman et al., 1997; Ferraioli & Harris, 2011). In addition, research suggested that both joint attention and play skills contribute to the developmental process for young children, which allow them to understand the mental representation of others, thereby developing better social, cognitive, and language abilities (Baron-Cohen, Tager-Flusberg, & Cohen, 1994; Kasari et al., 2006). Visual attention during play applied the concept of joint attention to measure the frequency of their visual attention. Specifically, visual attention during play examined if the student participants were able to initiate by looking at either their peers or towards the XbK gaming while waiting for their turn or playing. All six student participants showed consistently flat at zero or very low level of data points during the baseline phase. Then, all the students showed increased level, variability, and immediate effect of data points during the intervention sessions. All six student participants retained visual attention during play at a similar level and with a stable trend during maintenance.

The first research question examined the functional relation between the XbK intervention and the increase of visual attention during play for young children with developmental delays. The calculated mean PND was 98.61% in Experiment 1 and 100% in Experiment 2, which can be interpreted that the XbK intervention was very effective to improve visual attention during play for the target participants (Scruggs & Mastropieri,

1998). The increase in the level was significant and the improvement was immediate, compared to the level in baseline. One interpretation of these results suggests that gesture-based video gaming using the XbK provided motivation and engagement for the student participants (Ferguson et al., 2013; Wuang et al., 2011), thereby improving their visual attention immediately when the XbK intervention was introduced. However, across all student participants, variability of data points were observed during intervention. It is important to note that the children often alternated their eye gaze between the screen and the researcher when the researcher provided verbal prompts. Shifting their eye gaze in responding to the speaker is considered as responding to joint attention (Mundy & Newell, 2007). However, this study did not measure joint attention when the student shifted their gaze to the researcher but instead only focused on initiating joint attention when a child stared directly toward the screen or at their peers playing. Therefore, when the researcher provided a prompt to the student, they may shift their attention away from the screen or their peer playing and look at the researcher resulting in less than 5 seconds of visual attention. Although the prompts from the researcher improved accurate imitation, it may have reduced the occurrence of visual attention to the screen or their peer resulting in variability in the visual attention results.

The second research question examined whether the student participants maintain visual attention skills two weeks after the conclusion of the intervention phase. The finding shows that all six student participants retained the high level of visual attention after the intervention phase. Two student participants, Danny and James, had a slightly higher level of visual attention during play in maintenance, compared to the intervention

sessions. For Danny, due to the zero point in the intervention session 12, the mean level of the intervention phase might be lower and resulted in slightly higher mean level in maintenance. Previous intervention studies examined the use of technology (i.e., virtual reality) to improve joint attention skills for children with disabilities, such as ASD (Cheng & Huang, 2012). Their results indicated that the participants improved their joint attention skills through the technology-based intervention and they also sustained the learned skills during maintenance. Those Experiment results claimed that virtual environment provides a significantly positive stimulus to motivate learning. This Experiment investigation supports the finding that the use of technology stimulates children with disabilities to retain joint attention skills.

The results of visual attention during play were compared between Experiment 1 and 2. The data pattern observed between Experiment 1 and 2 were consistent. Both group had very low level of data points during baseline and increased the level with immediate effects during intervention. Then, both group retained joint attention skills at slightly lower level than intervention during maintenance. Overall, the results indicated that the XbK intervention was effective in improving joint attention skills for both students with identified disabilities and students at-risk for developmental delays.

Joint attention significantly contributes to developing social interaction (Mundy & Crowson, 1997). Particularly, Mundy and Newell (2007) depicted joint attention as "where my eye's go, my behaviors follows". Mundy and Crowson (1997) claimed that children with disabilities (i.e., ASD) often have lack of joint attention skills. Impairment in joint attention is not because of the problem with the form of attention, such as shifting

eye gaze, but because they have a lack of interest in social interaction with others. A number of literature stressed that gesture-based video gaming provides a stimulus for students to motivate and engage them to learn (Blum-Dimaya et al., 2010; Ferguson et al., 2013; Prensky, 2007). All student participants significantly improved their visual attention during play through the XbK intervention. In addition, they showed increased engagement not only during their own play, but also while waiting for their turn.

Turn taking. Turn taking skills allow children to engage in social interaction with others in an appropriate manner (Constantino et al., 2003). Throughout this study, turn taking was observed in three steps: (a) sit and wait, (b) come to play, and (c) return to the seat. During baseline, the student participants had variable trend with low level of turn taking. The results showed that during intervention, all student participants had an increase in the level of turn taking and the improvement was immediate. Three students, Eric, Fran, and James showed stable and consistent trend of data points during the intervention phase. The other three, Carl, Danny, and John had variability of data patterns during intervention sessions. In addition, all of them sustained their turn taking at a similar level during maintenance.

The first research question examined the functional relation between the XbK intervention and the increase of visual attention during play for the target student participants. With an increased level and the immediate effects, the calculated mean PND was 100 % for five students and 66.67% for Danny. The findings indicated that five out of six student participants increased their turn taking skills through the XbK video gaming during intervention. Possible explanations for the variable data patterns that

Danny showed was due to the outlier with zero point in session 12 and he was easily distracted by his play partner, John. John had behavioral issues throughout the baseline and intervention, such as leaving the waiting spot. Danny was easily distracted by John's negative behaviors. However, as John gradually improved his play skills, he became less of a distraction for Danny. This resulted in less variability in Danny's turn taking data, which became stable from session 13 to the end of the maintenance session.

