EVALUATING THE EFFECTS OF A POINT-OF-VIEW VIDEO PROMPT INTERVENTION ON THE COMPLETION OF SCIENCE EXPERIMENTS WITH AN INDIVIDUAL WITH AUTISM SPECTRUM DISORDER AND AN INDIVIDUAL WITH INTELLECTUAL DISABILITY

by

Molly Anne Matsik

Bachelor of Arts, Edinboro University of Pennsylvania, 2001

Master of Education, University of Pittsburgh, 2012

Submitted to the Graduate Faculty of

the School of Education in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2017

UNIVERSITY OF PITTSBURGH

SCHOOL OF EDUCATON

This dissertation was presented

by

Molly Anne Matsik

It was defended on

July 18, 2017

and approved by

Rachel Robertson, PhD, Department of Instruction and Learning

Douglas Kostewicz, PhD, Department of Instruction and Learning

Ben Handen, PhD, Department of Psychiatry

Dissertation Advisor: Steven Lyon, PhD, Department of Instruction and Learning

EVALUATING THE EFFECTS OF A POINT-OF-VIEW VIDEO PROMPT INTERVENTION ON THE COMPLETION OF SCIENCE EXPERIMENTS WITH AN INDIVIDUAL WITH AUTISM SPECTRUM DISORDER AND AN INDIVIDUAL WITH INTELLECTUAL DISABILITY

Molly Anne Matsik, PhD

University of Pittsburgh, 2017

Students with disabilities are spending increasingly more time included in general education classes in public schools. One class students with disabilities are often included in is science. However, student with disabilities tend to require increased assistance from the teacher, a peer, or a paraprofessional to actively participate in the class. Very little research has been done to evaluate the effects of interventions that can be used to promote independence and encourage learning in inclusive science classes. The current study was designed to evaluate the effects of point-of-view video prompt intervention on the completion of science laboratory experiments with two individuals with disabilities. The results of the study indicated that when the participants received a more traditional, verbal delivery of the instructions, they required a higher degree of support from the instructor. However, when the intervention was in place the participants were able to complete the science experiments more independently and with less prompting from the instructor. Social validity was assessed at the conclusion of the study and both participants reported to like using the intervention to conduct science experiments.

Keywords: video modeling, science content, video prompting, autism spectrum disorder, intellectual disability

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

This dissertation is dedicated to my daughter, Violet. Work hard, be kind, and you will always be successful.

Sincerest thanks to my advisor, Dr. Steven Lyon, who supported, guided, and encouraged me every step of the way. To my committee, Dr. Rachel Robertson, Dr. Doug Kostewicz, and Dr. Ben Handen, I am grateful for your feedback, time, and consideration.

To Dr. William J. Helsel, my mentor, my friend, my greatest teacher, thank you.

To my parents, Bob and Colleen and my in-laws, Jim and Susan, we could have never made it without your love and support. Thank you to my siblings, Sarah and Christian, James and Ashley, and Ginger for your unending enthusiasm and interest in my work.

To my dearest friends and colleagues, Kaitlin Brennan and Rachel Gwin. You are two of the smartest people I know. From classes to papers to competencies, we shared our experiences and supported one another, and for that I am grateful.

To Dr. Pete Heh who took a chance and hired me for a job that would change my life.

Finally, to my husband, Jesse, your encouragement has never waned. Thank you for loving and supporting me throughout.

1.0 INTRODUCTION

Since 1975 and the enactment of the Individuals with Disabilities Education Act (IDEA, 2004) the number of individuals who receive special education services in public schools has increased from 8.3 to 12.9 percent (U.S. Department of Education, National Center for Education Statistics, 2015; Digest of Education Statistics, 2013). According to the National Center of Education Statistics (2015), the majority of students' receiving special education services in public schools are those with specific learning disabilities. However, between the years 2004-05 and 2011-12 the percentage of students identified with specific learning disabilities decreased and the percentage of students diagnosed with autism spectrum disorder (ASD) increased from 0.4 to 0.9 percent (Digest of Education Statistics, 2013).

Our understanding of ASD has evolved exponentially over the last seven decades. Once thought to be a rare disorder, ASD is now a common term in both the English language and educational vernacular. Research has shown that ASD is not a result of poor parenting (Matson & Goldin, 2014) or of mother's being cold (Kanner, 1949) rather it is a group of developmental disabilities that can lead to significant challenges with social and communication skills (Centers for Disease Control and Prevention, 2015).

The prevalence of individuals diagnosed with ASD is not decreasing. In fact, it is increasing (Wong, Odom, Hume, Cox, Fettig, Kucharczyk, Brock, Plavnick, Fluery, & Schultz, 2014; Ganz, Earles-Vollrath, & Cook, 2011; Iovannone, Dunlap, Huber, & Kincaid, 2003). As of 2009, the worldwide population prevalence of ASD was approximately 1% (Lai, Lombardo, & Baron-Cohen, 2014). Reports from the Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring (ADDM) Network claim that one in 68 children has been identified with ASD (2014). Furthermore, individuals across all racial, ethnic, and socioeconomic groups have been identified with ASD (Centers for Disease Control and Prevention, 2015). Additionally, research shows that ASD is five times more common in boys than in girls (Centers for Disease Control and Prevention, 2015). Since the discovery of ASD, educators, parents, care takers, and scientists have searched for the most effective practices to provide in the schools and in the home (Wong et al., 2014). Thus, researchers must continue to explore and evaluate a variety of teaching methods and procedures that will encourage successful learning for individuals with ASD (Charlop-Christy, Lee, & Freeman, 2000).

The Pennsylvania Department of Education (PDE) reported that 15.9 % of all students enrolled in Pennsylvania public schools carry some form of diagnosis under the IDEA. Of the 15.9%, 7.8 % of those students are diagnosed with ASD and 7.1% of students are diagnosed with intellectual disabilities (ID) (Pennsylvania Department of Education, 2011). Due to growing numbers, research is needed to investigate and identify instructional strategies and interventions for a diverse population of students (Burton, Anderson, Prater & Dyches, 2013).

ASD is a lifelong disorder. It is usually diagnosed before the age of three and persists through adulthood (Iovannone et al., 2003). Individuals with ASD typically present with a wide range of abilities as well as disabilities (Iovannone et al., 2003; Heflin & Simpson, 1998a). Common defining characteristics of individuals diagnosed with ASD include deficits in social and communication skills and restricted repertoires of behaviors and interests (American Psychiatric Association, 2000). These deficits affect every aspect of quality of life (National research Council, 2001) and adaptive functioning (Allen, Wallace, Renes, Bowen, & Burke, 2010).

Individuals with ASD tend to have deficits in verbal and nonverbal communication, reciprocal social interaction, and display a restricted repertoire of activities of interest (American Psychiatric Association, 1994). Individuals with ASD may display difficulties with attention, eye contact, and processing social stimuli (Schmidt & Bonds-Raacke, 2013). Because of these core deficits, individuals who are diagnosed with ASD may exhibit atypical or peculiar responses in social settings (Corbett & Abdullah, 2005), they may avoid attending to socially relevant stimuli (Prior & Ozonoff, 1998) or they may have trouble with academic performance in math, reading, writing, and language (Delano, 2007; Minshew, Goldstien, Taylor, & Siegel, 1994). Lack of appropriate intervention may limit a student's educational progress and lead to further deficits in appropriate classroom behavior, functional communication, and social skills (National Research Council, 2001). Thus, communication, social, and academic skills are deemed essential targets for instruction for individuals with ASD (National Research Council, 2001).