Interestingly, James in the third tier demonstrated highest mean frequency of turn taking during intervention and maintenance ($M = 29.71$ and $M = 28.33$, respectively). In the beginning of baseline, James showed good turn taking skills, such as starting with 23 at the start of baseline session but gradually declined and maintained the lower level of data points towards the end of baseline sessions. He had low interest in the baseline game, showing inappropriate behaviors (i.e., sitting and facing toward the wall instead of the screen or flipping the placemat). He lost interest with the baseline game resulted in a low mean frequency of turn taking ($M = 16.39$, $SD = 4.76$) for baseline compared to his first baseline session ($n = 23$). When the XbK intervention was introduced, James completed the 5 turns ($n = 30$) in each session independently and maintained his performance throughout most of the intervention, with the exception of the last intervention session ($n = 28$). It was clear that James possessed turn taking skills before this study. Yet, James needed to be engaged in the activity to prevent loss of interest. The XbK with Air Band game provided high level of engagement resulting in his ability to demonstrate independent turn taking skills.

The second research question examined whether the student participants maintain accurate gesture imitation skills two weeks after the conclusion of the intervention phase. The calculated mean PND was 100% across all participants. During maintenance, the results of the visual analysis showed similar level of data points compared to the intervention, with an upward trend. It is surprising to find that all participants still retained the high degree of turn taking skills two weeks after the intervention.

The results of turn taking were broken down by each prompt that each participant followed. Libby, Weiss, Bancroft, and Ahearn (2008) addressed that the use of prompts assist students to learn and use the target skills and increase the level of independency. The use of prompts (i.e., independent, verbal, physical, and not occurred) in this study was to teach children appropriate manner in turn taking (i.e., sit and wait for turn) and eventually be able to independently take turn. On average, across all participants, the mean percentage of occurred independent turn taking was 20.86% during baseline. The mean percentage of independent turn taking increased to 66.43% during intervention and 72.44% in maintenance. The mean percentage for not occurred turn taking decreased significantly from 57.03% during baseline to 12.94% in intervention and 5.78% in maintenance. This indicated that the target students improved their independent turn taking skills, thereby relying less on prompts from the researcher. However, one interesting finding was that Eric's independent turn taking increased slightly during intervention. Yet, he responded to verbal prompts more frequently and decreased reliance on physical prompt. As described in his IPP, he was not able to follow one-step verbal direction due to severe delay in his language ability. Aside of improving his turn taking,

the increased frequency of turn taking by verbal prompt showed that he was aware of the turn taking during the game and understood the verbal direction.

When comparing the results of turn taking between Experiment 1 and 2, there was no difference in the data pattern observed between the two groups. Both group had very low level of data points during baseline and increased the level with immediate effects during intervention. Then, both group retained turn taking skills at a high level during maintenance. Moreover, Danny in Experimental 1 and John and Eric in Experimental 2 demonstrated higher level of turn taking skills during maintenance than intervention. Overall, the results indicated that the XbK intervention was effective in improving turn taking skills for both students with identified disabilities and students at-risk for developmental delays.

Social validity. The results of the social validity interviews with the professional participants provided responses to the third research question. As the three professional participants directly observed their students in all phases of this XbK intervention study, they were able to evaluate the XbK and the students' progress. Overall, the professional participants were positive toward the use of XbK with the Air Band game to teach social skills for the target students. They pointed out several benefits association with the use of XbK as an intervention to improve social skills, which included the following; (a) the XbK provided entertainment and motivated and engaged their students, (b) all student participants demonstrated improved target social skills, and (c) some students showed decreased negative behaviors. The feedback on the use of gesture-based video gaming from the professional participants were similar to the positive indications from the

previous literature (Blum-Dimaya et al., 2010; Ferguson et al., 2013). Besides the changes in the students' target behaviors during the study, the professional participants shared their observation from their classroom settings after the XbK intervention. Several students demonstrated changes in their classroom activities. For example, prior to the XbK intervention John did not allow his peers near him or around him while playing. Now he is accepting his peers and is willing to participate in the center activity with his peers. James, now, shows interest in others' play. He is able to wait for his turn and is more willing to watch his peers' play during classroom activities. Same as James, Eric also demonstrates his willingness to wait longer for his turn in his classroom activities. Furthermore, the student participants expressed positive attitudes toward the XbK gaming and the group format. They enjoyed the XbK intervention and they liked to play with their peers.

In terms of the classroom implementation of the XbK intervention, the professional participants shared some recommendations in the group format and the number of turns for the XbK intervention in the classroom setting. As the target student population lacked waiting skill, the use of smaller groups such as two students per group would work better than three. Also, they found that 5 turns of play was too many and was challenging for their students to remain focused on the game. Nevertheless, all professional participants thought the implementation of the XbK intervention was feasible in the classroom. They demonstrated high interest and willingness to use the XbK in their classroom. Therefore, the result of the social validity interviews supports that the use of the XbK to promote social skills for young children with developmental

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delays. Overall, the results of target skills through the XbK intervention were socially significant. The implementation of the XbK intervention was practical in the classroom settings.

Additional Observations

In addition to the findings for the three social skills from the XbK intervention, there were several anecdotal behavioral observations that are worth noting. Although those changes were not captured through the data analysis, this may help to understand the results of the visual analysis and extend the target goals for future study. Danny had a bad day during session 12 and he refused to play the Air Band game. His teacher mentioned that he had not participated in any classroom activity on that same day as he did in session 12. This resulted in him having zero point for all three dependent variables, which impacted on the level and trend of his behavioral changes. To overcome this situation from distorting the results, there would need to be a mechanism to determine if the students were having a bad day and from this the session would be rescheduled.

This study did not collect the student participants' inappropriate behaviors. However, anecdotal observations found some behavioral changes from several students. John showed negative behaviors during the baseline phase and did not engage in the game at all. Instead he was away from his spot and stayed in a corner of the room most of the time or just walked around the room. So even physical prompt did not help him return and sit on the placemat or come to play when it was his turn. Although he was not sitting in the waiting area, during the intervention phase, he showed interest in the game, and was watching the screen from a far while another student was playing, which contributed

to an increase in his visual attention during play. But he still did not demonstrate appropriate turn taking or accurate gesture imitation at the beginning of the intervention phase. Then, he gradually started to participate in the game, with high frequency of physical prompt for turn taking and verbal prompt for imitating the gesture. Toward to the end of the intervention, his independent turn taking increased and finally he completed 3 turns of play independently during the last two maintenance sessions. With the gradual changes in his data, he reduced his negative behaviors during intervention, such as deviating from his seat. This was a dramatic change by John from the XbK intervention.

During baseline, Fran showed a low level of turn taking because he was not engaged in the baseline game and had several negative behavioral repertories. For example, when he sat on the placemat while waiting for his turn, he frequently lay down on the floor and looked at the ceiling. Physical prompt did not help him to sit properly. Also, he occasionally made noise. With the XbK intervention, he changed his behavior. He sat properly and his eye gaze was toward the screen while waiting for his turn to play. Instead of making noise, Fran showed eagerness to play by calling out his color sign, "green sign" while the researcher was switching out the visual sign to display the green sign. This is particularly an interesting observation because his IPP described that he was not able to combine 2 words during play.

Most of participants in this study had limited social-communicative language skills. However, James and Carl in the third tier showed several communicative social skills. While they played the Air Band game during the intervention and maintenance

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phases, they frequently demonstrated simultaneous communicative behaviors. For example, they exchanged their attention with each other. While taking their turn to play, they both provided verbal prompts to each other, such as Carl's calling out "James' turn" or James's calling out "Carl's turn". Furthermore, they called out the musical instruments on the screen while they were watching other's play (i.e., "Oh, drum"). This anecdotal behavioral observation may support literature that joint attention reflects the development of cognitive, social, and language (Baron-Cohen et al., 1994; Mundy & Newell, 2007). Future study may investigate the effect of the gesture-based video gaming to increase joint attention and social and language development.

Implications

The results of this study are promising and support the use of gesture-based video gaming to teach social skills for young children with developmental delays. Limited research suggested that gesture-based video gaming provides motivation for rapid acquisition of the target social skills for children with disabilities (Blum-Dimaya et al., 2010; Ferguson et al., 2013) and the results of this study confirms these findings. Several meta-analysis provides significant evidence for the benefits of technology-based learning for individual with disabilities (Bellini & Akullian, 2007; Grynszpan et al., 2014; Wehmeyer et al., 2008; Weng et al., 2014) With the increased number of empirical studies on innovative technologies-based interventions, Fletcher-Watson (2015) stressed that it is critical for researcher to evaluate commercial technologies and examine the evidence-based practice for educators, practitioners, and individuals with disabilities. In this regards, this section address the findings from this study regarding the experience

with the use of XbK for social skills intervention and practical guidance for the educational and clinical implementation.

Kandroudi and Bratitsis (2012) claimed that the use of XbK technology has the potential to enhance kinesthetic learning, having the motion sensor capturing players' gestures. The current study used the XbK technology to teach social skills for young children with disabilities. The findings of this study validate the use of XbK as an effective social skills intervention tool. There are several considerations to check before using the XbK in the classroom or clinical setting. First, as the Kinect sensor captures the entire body of the player, the space should be flat and the area between the sensor and the players should be cleared of any objects. In this study, the researcher set up a TV screen with the XbK system at the front of the room. The play spot was marked 6 feet from the Kinect sensor and any objects that could potentially be a distraction were cleared. Second, an Internet connection should be available through the LAN cable or Wi-Fi. When the XbK is set up, the console is connected to Xbox Live via Internet and required sign-in using an Xbox Live profile. The Xbox Live is an online platform that an individual user may download and play free or paid games with the distinct profile. Third, careful consideration should be given in the selection of the game to ensure appropriateness depending on the instructional purpose and age level of the target students. For example, this study used the Air Band game, requiring simple body gestures to play musical instruments (i.e., piano, drum, and guitar). Student participants responded that they enjoyed the game. Professional participants mentioned that Air Band game provided entertainment for their student to engage in the activity and learn the target skills. Lastly,

the implementation of gesture-based video gaming should consider the target population and setting to ensure success. In this study, the student participants were divided into three groups, forming two students per group. Each participant took the opportunity to play 5 turns in each session. Professional participants suggested that they would reduce the number of turns per session to 3 or 4. The recommendations take into consideration the student who had short attention.

The findings of this study provided several benefits from the gesture-based video gaming as an educational tool. First, the feature of gesture-based video gaming increases motivation and engagement (Blum-Dimaya et al., 2010; Ferguson et al., 2013; Prensky, 2007). Motivation is a critical aspect in the learning process (Blum-Dimaya et al.; Ferguson et al.). In this study, the Air Band game required the target participants to motion the appropriate body movements, which the sensor would capture and display the student playing a musical instrument. These entertaining features provided the target participants with motivation and engagement, thereby increasing the target skills.