Individuals with ID are characterized as having significant limitations in intellectual functioning and adaptive behaviors (American Association for Intellectual and Developmental Disabilities, 2013). Intellectual functioning refers to mental capacities such as learning, reasoning, and problem solving skills. One way to measure intellectual functioning is with an IQ test. An IQ test score of 70 or below indicates a limitation in intellectual functioning and is therefore a characteristic of individuals diagnosed with ID. Adaptive behavior refers to a set of skills that people learn and perform on a regular basis in their everyday life (American Association for Intellectual and Developmental Disabilities, 2013).

Adaptive behaviors include conceptual skills, social skills and practical skills. Conceptual skills encompass language and literacy skills, numbers, time, money, and directionality (i.e., left, right, center). The social skills included under adaptive behaviors are skills such as interpersonal skills, social responsibility, self-esteem, social problem solving, and the ability to follow rules. Finally, practical skills refer to activities of daily living, personal hygiene skills, travel/transportation, safety, and schedules and routines (American Association for Intellectual and Developmental Disabilities, 2013). Individuals with ID must learn a variety of academic, domestic, social, and leisure skills in order to gain independence and function with autonomy in daily life (Bidwell & Refeldt, 2004).

The scope of academic skills taught in schools is wide and covers a variety of tasks and subject areas. Most commonly, academic skills refer to acquisition in the areas of mathematics, reading, writing, and science. However, the term “academic skills” can be expanded to include skills needed to be successful in a school or academic environment. Under the expanded term, skills such as making transitions, following rules, and establishing instructional control can be considered as academic. The rate of acquisition of those skills may vary depending on the student’s grade level, prior knowledge, and individual capabilities.

Individuals with ASD and ID commonly have difficulties developing functional academic skills such as reading (Morlock, Reynolds, Fisher, & Comer, 2015), math (Burton et al., 2013), spelling, (Kagohara, Sigafoos, Achmadi, O’Reilly, & Lancioni, 2011), and writing (Tripiana-Barnosa & de Souza, 2015) as well as transitioning and adhering to rules. To address these issues and to guide instructional practices, researchers have designed a system to assist educators and to promote the use of scientifically based or evidence based practices (EBPs) for students with disabilities (Spooner, Knight, Browder, & Smith, 2012).

Due to the variable and highly specific academic needs of individuals with ID, educators may encounter challenges when selecting and implementing effective instructional practices in the classroom (Courtade, Test, & Cook, 2015). Courtade et al. (2015) conducted a review of professional literature and found empirically validated practices for individuals with moderate, severe, and profound intellectual disability. They found a number of EBPs for individuals with ID in the areas of math, reading, science, and general academics. EBPs for teaching theses subject areas included: systematic instruction, opportunities to respond, massed trial training, time delay, systematic prompting, in-vivo instruction, and use of pictures (Courtade et al., 2015, Table 1). Ultimately, they concluded that while there have been advances in conducting and synthesizing research necessary to identify EBPs for individuals with ID, work is still needed to improve learner outcomes and classroom practices (Courtade et al., 2015).

Most effective practices are those that are systematic, objectively verified, used with fidelity, and customized to fit the individual needs of the learner (Simpson, 2005). Just as individuals with ID have specific learning needs, so do individuals with ASD. Odom, Brown, Frey, Karasu, Smith-Canter, & Strain (2003) examined single subject research studies for scientific evidence and support for effective interventions and educational practices for individuals with ASD. Their work yielded a number of interventions that were shown to be effective techniques for instructing individuals with ASD.

Techniques found to be effective for providing academic instruction to individuals with ASD included: adult-directed interventions, differential reinforcement of desired behavior(s), peer-mediated interventions, visual supports, self-monitoring, family involvement, positive behavior support, video modeling, and moderating characteristics of tasks (p 172). While all of these interventions have been studied and shown to have merit, this review will focus mainly on the literature supporting the intervention of video modeling.

Research has shown that technology can improve learning outcomes and increase access to core curriculum for students with disabilities (Cihak & Bowlin, 2009; Burton et al., 2013). Furthermore, research strongly supports the use of video technology as an effective way to enhance academic skills, communication, activities of daily living, leisure, social skills, and transitions skills for individuals with ID and/or ASD (Spencer, Mechling, & Ivey, 2015). Video-based instruction can be viewed as a viable teaching tool for individuals with disabilities because it allows students' to view themselves or others similar to them engaging in positive, successful behaviors (Dowrick, 1999; Cihak, Fahrenkrog, Ayres, & Smith, 2010). A series of literature reviews (Ayres & Langone, 2005; Delano, 2007; Hitchcock, Dowrick, & Prater, 2003; Machalicek, O'Reilly, Beretvas, Sigafoos, Lancioni, Sorrells, Lang, & Rispoli, 2008; Prater, Carter, Hitchcock, & Dowrick, 2012) and meta-analysis (Bellini & Akullian, 2007) have been conducted to demonstrate the effectiveness of video modeling procedures.

1.1 VIDEO MODELING

In general, modeling is an instructional approach based on the theory of observational learning (Prater et al., 2012). It has been shown to be an effective tool for teaching (Tereshko, MacDonald, & Ahearn, 2009). Technology, specifically video technology, offers a unique way to promote observational learning in schools (Hine & Wolery, 2006). Video modeling (VM) is a behavioral technique that allows students to observe the mechanics of a behavior or task before engaging in it (McCoy & Hermansen, 2007). It requires observation through video rather than live scenarios (McCoy & Hermansen, 2007). There are three main forms of VM interventions: VM with others as a model, video-self modeling, and point-of-view video modeling. The instructional techniques of VM are implemented when a student is shown a video of a model (i.e., self, other, or point-of-view) performing a skill and is expected to imitate the skill in the same way as the model (Odom et al., 2003). The student has the opportunity to watch the full video prior to engaging in the task. The student is then given the opportunity to engage in the task or behavior that was modeled (Miltenberger & Charlop, 2015). This process is repeated until the student is able to consistently engage in the task on his/her own (Bellini & Akullian, 2007).

1.1.2 VM with others as models

VM with others as a model occurs when a novel or known, peer, sibling, or adult is recorded engaging in a sequence of steps in order to complete a task. Specifically, models preform a series of scripted actions or vocalizations (Tereshko et al., 2009). Following the presentation of the video, the student is given the opportunity to imitate the scripted movements made by the model. The video may be shown once or multiple times before the student is asked to imitate the responses (Tereshko et al., 2009). The individualized video may include instruction delivered as a voiceover (e.g., a spoken directive regarding the target behavior) and/or a reward system (e.g., animation, images of favorite characters, sounds, etc.) at the end of the task (Wilson, 2013). Some research suggests that VM with others is most powerful when the selected models are similar in age, gender, and ethnicity to the target students (Schunk, Pintrich, & Meece, 2007).

However, Prater et al. (2012) posited, “Oneself may be considered the most powerful model of all” (p. 71).

1.1.3 Video Self-Modeling (VSM)

VSM is a technique that capitalizes on the power of self-perception as it shows the learner engaging in a skill they have not yet learned. This is achieved through strategic filming and editing. Two forms of VSM, positive self-review and feedforward are seen in research and commonly used in practice (Prater et al., 2012). Positive self-review does not require editing but it does involve “catching” the student engaging in the target behavior, filming it, and showing the student the positive example of themself (Prater et al., 2011). This can be used to increase the frequency of a desired behavior that is already in the student’s repertoire but not frequently selected (e.g., hand raising rather than calling out). Positive self-review can be used to increase low frequency behaviors or to encourage the student to engage in previously mastered behaviors (Bellini & McConnell, 2010). Technologically, this intervention is not complicated. However, it may be time consuming and require the filming of copious amounts of raw footage in order to capture an image of the individual engaging in the desired/low frequency behavior (Bellini & McConnell, 2010).