Second, the feature of XbK provides increases student's independence. XbK game includes visual and audio interactions through the student's body movement. Kandroudi and Bratitsis (2012) suggested that the audio and visual interactions of gesture-based video gaming can be a stimulus for students to engage in play naturally with limited teacher prompts. In order to assist appropriate turn taking skills, this study provided verbal and physical prompts when they did not show appropriate actions throughout all phases. Baseline results indicated that student participants demonstrated poor turn taking skills. Even verbal and physical prompts did not help them to take turns.

However, the findings showed that all student participants had increased frequency of independent turn taking, resulting in higher mean frequency of turn taking during intervention and maintenance. This indicated that the researcher provided less verbal or physical prompts during the XbK intervention due to the improved independent turn taking skills. The findings from this study supports that the target students were able to improve their independence through gesture-based video gaming.

Third, XbK gesture-based video gaming may allow students with disabilities to reduce inappropriate or negative behaviors. Data collection from this study did not include inappropriate behaviors. Nonetheless, anecdotal observations found positive changes from the student participants. For example, John showed negative behaviors during baseline, such as leaving his seat while waiting. Even the researcher provided physical prompts to bring him back to the seat or play spot, he immediately ran away to the other side of the room. When the XbK intervention started, he gradually reduced the time of being away from his seat. Finally, John was able to sit and wait for this turn to play without showing negative behaviors. Ben-Sasson, Lamash, and Gal (2013) claimed that technology-based gaming intervention can strengthen positive social interaction while reducing negative behavioral issues for children with autism. The anecdotal findings may provide support for future study to examine the empirical evidence of the functional relation between gesture-based video gaming and decrease inappropriate behaviors.

Finally, the XbK gesture-based game system or other gaming systems are practical to implement in the class. When technology is introduced in the educational

settings, a key and important fact for success is whether the technology can be easily implemented (Goodwin, 2008). Most gesture-based video gaming systems consist of a game console and a sensor and can be easily setup. Once the system is setup, the user can navigate the game through the use of hand gesture or a game controller. Throughout this study, the researcher spent approximately 10 minutes to set up the XbK system during the intervention and maintenance session. The set up allowed for time to bring the TV screen from the other room, connect all the cables, mark the play spot, setup the waiting area using placemats, and setup the video recording devices. For the XbK intervention, there was no need to train the student participants on how to play the Air Band game. The student participants were able to come to the play spot and play without any prerequisite knowledge and skills.

Literature suggests that gestures or body movements promote students' learning (Alibali & Goldin-Meadow, 1993; McNeill, 1992). The Horizon Report supports the claim that gesture-based technology can enhance various areas of learning in education (Johnson et al., 2011). However, limited body of literature examined the effects of the use of gesture-based video gaming in various areas (i.e., social skills) in special educational setting (Blum-Dimaya et al., 2010; Ferguson et al., 2013). This study provided preliminary findings that gesture-based video gaming may promote social skills for young children with disabilities. Additional replications are needed to provide empirical evidence for researchers, educators and practitioners to implement this type of technology to improve various needs of individuals with disabilities.

Future Research

As described in Chapter Two, there was limited numbers of studies in the literature to examine the effectiveness of the use of gesture-based video gaming to teach social skills for children with disabilities. This study supports the findings of the limited body of literature. Kratochwill et al. (2010) argued that the validity of intervention effects can be enhanced by replication of effects across inter-subjects, studies, and different research group. Gast and Ledford (2014) claimed that replication allows researchers to minimize the margin of error and enhance the evidence of the findings through the repeated tests. Therefore, additional replications are needed to provide empirical evidence on the effectiveness of gesture-based video gaming across students with disabilities, various content areas, and from various researchers.

This study included three maintenance sessions, but did not include generalization condition with the XbK intervention. Without the generalization phase, the results of this study did not provide strong evidence as to whether the learned target skills were generalized in other setting or in other activities. According to Kratochwill et al. (2010), at least five data points per phase are required to meet evidence standards in multiple baseline designs. Having a complete maintenance and generalization conditions, the research study may be able to provide strong evidence on the effects of the XbK intervention and whether the participants are able to maintain and generalize the target skills. Therefore, future research studies should include at least five sessions of maintenance and generalization condition. Particularly, the generalization phase should

be examined in different settings and with different activities to provide the effects of gesture-based video gaming intervention.

Visual attention during play was one of the dependent variables in this study, measuring the child's eye gaze toward the screen or others. The operational definition of visual attention during play was when the participant demonstrated visual attention for 5 seconds. While the researcher provided verbal prompts, alternating their eye gaze between the screen and the researcher were observed frequently. Therefore, across all student participants, variable data pattern was observed during the XbK intervention. Future study may include the different types of joint attention for data collection, so the data analysis may provide a wide range of joint attention, such as initiating to joint attention and responding to joint attention to prevent variability.

Literature suggested that gesture-based video gaming devices provide positive potential for students learning through the use of their intuitions by interacting with the devices (Johnson, et al., 2011; Vernadakis et al., 2015; Wuang et al., 2011). In current commercial video gaming market, several gesture-based video gaming devices are available, such as XbK, Nintendo Wii, and PlayStation. For example, Ferguson et al. (2013) used Nintendo Wii to investigate the effects of Wii gaming on the social skills for children with ASD. Regardless of the different gaming devices, future replication studies may involve various gesture-based video gaming devices to support a wide availability of practical implementation for various participants group and their preference.

Limitations

Several limitations should be discussed with the conclusions of this study. The procedures in baseline with the Sue say game and the intervention with XbK Air Band game were mostly identical. The musical instruments the students imitated were identical across all phases (i.e., piano, drum, and guitar). In all phases, visual color signs were used to signal each child's turn to play. Verbal prompt was provided by the researcher to assist the participant in properly imitating the musical instrument. Verbal and physical prompts were used to assist students in completing turn taking. The only distinction between baseline and intervention was that the intervention sessions showed the introduction screen on how to play the musical instrument at the beginning of each intervention session. The justification of this different condition was because of the differences in the nature of the games. While children played the Sue says game, the researcher prompted them to play a specific instrument (i.e., "Sue says play the piano"). This directed them to the musical instrument they would imitate. With the nature of the XbK Air band game, a child had to initiate the gesture imitation of a musical instrument first and the virtual musical instrument was shown on the screen in accordance with the child's imitated playing. Therefore, the introduction screen was used to remind them of the three different musical instruments that they could play (piano, drum, and guitar). This difference might provide confounding factor to demonstrate evidence of the functional relation between the XbK intervention and outcomes of accurate gesture imitation.

The study used the XbK with the Air Band for social skills training. The XbK is a commercial device and the Air Band game is for entertaining purpose. This limited the

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ability to customize the intervention compared to a customized tool or game that would allow the researchers to tailor the software to meet the intervention purpose. For example, the Air Band game was limited and did not include any visual or audio cues to signal each participant's turn. To overcome this, the study used visual color signs to signal each participant's turn. As the same visual signs were used across all phases, this study tried to remove a potential confounding influence on the outcomes of turn taking, which effects internal validity (Kratochwill et al., 2010).

Another limitation from the XbK system was observed during several occasions when students in the third tiers were playing the Air Band game during the intervention phase. In order to play the Air Band game, a player imitates a musical instrument first, then the Kinect sensor captures the body movement and show the virtual instrument on the screen accordingly. In order to imitate playing the piano, both hands are required to move side to side. For drumming, both hands are needed to move up and down. When a child imitated playing the piano or drum with minimal movements, the Kinect sensor did not capture accurately what the student was imitating on several occasions. On one occasion, the child stopped playing and watched the researcher when he saw the unintended musical instrument on the screen. After 5 seconds, the researcher provided verbal prompt (i.e., "big movement") to help him correct the imitation. On two other occasions, when the child saw the unintended instruments, he immediately changed his imitations to the one on the screen. However, the data collection of accurate gesture imitation was measured only based on the occurrences of the virtual musical instruments after a child's imitation. Therefore, accurate gesture imitation data did not reflect those

happenings. Although gesture-based video gaming using the XbK provided positive results with improvement in social skills, careful consideration in the selection of the game and the appropriate customization plan are required to strengthen internal and external validity of the intervention effect.

This study examined the XbK intervention across baseline, intervention, and maintenance. The results of the maintenance phase showed that all participants retained the target skills two weeks after the intervention. The social validity interviews with the professional participants revealed that several students showed increased attention and waiting skills in the classroom activities after the XbK intervention. However, in terms of generalization of the target skills, it was unclear whether they demonstrated similar degree of target behaviors in their classroom. Therefore, future study may consider extending the examination of the gained skills across multiple settings and different activities.

The current study was unable to compare the results against a standardize assessment score to measure improvement. The selection of student participants relied on their IPP to include participants with lack of social skills. Having the detail descriptions of standardized social skills assessment, such as Social Skills Rating System (SSRS), future study may help to draw conclusions about possible improvement from pre-assessed level.

Appendix A

IRB Approved Letter

GEORGE MASON UNIVERSITY

Office of Research Integrity and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030
Phone: 703-993-5445; Fax: 703-993-9590

DATE: October 29, 2015

TO: Michael Behrmann, Ed.D
FROM: George Mason University IRB

Project Title: [763767-2] Gesture-Based Video Gaming to Promote Social Skills for Young
                         Children with Developmental Delays

SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: October 29, 2015
EXPIRATION DATE: August 19, 2016
REVIEW TYPE: Expedited Review

Thank you for your submission of Amendment/Modification materials for this project. The George Mason University IRB has APPROVED your submission. This submission has received Expedited Review based on applicable federal regulations.

Please remember that all research must be conducted as described in the submitted materials.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to the Office of Research Integrity & Assurance (ORIA). Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed (if applicable).

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to the ORIA.

The anniversary date of this study is August 19, 2016. This project requires continuing review by this committee on an annual basis. You may not collect date beyond this date without prior IRB approval. A continuing review form must be completed and submitted to the ORIA at least 30 days prior to the anniversary date or upon completion of this project. Prior to the anniversary date, the ORIA will send you a reminder regarding continuing review procedures.

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Generated on IRBNet

Please note that all research records must be retained for a minimum of five years, or as described in your submission, after the completion of the project.

If you have any questions, please contact Karen Motsinger at 703-993-4208 or kmotsing@gmu.edu. Please include your project title and reference number in all correspondence with this committee.

Appendix B

Informed Consent Form: Student Participants

Research Title: Gesture-Based Video Gaming to Promote Social Skills for Young Children with Developmental Delays

INFORMED CONSENT FORM - Parent/Guardian Permission for Participating in Research Study

RESEARCH PROCEDURES
This research is being conducted to examine the use of the XBOX Kinect system by children with disabilities. The goal is to explore if games, that use gesture-based and whole-body movement, increase or improve targeted social skills for young children with disabilities.
If you agree to have your child participate, he/she will be asked to play XBOX Kinect games that use gesture-based technology. If permission is obtained, demographic information (age, gender, race, type of disabilities, and specific educational goals) will be obtained for characteristics of a population for this study. All sessions will be video tapped using the XBOX Kinect interface and a digital video recorder. The recordings from the XBOX Kinect may be used to provide a record of performance (e.g. highlight improvement in student skills). The recordings from video tapped will be used for taking data on students' performance. Children will participate in an XBOX Kinect game for 3 to 4 times per week (20 minutes per session) for 2 months.