Conversely, feedforward is an intervention used to show a student engaging in a skill that is slightly above or not yet in their current repertoire (Bellini & McConnell, 2010). Through editing, feedforward captures and combines a series of known component skills to show the student engaging in a novel skill (Prater et al., 2012). This intervention may be implemented with a student who is not able to independently perform a skill or task (Bellini & McConnell,

2010) or who is not able to transfer a skill between contexts or settings (Prater et al., 2012).

Feedforward is somewhat more complicated and may involve the use of hidden supports (Bellini & McConnell, 2010). For example, prompting or verbal cues may be provided to the student to help them correctly complete the task or sequence of behaviors (Bellini & McConnell, 2010). Those prompts would be edited out of the final video. Through this editing process, the student is able to see themself engaging in a new set of skills (Bellini & McConnell, 2010). Ultimately, the goal of any VSM intervention is to promote independence, acquisition, and increase frequency of desired behaviors (Bellini & McConnell, 2010).

1.1.4 Point-of-View (POVM)

POVM is a relatively new form of VM (McCoy & Hermansen, 2007). It involves filming a task or a sequence of movements from the perspective of the actor or the person who is meant to perform the skill (Hine & Wolery, 2006). Most commonly, the video shows only the model's hands performing a task. Thus showing instruction and task completion as it would be seen if the individual were engaging in the desired task (McCoy & Hermansen, 2007; Shrestha, Anderson, & Moore, 2013). When using POVM, the learner views the entire clip of the target task prior to being asked to engage in the task (Katsioloudis, Fantz, & Jones, 2013). This form of VM is not as widely used as VM with others or VSM and thus there is less research available concerning its effectiveness (Shrestha et al., 2013). However, it is speculated that POVM may improve stimulus control guiding the viewer's attention to the specific movements or elements of the task within the image (Moore et al., 2013).

Three main perspectives can be used with POVM, the subjective, reportorial, and objective (Katsioloudis et al., 2013). The subjective point of view shows a task being completed from the instructor's/observers perspective. To capture this view, the instructor would wear a camera mounted to his/her head and film their hands completing the task (Katsioloudis et al., 2013). An instructional video shot from the reportorial point of view shows the task as seen from an observer standing next to the instructor (Katsioloudis et al., 2013). To film this point of view, a camera would be placed next to the instructor (i.e., left or right) facing the student (Katsioloudis et al., 2013). The objective point of view mimics face-to-face instruction. The camera focuses on the task as seen by the viewer (Katsioloudis et al., 2013). POVM is an intervention that can be used to help teachers individualize instruction and help students gain access to instruction through multiple viewings and individualized pacing (Shrestha et al., 2013).

1.2 BENEFITS AND POTENTIAL BARRIERS

1.2.1 Access to information and core curriculum

The availability of technology has changed the way we live, work, play, and interact with the world (Knight, McKissick, & Saunders, 2013). It has changed the way educators teach and disseminate information (O'Malley, Lewis, Donehower, & Stone, 2014). The addition of technology in schools has opened a myriad of doors for all learners, especially those with disabilities. For example, handheld devices such as the iPad®, iPod®, Kindle Fire®, and smartphones have the ability to make learning mobile, portable, and accessible from anywhere

(O’Malley et al., 2014). These devices can have great implications for using interventions such as VM in the classroom.

The portability of a handheld device allows the student to view the intervention in the environment that is most suitable to the task (Miltenberger & Charlop, 2015). Specifically, a cooking video can be viewed in a kitchen or a kicking video can be viewed on a ball field rather than in the classroom. Finally, handheld devices with specialized features such as storage capacity, Wi-Fi connectivity, and a built in camera allow the learner to access, capture, store, and revisit pertinent information as often as necessary (O’Malley et al., 2014).

1.2.2 Repeatability

Handheld video technology not only allows the student to view an instructional video in the appropriate setting but it also allows them to view the video multiple times. Unlike in vivo modeling, the model in VM instruction is captured on film. This provides the student with the unique opportunity and convenience of viewing the same model repeatedly (Charlop-Christy, Le, & Freeman, 2000). In addition, a filmed model does not need to be present at the time of intervention, which eliminates the difficult task of coordinating schedules, and times with other individuals (Charlop-Christy et al., 2000). In special education, student’s academic plans should be individualized and reflective of their strengths and areas of concern. However, with current legislation and the promise that all students will have access to the common core curriculum, it stands to reason that multiple students may need assistance with similar skills (O’Malley et al., 2014). Once the instructional videos are created, they may be repeated/reused with multiple students and in various settings (Charlop-Christy et al., 2000).

1.2.3 Independence and social validity

It is a common goal in special education to want students become efficient and independent learners. This goal can sometimes be challenging when working with individuals with ASD. Research has shown that individuals with ASD are known to run the risk of becoming more prompt dependent and less independent with one-to-one instruction (Hume, Loftin, & Lantz, 2009). However, according to Binder (1993) interventions that allow students to practice a skill without interruption (e.g., prompt, instruction, or praise from an adult) are more likely to be successful over time.

A VM intervention allows the student to view a full sequence of movements before engaging in a task. This sequence can be altered through editing, and the visual cues can be faded to promote independence. VM interventions can also support independence by using the screen as the main form of prompt delivery rather than relying on the teacher. This can decrease the potential stigma associated with constant teacher prompting (i.e., nagging) and increase the amount of time the teacher is able to spend with the whole class (O'Malley et al., 2014). In terms of social validity, it has been suggested that children enjoy watching videos (Bellini & McConnell, 2010) and prefer using small portable devices when working in groups (Allen, 2011). The implementation of a VM intervention on a handheld device would lend itself to the strengths and preferences of students today.

1.2.4 Potential barriers to implementing VM interventions

The amount of empirical evidence supporting VM interventions in academic settings is growing. According to the quality indicators (Horner et al., 2005) a sufficient amount of scientific research has been done to qualify VM and VM interventions as EBP's for individuals with ASD. However, in lieu of its qualifications, only a small number of schools are implementing VM interventions in their classrooms (Bellini & McConnell, 2010). Educators reported a number of barriers to implementing VM interventions in the classroom. Barriers included: lack of access or ability to purchase the necessary equipment, amount of time required to implement a VM/VSM intervention, and lack of technical knowledge/support (Bellini & McConnell, 2010; O'Malley et al., 2014). The lack of implementation may be attributed to the perceived notion that producing and editing videos is a difficult and time-consuming task (Bellini & McConnell, 2010; O'Malley et al., 2014).

The amount of time it takes to edit a video can vary depending on the intervention (Bellini & McConnell, 2010). Unfortunately, the amount of time required to edit a video is directly related to the proficiency of the editor and the usability of the editing software (Bellini & McConnell, 2010). The time it takes to learn the software may be somewhat lengthy, depending on the individual. Additionally, teachers' confidence levels when using technology can also help or hinder the issue of time and editing (O'Malley et al., 2014). It is important to note that the bulk of time spent creating a VM intervention is in the beginning during the recruitment of models, filming, and editing stages. Once completed, the VM intervention will only take 1-2 minutes a day to implement (Bellini & McConnell, 2010).

Many teachers may be surprised to learn that filming can be made easier by using a small handheld device (e.g., a smartphone) or a Flip video camera. These devices are easy to use, have small screens for quick viewing, and can be connected to a larger screen/monitor for more comfortable viewing (Bellini & McConnell, 2010). Popular trends in photo/video sharing have helped to make the process of creating a VM intervention a less intimidating task. Innovations in video technology and editing software also help to make the process straightforward and easy to do (Bellini & McConnell, 2010).