RISKS
There are minimal risks for participating in this research. To avoid injury, the physical space will be evaluated to ensure that there is sufficient space for unhampered interaction with the XBOX Kinect.

BENEFITS
There are no direct benefits to your child as a participant other than to assist with research on the impact of a gesture-based technology to enhance social skills for students with disabilities. Your child will have the opportunity to explore XBOX Kinect games and experience the impact on his/her learning goals. I believe that his/her participation will lead to a better understanding of how gesture-based gaming could impact social skills for students with disabilities.

CONFIDENTIALITY
The data in this study will be confidential. All data will be coded so that nobody, including individual students or their families, can be identified. (1) Your child's name will not be included on the collected data; (2) a code will be used for your child's name on the collected data; (3) through the use of an identification key, the researcher/data

collector will be able to link your child's data to your child's identity; and (4) only the researcher will have access to the identification key. The data will be collected using a data collection sheet by the following data collectors: teachers/program managers/researcher. The researcher will directly pick up the collected data sheets and transfer the data onto the computer. The data will be saved on a personal computer with password protection and only the researcher will have access to the data. The written data sheets will be stored in a locked file cabinet, for which only the researcher has keys. There is one exception to confidentiality. It is our legal responsibility to report situations of suspected child abuse or neglect to appropriate authorities. Although we are not seeking this type of information in this study nor will you be asked questions about these issues, we will disclose them as required under the law if discovered.

PARTICIPATION
Your child's participation is voluntary, and your child may withdraw from the study at any time and for any reason. If your child decides not to participate or if your child withdraws from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to your child or any other party.

CONTACT
Soojin Jang, a PhD candidate from George Mason University, is conducting this research. If you have any questions, you can be reached at 403-463-3007 or sjang6@gmu.edu. You may also contact her supervisor, Dr. Michael Behrmann, at 1-703-993-2051 or mbehrman@gmu.edu. You may also contact the George Mason University Office of Research Integrity & Assurance at 1-703-993-4121 if you have questions or comments regarding your child's rights as a participant in the research.
This research has been reviewed according to George Mason University procedures governing your child's participation in this research.

CONSENT
I have read this form, all of my questions have been answered by the research staff, and I agree to allow my child to participate in this study.

Please check one:

_____ I agree to audio and video taping

_____ I do not agree to audio and video taping

_____

Name

_____

Date of Signature

IRB: For Official Use Only

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MASON
UNIVERSITY
Office of Research
Integrity & Assurance

Project Number: 763767-1
Date Approved: 8/20/15
Approval Expiration Date: 8/19/16

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Appendix C

Introduction Letter to Parents

Introduction Letter to Parents of Children with Disabilities

Dear Parents/Guardians,

My name is Soojin Jang and I am a doctoral student at George Mason University in Virginia, U.S.A. I am conducting a research study on increasing social skills for preschoolers with special needs through XBOX video games. I invite your child to participate in this study.

If you agree for your child to participate, he/she will be asked to play the XBOX games with peers. More information is included in the attached consent form.

Please let me know if you have any questions.

Sincerely,

Soojin Jang

Appendix D

Informed Consent Form: Professional Participants

Research Title: Gesture-Based Video Gaming to Promote Social Skills for Young Children with Developmental Delays

INFORMED CONSENT FORM (Teacher/Program Manger)

RESEARCH PROCEDURES
This research is being conducted to examine the use of the XBOX Kinect system by children with disabilities. The goal is to explore if games that use gesture-based and whole-body movement, increase or improve targeted social skills for young children with disabilities.

If you agree to participate, you will be asked to take part in a 30-minute interview. The interview will be conducted at the completion of the intervention with the XBOX Kinect. The interviews will be used to elicit your thoughts and perceptions of the effectiveness of the use of the XBOX Kinect games with your students. The interview will take approximately 30 minutes to complete and will be scheduled at a time convenient for you. Interviews may be conducted over the phone or in person depending on your needs. The audio of the interview will be recorded to capture the data on the professionals' perspectives and experiences with using XBOX games for social skills intervention.

RISKS
There are no foreseeable risks for participating in this research.

BENEFITS
There are no direct benefits to you as a participant other than to assist with research on the impact of a gesture-based technology to enhance social skills for students with disabilities. I believe that your participation will lead to a better understanding of how gesture- based gaming could impact social skills for students with disabilities.

CONFIDENTIALITY

The data in this study will be confidential. (1) Your name will not be included on the collected data; (2) a code will be used for your name on the collected data; (3) through the use of an identification key, the researcher/data collector will be able to link your data to your identity; and (4) only the researcher will have access to the identification key. The data will be collected using an interview protocol by the researcher. The researcher will maintain control over the interview data collected. The data will be saved on a personal computer with password protection and only the researcher will have access to the data. All written notes taken during the interview will be stored in a locked file cabinet, for which only the researcher has keys. There is one exception to confidentiality.

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GEORGE MASON UNIVERSITY
Office of Research Integrity & Assurance

Project Number: 763767-1
Date Approved: 8/20/15
Approval Expiration Date: 8/19/16

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It is our legal responsibility to report situations of suspected child abuse or neglect to appropriate authorities. Although we are not seeking this type of information in this study nor will you be asked questions about these issues, we will disclose them as required under the law if discovered.