2.0 LITERATURE REVIEW

The purpose of this review is to analyze, synthesize, and identify gaps in the literature surrounding the use of VM interventions to teach academic skills to students with ASD and/or ID. Research questions to be addressed are:

1. What were the characteristics of the participants and settings for the studies?
2. What types of experimental designs were used?
3. What variations of VM were used?
4. What types of academic skills were targeted and what types of outcome measures were used to evaluate the effects of VM (including interobserver agreement, generalization, and/or social validity)?
5. What was the overall efficacy of VM interventions as determined by visual analysis of the results?

2.1 SEARCH METHOD

2.1.1 Search procedures

A multiple step literature search was conducted. First, studies were located through a computerized search using three databases (PsycINFO, PsycArticles, and ERIC). Search terms included: *video modeling or videotape modeling, and autism spectrum disorders, autism, or intellectual disability or ID*, and *academic skills, math, science, reading skills, science, or writing.* The initial search resulted in 733 total articles, five (5) of which met inclusion criteria (Burton, Anderson, Prater, & Dyches, 2013; Kagohara, Sigafoos, Achmadi, O'Reilly, & Lancioni, 2012; Marcus & Wilder, 2009; Morlock, Reynolds, Fisher, & Comer, 2015; Yakubova, Huges, & Hornberger, 2015).

Following the computerized search, ancestral searches of the resulting articles led to an additional article (Cihak, Fahrenkrog, Ayers, & Smith, 2010). Finally, four (4) relevant journals- *Education and Training in Autism and Developmental Disabilities, Focus on Autism and Other Developmental Disabilities, Journal of Developmental and Physical Disabilities*, and *Research in Autism Spectrum Disorders* – were hand searched, leading to two (2) articles (Lang, Shogren, Machalicek, Rispoli, O'Reilly, Baker, & Regester, 2009; & Moore, Anderson, Treccase, Deppeler, Furlonger, Didden, 2013).

2.1.2 Inclusion criteria

Articles included in this review were selected based on the following criteria:

1. Researchers must use single-subject experimental designs. Studies were excluded if they did not use a single-subject experimental design (e.g., Kinney, Vedora, & Stromer, 2003)
2. Research must be published in a peer-reviewed journal.
3. Researchers must report student(s) as having a diagnosis of ASD or ID. Studies were excluded if the participants were diagnosed with a disability other than ASD or ID (e.g., Bray, Kehle, Spackman, & Hintz, 1998; Decker & Buggey, 2014; Hitchcock, Prater, & Dowrick, 2004).
4. Participants must be school-aged (i.e., grades K-12 or ages 5-21).
5. The independent variable must involve some form of VM or compare forms of VM interventions. Studies were excluded if they used interventions other than VM (e.g., O'Malley, Lewis, Donehower, & Stone, 2014).
6. The dependent variable must focus on student performance of an academic skill, (i.e., math, spelling, transitioning, following rules, and reading). Studies were excluded if the dependent variable focused on increasing non-academic skills such as: imitation skills (e.g., McDowell, Gutierrez, & Bennett, 2015; Tereshko, MacDonald, & Ahern, 2010), social initiations (e.g., Buggey, 2012), self-help skills (e.g., Lee, Anderson, & Moore, 2014; Shrestha, Anderson, & Moore, 2012; Spencer, Mechling, & Ivey, 2015), daily living skills (e.g., Gardner & Wolfe, 2015), or naming facial expressions (e.g., Akmanoglu, 2015).
7. Research must include a graphic display of results to allow for visual analysis.

2.2 RESULTING STUDIES

An extensive search of the literature resulted in eight (8) studies published in six (6) education and psychology journals. The studies that met criteria and are under review are: Burton, Anderson, Prater, & Dyches, 2013; Cihak, Fahrenkrog, Ayers, & Smith, 2010; Kagohara, Sigafoos, Achmadi, O'Reilly, & Lancioni, 2012; Lang, Shogren, Machalicek, Rispoli, O'Reilly, Baker, & Regester, 2009; Marcus & Wilder, 2009; Moore, Anderson, Treccase, Deppeler, Furlonger, Didden, 2013; Morlock, Reynolds, Fisher, & Comer, 2015; and Yakubova, Huges, & Hornberger, 2015. A list summarizing the resulting studies is shown in Table 1.

Table 1. Summary of the eight studies included in the review.

Study	Setting	Experimental Design
Burton et.al. (2013)	Special education classroom	Multiple Baseline across participants
Cihak et al. (2010)	General education classroom,	ABAB Reversal
Kagohara et al. (2012)	General education classroom	Delayed Multiple Baseline across participants
Lang et.al (2009)	Private School	Multiple Baseline across participants
Marcus & Wilder (2009)	Participant's home	Multiple Baseline across participants
Moore et al. (2013)	Participant's home	Multiple Baseline across letters
Morlock et al. (2015)	Private School	Multiple Baseline across participants
Yakubova et al. (2015)	Special education classroom	Multiple Probe across participants

2.3 RESULTS

2.3.1 Participant characteristics and settings

2.3.1.1 Participants.

All of the studies under review evaluated the effects of a VM intervention with one or more individuals with ASD or ID. Twenty-two individuals participated in eight different studies.

Participants ranged in age from four years old (Marcus & Wilder, 2009) to 19 years old (Yakubova et al., 2015) with an average age of 11 years and 3 months.

The majority of individuals who participated in the studies were male (*N*=18; 81%). Female participants were the minority across studies (*N*=4; 18%). Only four sets of authors included female participants in their investigations (Cihak et al., 2010; Kagohara et al., 2012; Marcus & Wilder, 2009; & Moore et al., 2013). Most individuals who participated in the studies were diagnosed with ASD (*N*= 15; 68%). However, some were diagnosed with Asperger syndrome (*N* = 2; 9%), intellectual disability (*N*= 1; 5%) or carried a dual diagnosis (*N* = 3; 14%).

Three sets of authors (Cihak et al., 2010; Moore et al., 2013 & Morlock et al., 2015) reported qualifying scores for participants' diagnosis via the *Childhood Autism Rating Scale* (CARS; Schopler, Reichler, & Renner, 1988) or the *Gilliam Autism Rating Scale – Second Edition* (GARS-2; Gilliam, 2006). The average score among participants for the CARS was 35.3 (*N*=5; 63%), which can be interpreted as moderately autistic on the diagnostic scale.

In addition to reporting diagnostic scores, some authors (Burton et al., 2013; Cihak et al., 2010; & Yakubova et al., 2015) reported IQ equivalence scores via the *Wechsler Intelligence Scale for Children-IV* (WISC- IV; Wechsler, 2004). The average IQ score among participants was 58.4 (*N*= 8; 36%). Finally, one set of authors (Kagohara et al., 2012) reported their participants' adaptive behavior scores via the *Vineland Adaptive Behavior Scales* (Vineland II: Sparrow, Cicchetti, & Balla, 2005). Vineland scores indicated low adaptive levels for both participants (*N* =2; 9%).

Table 2. Summary of the student participant characteristics included in the review.

Study	Participant Gender/Age	Participant Diagnosis
Burton et.al. (2013)	4 males/ages 13-15	3 ASD /1ID
Cihak et al. (2010)	3 males, 1 female /ages 6-8	ASD
Kagohara et al. (2012)	1 male, 1 female /ages 10 and 12	AS/ADHD
Lang et.al (2009)	2 males /age 5	AS
Marcus & Wilder (2009)	2 males, 1 female /ages 9,4,9	ASD
Moore et al. (2013)	1 female /age 5	ASD/ADHD
Morlock et al. (2015)	3 males /ages 17-18	ASD
Yakubova et al. (2015)	3 males /ages 17-19	ASD

2.3.1.2 Settings.

The majority of the studies took place in school settings (Burton et al., 2013; Cihak et al., 2010; Kagohara et al., 2012; Lang et al., 2009; Morlock et al., 2015; & Yakubova et al., 2015). Some took place in general education classrooms (Cihak et al., 2010 & Kagohara et al., 2012) but most were set in special education classrooms (Burton et al., 2013; & Yakubova et al., 2015) or in private schools (Lang et al., 2009; & Morlock et al., 2015). Two sets of authors (Marcus & Wilder, 2009; & Moore et al., 2013) conducted their research in the homes of their participants.

Of the researchers who conducted their studies in school settings, five provided additional information about the environment. For example, three sets of authors (Burton et al., 2013; Cihak et al., 2010; & Lang et al., 2009) reported the presence of children other than the participant(s) in the environment as well as a licensed or certified teacher and additional classroom staff. One group of participants was fully included in the general education classroom (Cihak et al., 2010) thus they were surrounded by typically developing peers. Interventions took place in secluded environments for two sets of participants (Kagohara et al., 2012 & Yakubova et al., 2015) however; one group was in a separate space within the classroom (Kagohara et al., 2012) while the other was in a separate room in the school (Yakubova et al., 2015). The authors explained that the full separation was implemented so as not to "distract the other students in the class" (Yakubova et al., 2015 p. 2868).

One set of the authors who conducted their research in the participants' homes (Marcus &Wilder, 2009) reported that all of the participants had received behavioral services in the home prior to the start of the study. They also reported "toys and potentially distracting stimuli were removed from the rooms during the sessions" (Marcus & Wilder, 2009, p. 336). Moore et al. (2013) implemented their intervention in the participant's family living room. They reported that their study had met approval from the ethical review board and that they had written consent from the participant's parents. Consent was warranted and granted, as they did not use a pseudonym in place of the participant's name. Due to the nature of the task (i.e., name writing), the participant's name was a relative component of the study.

2.3.2 Experimental designs

All of the researchers used single subject experimental designs for their studies. Most commonly, researchers used a multiple baseline across participants design (Burton et al., 2013; Kagohara et al., 2012; Lang et al., 2009; Marcus &Wilder, 2009; Morlock et al., 2015; &

Yakubova et al., 2015). Kagohara et al. (2012) reported using a delayed multiple baseline design across participants. The authors reported that the delay was due to the schedule and availability of one of the participants. However, the researchers adjusted for this by conducting one session a week for one participant and two sessions a week for the other participant.

Other research designs included an ABAB design (Cihak et al., 2010) and a multiple baseline across stimuli design (Moore et al., 2013). Cihak et al. (2010) used an ABAB design to determine the efficacy of a VM intervention for teaching students to transition from place to place independently and with out engaging in unwanted behaviors. They reported that the design allowed them to show "sequential application, comparison effectiveness, and intrasubject replication of the effect" (Cihak et al., 2010 p. 108). The study was conducted over five phases. The phases included: baseline, VM, removal of VM, reinstatement of VM, and maintenance. This study also included a pre-training period prior to collecting baseline data.

Moore et al. (2013) used a multiple baseline across stimuli design to evaluate the effectiveness of a VM intervention to teach letter formation. In this study, the letter formation was specific to the participant, (i.e., her name). The authors used a combination of VM and backwards chaining to prompt the desired behavior in each phase. The phases in this study included: baseline, intervention, and follow up. During the first intervention phase, the participant was only expected to write one letter of her name correctly. However, because the authors used a backward chaining procedure, each intervention stage was different in terms of letter production.

2.3.3 Independent variables and video production information

2.3.3.1 VSM.

Table 1 provides a summary of the variations of VM interventions used in the studies under review. Three sets of authors evaluated the effects of VSM interventions for teaching academic skills (Burton et al., 2013; Cihak et al., 2010; & Lang et al., 2009). Burton et al. (2013) used a Panasonic HM-TA 1 flip video recorder to film the videos and Windows Live Movie Maker software to edit them. Five videos were created for each participant thus the authors created 20 individual videos for purpose of this study. Cihak et al. (2010) created 40 self-modeling videos by using a Sony 72X Digital Zoom camera to film and iMovie software for iMac G4 to edit. Four students participated in this study and each student was shown 10 videos during the intervention. Videos were downloaded and shown on a 30 GB Apple video iPod®. Each video lasted between 2-5 minutes, depending on the location of the transition.

Lang et al. (2009) did not report the type of camera or software they used for recording or editing but they did report the process they used to capture the desired student behaviors on tape. To create the self-models they used in their intervention, Lang et al. (2009) positioned a common handheld video recorder on a tripod in the back of the participant's classroom. On separate occasions, each student was filmed for 30 minutes during regularly scheduled classroom routines. One of the investigators (i.e., the first author) viewed all of the tapes and noted when rule violations occurred as well as when students were engaged in behaviors that complied with the classroom rules (e.g., sitting at desk, beginning work, listening to the teacher). The researchers used the videos in conjunction with the rewind and fast-forward features to demonstrate examples and non-examples of appropriate classroom behaviors. Their videos did not require editing of any kind.

2.3.3.2 POVM

Three sets of authors used POVM interventions to affect the acquisition of academic skills (Kagohara et al., 2012; Moore et al., 2013; & Yakubova et al., 2015). Kagohara et al. (2012) used an iPhone to film their instructional video and iMovie to edit it. The video was shot from the subjective point of view (i.e., from the observers point of view) and lasted two minutes and four seconds. It showed a pair of hands engaging in a sequence of steps (as dictated by a task analysis) to use the spell-check function on a word processor. The participants viewed the video on a 16GB iPad®.

Moore et al. (2013) also shot from a subjective point of view but also incorporated a voiceover feature to their videos. Each video had the same basic structure. Specifically, each video included: an introduction, three demonstrations of the target skill, praise and a popular cartoon figure at the end of the model, audio excerpts, and applause at the conclusion of the video. Videos ranged in length from one to four minutes long based on the phase of intervention and the number of letters being demonstrated. They also created five short videos (e.g., approximately 10 seconds long) to use as visual prompts if needed. The short videos showed the construction of the letter one time in conjunction with the verbal description. These authors did not report the type of recording or editing equipment used to create their videos.

Yakubova et al. (2015) did not report the equipment they used to make their videos. However, they did report that students used an iPad® 2 to access and view the video. The video was four minutes and 34 seconds long and shot from the subjective point of view. It showed an adult's hands using a black marker and blank sheet of paper to solve a fraction word problem. The video also included a systematic narration of the steps involved in solving the problem.

2.3.3.3 VM and VM Comparisons.

Finally, two sets of authors used VM with others as their interventions (Marcus &Wilder, 2009; & Morlock et al., 2015). Marcus &Wilder (2009) conducted a comparison of VM with a peer model and VSM to teach textual responses to three individuals with ASD. They created two videos for each participant (i.e., six total videos). The peer shown in the VM video was a typically developing child, who was reported to be a friend of the participant. The authors determined the peer as a "friend" because he had a previous history of interacting with the participant(s). The video showed the peer correctly answering a question delivered by the therapist.