PARTICIPATION
Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party

CONTACT
Soojin Jang, a PhD candidate from George Mason University, is conducting this research. If you have any questions, you can be reached at 403-463-3007 or sjang6@gmu.edu. You may also contact her supervisor, Dr. Michael Behrmann, at 1-703-993-2051 or mbehrman@gmu.edu. You may also contact the George Mason University Office of Research Integrity & Assurance at 1-703-993-4121 if you have questions or comments regarding your rights as a participant in the research.
This research has been reviewed according to George Mason University procedures governing your child's participation in this research.

CONSENT
I have read this form, all of my questions have been answered by the research staff, and I agree to participate in this study.

Please check one:
_____ I agree to audio taping
_____ I do not agree to audio taping

_____
Name

_____
Date of Signature

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Project Number: 763767-1
Date Approved: 8/20/15
Approval Expiration Date: 8/19/16

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Appendix E

Candidacy Checklist: Student Participants

Student: _____   Student's Teacher_____

Completed by: _____   Date: _____

Inclusion Criteria for Participation:

	Yes	No
1. Is the child in preschool?	☐	☐
2. Does the child have a clinical diagnosis of disabilities?	☐	☐
3. Does the child receive educational services by the school authorities because he/she is suspected of having developmental disabilities (ASD or ID)?	☐	☐
4. Is the child identified the needs of social skills training on the IPP?	☐	☐
5. Is the child able to understand English?	☐	☐
6. Does the child' parents/guardians give the permission for video recording of all sessions?	☐	☐
7. Does the child have experiences in playing XBOX games?	☐	☐
8. Is the child able to see and hear the XBOX games on the screen either aided (i.e., hearing aid or glasses) or unaided?	☐	☐

Notes:

Data Collection Sheet

Child ID: Date:

Observer: Session#

Accurate Gesture Imitation

No	Occurrence	Occurred Imitation	No	Occurrence	Occurred Imitation
1			6		
2			7		
3			8		
4			9		
5			10		

"I"=Independent, "V"=Verbal

Visual Attention during Play

No	Occurrence	Note	No	Occurrence	Note	No	Occurrence	Note
1			11			21		
2			12			22		
3			13			23		
4			14			24		
5			15			25		
6			16			26		
7			17			27		
8			18			28		
9			19			29		
10			20			30		

* S=screen and O= other's play; W=waiting and P=playing

Turn Taking

Steps \ Trial	1	2	3	4	5
1. Wait in seat					
2. Move to the spot for their turn					
3. Return to the seat					
Total					

"I"=Independent, "V"=Verbal, "P" = Physical, "N"=Not Occurred

Researcher's Script for Baseline, Intervention, and Maintenance

Baseline – Sue Says Game

Introduction: It's time to play the Sue says game. My name is Sue. When I ask you something, you will play what Sue says

(Show red sign and call a student name) Red sign.
(Show green sign and call the other student name) Green sign.
(Show yellow sign and call the other student name) Yellow sign.

When you see your color, come and play. When I move your color, return to your seat and wait.

Starting the game: Let's start.
Put the red/green (/yellow) sign (alternate color signs after each session).
Start the timer for 30 seconds.
Sue says, play the _____ (guitar, piano, or drum).
After 30 seconds, remove the sign.

(Repeat this until everyone has 5 turns.)

To end session: It's time to finish the game. Well done!!

Intervention – XbK with Air Band Game

Introduction: It's time to play the Air Band game.

Look at the screen. (Pointing to the screen of each instrument) Piano (Moving hands side to side to play the piano). Drum (Moving hands up and down to play the drum). Then, guitar (straight one hand and moving the other hand up and down to play the guitar).

(Show red sign and call a student name) Red sign.

(Show green sign and call the other student name) Green sign.
(Show yellow sign and call the other student name) Yellow sign.

When you see your color, come and play. When I move your color, return to your seat and wait.

Starting the game: Let's start!
Put the red/green sign (alternate between red and green signs after each session).
Start the timer for 30 seconds
(Children playing for 30 seconds)
After 30 seconds, remove the sign.

Repeat this until each player has 5 turns.

To end session: It's time to finish the game. Well done!!

Maintenance – XbK with Air Band Game

Introduction: It's time to play the Air Band game.

(Show red sign and call a student name) Red sign.
(Show green sign and call the other student name) Green sign.
(Show yellow sign and call the other student name) Yellow sign.

When you see your color, come and play. When I move your color, return to your seat and wait.

Starting the game: Let's start!
Put the red/green sign (alternate between red and green signs after each session).
Start the timer for 30 seconds
(Children playing for 30 seconds)
After 30 seconds, remove the sign.

Repeat this until each player has 5 turns.

To end session: It's time to finish the game. Well done!!

Appendix H

Procedural Reliability Checklist for Baseline

Observer: Session #:
Student Group: Date:

Note: Mark each step completed or not completed by the researcher. The procedural reliability will be calculated by dividing the number of steps completed by the number of steps planned.