The self-modeling videos showed the participant answering questions delivered by the therapist. The videos were created through a process of filming and editing raw footage of the participant interacting with the therapist. For example, the therapist would prompt the participant to say the name of the letter without any further instruction or context. For the film, the prompt was edited out and a view of the therapist holding a card with the letter on it was added. Both sets of videos showed the therapist asking a question (e.g., "What letter is it?") and holding up a card with the correct corresponding letter or letters on it. Each video consisted of the delivery, response, and reward (i.e., praise statement) of a series of five trials.

Morlock et al. (2015) used commercially made videos in their intervention. They used videos that were created by GemIIni Educational Systems. GemIIni Educational Systems is a company that provides online and offline access to VM therapy sessions. Even though the videos were commercially made, the intervention was still individualized. Classroom teachers identified areas of need for each of the participant's. The videos were selected from the GemIIini library based on those unique needs.

The researchers used three videos for their intervention. The videos were all different in terms of the skills they presented but they had many similarities as well. For example, all three videos were used to teach word pronunciation but one set of words were relative to vocational training and one set were sight words. The third set was still focused on word pronunciation but with the added component of word meaning (i.e., definition).

For the two similar sets of words, the participants watched videos of a “similarly-aged, female, typically-developing peer model” (Morlock et al., 2015 p. 103). The videos showed the model from the waist up. First, she said the target word while the word appeared on a card at the bottom of the screen. Next, the camera zoomed in on her mouth as she said the word again. Finally, the camera cut back to the model from the waist up, speaking the target word and the word appearing on a card at the bottom of the screen. Each video ranged in duration from nine to 12 seconds.

The third video that was used to teach pronunciation as well as definition consisted of a typically developing male model of a similar age to the participant. The video first showed the target word in white text on a black background, next the peer pronouncing the target word (multiple times), and finally using the target word in a scenario with an adult, as to illustrate the meaning of the word. After the scenario, the definition of the word appeared on the screen along with a voiceover of the definition being read. These video ranged in duration form 19-43 seconds.

Table 3. Summary of the independent variables included in the review

Study	Independent Variable
Burton et.al. (2013)	Video Self Modeling
Cihak et al. (2010)	Video Self Modeling
Kagohara et al. (2012)	Point Of View Video Modeling
Lang et.al (2009)	Video Self Modeling
Marcus & Wilder (2009)	Video Self Modeling & Video Modeling with Others
Moore et al. (2013)	Point Of View Video Modeling
Morlock et al. (2015)	Video Modeling with Others
Yakubova et al. (2015)	Point Of View Video Modeling

2.3.4 Dependent variables

The dependent variable in an experiment is the measurement of change. It shows whether there is a relationship between the behavior and the environment and more importantly, whether the researcher/practitioner should continue (stop or change) to implement an intervention (Cooper, Heron, & Heward, 2007). A broad range of target skills were measured across the studies under review. However, regardless of the topography of the skill, the majority of depend variables are measured as a percentage of correct movements across the studies.

2.3.4.1 Target Skills

All of the authors evaluated the effects of a VM intervention on the acquisition of an academic skill. They focused on a variety of target skills that fall under the category of academic and school readiness skills. For example, three sets of authors concentrated on spelling/reading skills (Kagohara et al., 2012; Marcus & Wilder, 2009; & Morlock et al., 2015). The skills under investigation included: using a word processing application to check spelling in a word document (Kagohara et al., 2012), identifying novel textual stimuli (Marcus & Wilder, 2009), and pronouncing and defining novel and meaningful words (Morlock et al., 2015).

Other authors evaluated the effects of VM on the acquisition of math skills (Burton et al., 2013; & Yakubova et al., 2015). Burton et al. (2013) looked specifically at the effects of VSM on teaching functional math skills such as estimating and making proper change from a cash register. Yakubova et al. (2015) used a POVM video clip in conjunction with a self-prompt checklist to teach problem solving skills with mixed fractions with unlike denominators.

One set of authors evaluated the effects of POVM + backward chaining + reinforcement to teach a child with ASD to write her name (Moore et al., 2013). They posited that handwriting is a vital skill for school performance. Thus, students with poor handwriting may encounter unnecessary challenges in classes where writing is the main mode of communication or assessment (Moore et al., 2013). Early instruction in handwriting may improve a student's legibility but also their quantity and quality of work (Graham, 2010). When children are able to form letters with some degree of accuracy and speed, they are more likely to be able to translate language into text (Graham, 2010). Research has suggested that handwriting is a foundation skill for other essential academic skills such as reading and written composition (Graham, 2010).

Finally, two sets of authors studied the effects of a VM intervention on teaching school readiness or “learning skills” to students with ASD (Cihak et al., 2010; & Lang et al., 2009). Specifically, Cihak et al. (2010) focused on teaching students how to transition more easily from place to place throughout the school day. Times of transition can be difficult for individuals with ASD and can sometimes lead to aggressive outbursts and/or feeling of anxiety or distress (Cihak et al., 2010). As more students with ASD enter into inclusive educational settings, the expectation to transition (without incident) will be heightened.

Lang et al. (2009) focused on teaching another skill that will help students with ASD and/or LD to be successful in the classroom. They targeted rule following behaviors as the focus of their intervention. They defined classroom rules as contingencies (verbal or written) that specify the expected and prohibited classroom behaviors. They reported that classroom rules are best received when they are designed as a collaborative effort, visually posted, and taught explicitly (Glenn & Thomas, 1974). Individuals with ASD, especially those with Asperger Syndrome (AS) have difficulty self-monitoring and recognizing social and nonverbal cues in the environment. Thus, they may appear to be “inattentive”, “impulsive”, or “unorganized” (p.484). However due to the inclusive nature of schools today, students with AS may be included in classrooms where rules are not exclusively taught. A summary of the dependent variables included in this review is provided in table 4.

Table 4. Summary of the dependent variables included in the review

Study	Dependent Variable
Burton et.al. (2013)	Percentage of correct responses (math word problems)
Cihak et al. (2010)	Percentage of independent transitions (from place to place)
Kagohara et al. (2012)	Number of steps correct in spell check sequence
Lang et.al (2009)	Number of class rules correctly recited
Marcus & Wilder (2009)	Percentage of correct textual responses
Moore et al. (2013)	Number of letters written correctly
Morlock et al. (2015)	Percentage of correct word recognition
Yakubova et al. (2015)	Percentage of fraction word problems correct

2.3.5 Outcome measures and generalization

Most of the authors measured their dependent variables in terms of percentage correct or number of steps completed correctly in a sequence. Specifically, five sets of authors' measured/represented their dependent variables as a percentage of correct responses (Burton et al., 2013; Cihak et al., 2010; Marcus & Wilder, 2009; Morlock et al., 2015; & Yakubova et al., 2015). The percentage of correct responses can be found by counting the number of correct responses, dividing that number by the total number of possible responses and multiplying that number by 100.

Three sets of authors measured their dependent variables through a count or number of correct movements or steps in a sequence (Kagohara et al., 2012; Lang et al., 2009; & Moore et al., 2013). The "count" of a behavior refers to the number of times it occurs. This can be collected through a simple tally or click system. None of the authors measured their dependent variables by rate or frequency. Rate refers to the number of times a behavior occurs within a specific observation period (Cooper et al., 2007). As a ratio, it can be calculated as the number of responses over time in the observation period (i.e., occurrence over time).

Two sets of authors reported data on stimulus generalization or generalization probes (Burton et al., 2013 & Moore et al., 2013). Burton et al. (2013) conducted post-intervention phases that allowed the participants to practice previously learned skills with novel stimuli. Specifically, they were given the opportunity to solve a novel problem without the assistance of the video. The participants were able to complete an average of 70% of steps correctly across the five post intervention sessions.

Moore et al. (2013) conducted generalization probes before introducing a new letter to the participant. For example, before each new phase of intervention the participant was asked to "write her full name on a blank page without underscoring prompts and no vocal prompting was provided" (p.498). She was praised for her effort at the end of each probe, regardless of the quality of her work. Table 5 summarizes the outcomes of the studies included in the review.

Table 5. Summary of outcome results included in the review

Study	Results
Burton et.al. (2013)	All participants showed marked improvements as a result of VSM.
Cihak et al. (2010)	All participants showed marked improvements as a result of VSM.
Kagohara et al. (2012)	Both participants showed marked improvement as a result of POVM.
Lang et.al (2009)	All participants showed marked improvements as a result of VSM.
Marcus & Wilder (2009)	All participants reached criterion in the VSM condition but only 1 reached criterion in both conditions.
Moore et al. (2013)	The participant showed marked improvement as a result of POVM
Morlock et al. (2015)	All participants showed marked improvements as a result of VM.
Yakubova et al. (2015)	All participants showed marked improvements as a result of POVM

2.3.6 Interobserver agreement, maintenance, and social validity

All of the studies under review reported inter-observer agreement (IOA) data. Five sets of authors reported data on IOA, maintenance/follow-up, and social validity (Burton et al., 2013; Cihak et al., 2010; Moore et al., 2013; Morlock et al., 2015; & Yakubova et al., 2015). Two studies reported IOA and maintenance/follow-up data (Kagohara et al., 2012 & Lang et al., 2009). Finally, one set of authors reported only IOA data for their study (i.e., Marcus & Wilder, 2009).

2.3.6.1 Inter-observer agreement.

Authors across all studies used similar formulas to calculate IOA data. IOA data was collected when two trained observers watched the participant(s) performing during a session. Each observer scored the participant's performance and evaluated the similarities and differences between the two scores. Most authors calculated IOA by applying the point-by-point method (Kazdin, 1982) to their observations (*N*= 6; 75%). To use this calculation one must divide the number of agreements of responses by the number of agreements plus disagreements and multiply by 100. One applied the trial-by-trial method to find their percentage of agreement (Moore et al., 2013). To do so, they divided the number of items/movements that were agreed upon by the total number of items/movements, and multiplied that number by 100 (Cooper et al., 2007). One set of authors did not specify which calculation they used to find IOA (Kagohara et al., 2012). Four sets of authors collected IOA data for an average of 33% of sessions (Kagohara et al., 2012; Marcus & Wilder, 2009; Morlock et al., 2015; & Yakubova et al., 2015). Four sets of authors collected IOA data for an average of 55% of sessions (Burton et al., 2013; Cihak et al., 2010; Lang et al., 2009; & Moore et al., 2013).

2.3.6.2 Maintenance/Follow-up.

The majority of authors collected some form of maintenance or follow up data (*N*= 7; 88%). Three sets of authors collected follow-up data one week after the conclusion of the intervention (Burton et al., 2013; Moore et al., 2013; & Yakubova et al., 2015). Three sets of authors had lengthier periods of time between their intervention and follow-up phases. Greater lengths ranged from two months, one week (Cihak et al., 2010) to three months (Lang et al., 2009 & Morlock et al., 2015). Kagohara et al., (2012) conducted follow-up sessions 4, 5, and 10 weeks after intervention for one participant, and 3 and 5 weeks after intervention for another participant.

2.3.6.3 Social Validity.

A number of studies included a social validity component (*N*= 5; 63%). Four sets of authors evaluated the social validity of their interventions through surveys or questionnaires given to both teachers and participants (Burton et al., 2013; Cihak et al., 2010; Morlock et al., 2015; & Yakubova et al., 2015). Social validity assessments ranged from Likert-type scale surveys to questionnaires. Likert scales typically ranged from 1(strongly disagree) to 6 (strongly agree). Questionnaires consisted of yes/no questions as well as open-ended questions. Finally, one set of researchers assessed social validity through an interview with the participant's mother (Moore et al., 2013). The interview addressed important components of social validity including: social significance, social appropriateness, and outcomes (Wolf, 1978).

2.3.7 Efficacy of VM interventions

The effects of an intervention that imply dramatic, lasting, replicable behavior changes can be seen in well-designed graphic displays (Cooper et al., 2007). The efficacy of the VM intervention(s) was decided through the review of the authors' graphic displays of data. As proposed by Cooper et al. (2007) a visual analysis of the data was evaluated to answer two questions: (1) Did behavior change in a meaningful way, and (2) if so, to what extent is behavior change related to the independent variable? Key components such as the figure legends, axis labels, condition labels, and scaling were evaluated for overall construction of the graphs.

Finally, graphs were evaluated on the evidence of variability, level, and trends in the data (Cooper et al., 2007).

Overall, graphs were properly labeled and scaled. Six sets of authors scaled their y-axis from 0-100 to report percent correct per session (Burton et al., 2013; Cihak et al., 2010; Kagohara et al., 2012; Marcus & Wilder, 2009; Morlock et al., 2015; & Yakubova et al., 2015). Two sets of authors based their y-axis scales on number counts rather than percentage. One set of authors reported a total score per session on a scale of 0-25 on the y-axis (Moore et al., 2013) and the other reported the number of correct phrases per session on a scale of 0-3 (i.e., Lang et al., 2009). All authors reported session numbers along the abscissa or x-axis. Some reported session numbers in increments of two, five, or 10 (Burton et al., 2013; Marcus & Wilder, 2009; & Moore et al., 2013). However, most authors reported sessions on a successive number scale from 1-20, 30, etc. (Cihak et al., 2010; Kagohara et al., 2012; Lang et al., 2009; Morlock et al., 2015; & Yakubova et al., 2015).

Visual displays of data were evaluated on variability, level, and trends. The variability in a set of data referrers to “how often and the extent to which multiple measures of behavior yield different outcomes” (Cooper et al., 2007 p. 150). The amount of variability within a condition can indicate the level of control the researcher has over factors that may (or may not) influence the dependent variable (Cooper et al., 2007). Most studies showed some degree of variability in the data. However, some graphs showed more variability than others. Three sets of authors reported data with a considerable degree of variability between conditions (Cihak et al., 2010; Marcus & Wilder, 2009; & Moore et al., 2013). Four sets of authors reported data with minimal variability for at least one participant (Kagohara et al., 2012; Lang et al., 2009; Morlock et al., 2015; & Yakubova et al., 2015). One set of authors reported data with little to no variability between conditions for all participants (Burton et al., 2013).

In a visual analysis, the level refers to the value on the y-axis “around which a set of behavioral measures converge” (Cooper et al., 2007 p. 150). In other words, it is the mean, median, and/or range of a data path within a condition (Cooper et al., 2007; Horner et al., 2005). The level of each graph was examined for all studies. Studies showing higher degrees of variability were evaluated with the addition of a mean level line. A median level line was used to examine highly stable data and data with outliers.

Finally, graphs were evaluated for trends in the data. The trend is the overall direction taken by a data path (Cooper et al., 2007). Trends are typically described in terms of direction (i.e., increasing, decreasing, or zero), magnitude, and variability (Cooper et al., 2007). One method of drawing a trend line is to visually inspecting the data and draw a line that best fits through the data path. Trend lines can also be calculated mathematically by using the ordinary least-squares linear regression equation (McCain & McCleary, 1979; Parsonson & Baer, 1978) or the split-middle line of progress method (White, 1971). Trend lines across all graphs were either increasing or stable at 100% correct with no variability at the conclusion of intervention.