Baseline and Maintenance Procedures

	Yes	No
1. Ensures the two video cameras are on and recording the session from start to finish.	☐	☐
2. Set up two or three placemats on the left side of the room.	☐	☐
3. Ensures that a play spot is marked using color tape on the floor 6 foot from the front of the room.	☐	☐
4. Facilitate the game according to the intervention script.	☐	☐
5. Visual signs are in the front of the room to signal each participant's turn.	☐	☐
6. The researcher sets the timer for 30 seconds after putting the visual sign and remove it when the timer alarm goes off.	☐	☐
7. Ensures that the researcher waits for 5 seconds before providing any prompt.	☐	☐
8. Ensure each student has 5 turns of playing the game.	☐	☐

Note:

Appendix I

Procedural Reliability Checklist for Intervention and Maintenance

Observer: Condition:
Student Group: Date:

Note: Mark each step completed or not completed by the researcher. The procedural reliability will be calculated by dividing the number of steps completed by the number of steps planned.

|	Yes	No
1. Ensures the two video cameras are on and recording the session from start to finish.	☐	☐
2. Set up two or three placemats on the left side of the room.	☐	☐
3. Set up a TV screen with XBOX Kinect in the front of the room.	☐	☐
4. Open Air Band game to be ready.	☐	☐
5. Ensures that a play spot is marked using color tape on the floor 6 foot from the TV screen	☐	☐
6. Facilitate the game according to the intervention script.	☐	☐
7. Visual signs are in the front of the room to signal each participant's turn.	☐	☐
8. The researcher sets the timer for 30 seconds after putting the visual sign and remove it when the timer alarm goes off.	☐	☐
9. Ensures that the researcher waits for 5 seconds before providing any prompts.	☐	☐
10. Ensure each student has 5 turns of playing the game.	☐	☐

Note:
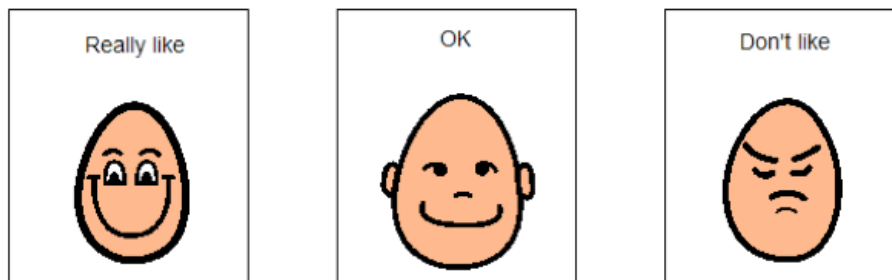
Student Participant Social Validity Survey

The researcher will circle the picture corresponding to the one the student pointed to when she verbally asked the following questions.

1. Did you like playing the Air Band game?

Really like	OK	Don't like
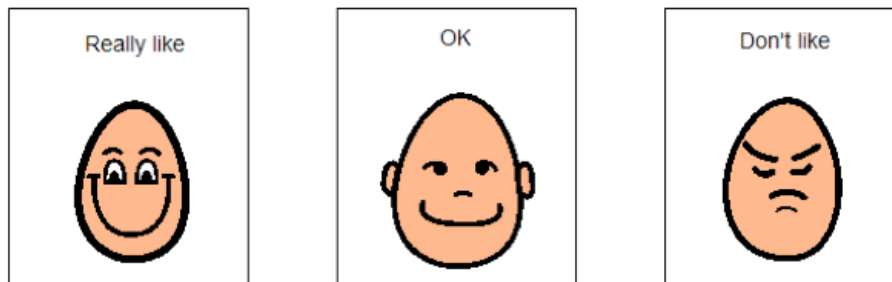
2. Did you like playing the game with your friend?

Really like	OK	Don't like

Appendix K

Professional Participant Social Validity Interview

Professional Position (circle one): Teacher   Instructional Assistant   Site Director

1. Do you think the XBOX Kinect benefit your student(s)?

2. Do you believe the Air Band game this study selected for your students helped them accomplish their goals and objectives?

3. Did you find any difficulties or barriers with the use of XbK during this study? If yes in what way?

4. Would you like to use the Xbox Kinect with your student(s)?

5. What other instructional areas would you like to address using the Xbox Kinect?

6. Do you have any suggestions/advice to implement the XBOX Kinect into your classroom or program?

7. Is there anything else you would like to add?

Appendix L

Demographic Data for Student Participant

Participant ID _____

Demographic Data

1. Gender.
   a. Male
   b. Female

2. Age (month). _____

3. Ethnicity/Race.
   a. Caucasian
   b. African American
   c. Hispanic
   d. Native American
   e. Asian/Pacific Islander
   f. Other

4. Types of disabilities (Check all that apply). Diagnosis_____ or Suspected _____
   a. ADD/ADHD   h. ED   n. OI
   b. ASD   i. HI   o. SLI
   c. Blind   j. ID   p. TBI
   d. Deaf-Blind   k. LD   q. VI
   e. Deaf   l. MD
   g. Dev. Delay   m. OHI

5. Standardized test scores (i.e., receptive and expressive language skills).

6. Describe IPP goals: focus areas of therapy, social skills, etc.

Appendix M

Demographic Data for Professional Participant

Demographic Questionnaire

1. Gender: Male _____ Female _____

2. Age: _____

3. Ethnicity/Race.

    a. Caucasian

    b. African American

    c. Hispanic

    d. Native American

    e. Asian/Pacific Islander

    f. Other

4. Years of teaching experience in preschool setting: _____

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Biography

Soojin Jang. She earned her B.S. in Computer Science from Seoul Women's University in 1997 and M.Ed. in Special Education from DanKook University in 2006, in Seoul, Korea. With 9 years of teaching at an elementary school in Korea, she moved to Virginia, U.S to continue her professional journey in Assistive Technology. After receiving a certificate of Assistive Technology from George Mason University in 2007, she worked for the Training and Technical Assistance Center at George Mason University as an assistive technology coordinator until 2014. Currently, she resides in Calgary, Canada.