The majority of graphs showed ascending trend lines with little variability between baseline, intervention, and mastery criteria (Burton et al., 2013; Cihak et al., 2010; Kagohara et al., 2012; Lang et al., 2009; Marcus & Wilder, 2009; Morlock et al., 2015; & Yakubova et al., 2015). However, the data presented in Moore et al (2013) was highly variable and showed ascending as well as descending trend lines. A small amount of bounce can be seen in the baseline data but trends were mostly declining before the start of intervention.

2.4 DISCUSSION

2.4.1 Participant characteristics and settings

All of the individuals who participated in the studies under review were of school age and diagnosed with a disability. All authors reported the ages and diagnoses of their participants. However, only three sets of authors (Cihak et al., 2010; Moore et al., 2013 & Morlock et al., 2015) reported the diagnostic criteria or practices used to qualify their participants as ASD, AS, ID, or ADHD. Yakubova et al. (2015) reported that their participants met the "ASD diagnostic criteria according to Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5)" (p.2868) but did not include qualifying scores. Three sets of authors (Kagohara et al., 2012; Lang et al., 2009; & Marcus & Wilder, 2009) merely reported that their participants were diagnosed with AS/ADHD or ASD. They did not reference the DSM-5, the CARS or any other practices used to diagnose an individual with a disability.

Reporting the diagnostic or qualifying information of the individuals who participated in an intervention study can offer further insight into the potential effectiveness of the intervention. Furthermore, reporting highly accurate information about participants can help to guide practitioners who are striving to meet the needs of a diverse population of students. The search for effective interventions and strategies can be confusing and misleading for some educators (Marder & Fraser, 2012). This may lead to a willingness to rely on or experiment with untested interventions. The reliance on interventions that lack evidence can lead to unrealistic expectations for students and hinder potential academic progress (Marder & Fraser, 2012). Thus, it is important that researchers provide complete and accurate information about the participants involved in intervention studies.

According to Horner, Carr, Halle, McGee, Odem, & Wolery (2005) operational descriptions of the participants, settings, and participant selection processes are a requirement in single-subject research. The descriptors should be clearly defined so another researcher could easily recruit similar participants from similar settings (Horner et al., 2005). The inclusion of qualifying information in published research not only promotes quality single-subject research but it increase the likelihood that the study could be accurately replicated.

All of the studies under review, with the exception of two (Marcus & Wilder, 2009; & Moore et al., 2013) took place in a school setting. These studies showed that VM interventions did not require the isolation or amenities' of a clinical setting. They showed that they could be implemented with some degree of success in an academic setting with or without other students in the environment. The settings varied from public to private schools and between special education classrooms and general education classrooms. The successes of theses interventions in academic settings may serve as encouragement for teachers who are weary of using technology in the classroom. These studies showed that a highly individualized, academic intervention could be implemented in a classroom setting without disrupting the other students (with the exception of Yakubova et al., 2015) or taking away from lecture/teaching time. These studies provide evidence that supports the use of technology and visual supports to teach academic skills to individuals with ASD and ID.

The two studies that took place outside of an academic setting required very few materials and were conducted in a therapy room (Marcus & Wilder, 2009) and the living room (Moore et al., 2013) of the participants' homes. No additional training or equipment was needed to implement the interventions. Marcus and Wilder (2009) reported that they removed potentially distracting stimuli from the therapy rooms during the intervention sessions. The removal or those items or the time it took to remove them was not reported as an issue for the researchers, participants or parents. Moore et al. (2013) conducted their research in the participant's family living room. No adjustments to the environment were noted. These studies have shown that a successful VM intervention could be implemented in the home with little to no disruption to the environment. The range of settings across the studies under review speaks to the usability and versatility of VM interventions.

2.4.2 Experimental designs

All of the studies under review employed single-subject experimental designs. The majority of authors used multiple baseline designs. Researchers often choose multiple baseline designs because it allows them to analyze the effects of an independent variable across participants, settings, or behaviors without having to withdraw the intervention (Cooper et al., 2007). The multiple baseline design can be used as an alternative to a reversal design. For example, a researcher may choose a multiple baseline design if the dependent variable is an irreversible behavior (e.g., reading) or an undesirable behavior (e.g., self-injurious behavior) that require ethical consideration (Baer, Wolf, & Risley, 1968).

Most of the authors of the studies under review chose to use multiple baseline across participants designs (Burton et al., 2013; Kagohara et al., 2012; Lang et al., 2009; Marcus &Wilder, 2009; Morlock et al., 2015; & Yakubova et al., 2015). Generally, in a multiple baseline across participants design one target behavior is taught to two or more individuals in the same setting (Cooper et al., 2007). This design is commonly used in single subject research (Cooper et al., 2007). It may be appealing to researchers because it allows them to evaluate the effects of the same intervention on the same skill for variety of learners (Cooper et al., 2007).

Teachers and practitioners often encounter students with similar academic needs so they may be prone to this design as well (Cooper et al., 2007).

One set of authors used an ABAB design (Cihak et al., 2010) to determine the efficacy of a VM intervention. According to Cooper et al. (2007), an ABAB design is preferable because it allows the researcher to the reintroduce the B or intervention condition. This reintroduction allows for replication and strengthens the demonstration of experimental control (Cooper et al., 2007). Additionally, the reintroduction of the independent variable meets the criteria for the appropriate application of single-subject methodology (Horner et al., 2005). Measuring the dependent variable across conditions allows for the detection of performance patterns before and after intervention for each participant (Horner et al., 2005). The removal and reintroduction of the intervention show that the researchers were actively manipulating the independent variable to affect the dependent variable. This manipulation provides evidence that the change in behavior was due to the addition of the intervention. Data that confirms that evidence increases the overall confidence in the intervention.

Finally, Moore et al. (2013) used a multiple baseline across stimuli design to establish the effectiveness of a POVM intervention package. More specifically, they used a multiple baseline across letters design in conjunction with a backward chaining procedure to teach the participant how to correctly write/spell her name. This design was appropriate for the generative nature of the dependent measures. The dependent measures included: (a) letter production (i.e., written) and (b) total task performance (i.e., full name written). Each attempt made by the participant was scored on a scale of zero to five based on legibility, execution, letter components, placement, and size. The participant was asked to write the target letter five times each session. The data from each session reflected a cumulative score on the scale for each letter (i.e., score out of 25 possible points). Initially, the participant was praised for all attempts at writing and was offered a previously identified "reinforcer" at the conclusion of the session (i.e., a preferred sticker). If she was unable to correctly produce the target letter, the authors told her "that was a good try, but let's watch again to see how we write that letter" (Moore et al., 2013 p. 497).

To improve the quality of the student's work, the researchers changed the criteria for success half way through the study (i.e., session 33 out of 60). The authors' decision to change the criterion was due to the student's drop in performance after the intervention had been implemented. These authors also introduced a token economy 20 sessions into the study. They claimed that the token economy was put in place because of a "performance decrement from sessions 12 to 20" (Moore et al., 2013, p.498). They acknowledged that there was a correlation between the token economy and the increase in performance of the letters in intervention.

It appeared as though the authors were making decisions based on performance data but the results of those decisions may have changed the focus of the study. The authors intended to evaluate the effects of POVM plus reinforcement (i.e., the preferred sticker) and backward chaining on teaching an individual with ASD how to write her name. However, they added two additional procedures that could have stood alone as independent variables for the study. For example, the authors noticed that the participant's motivation to engage in the task was diminishing so they introduced a token economy. Token economies can be used to decrease unwanted behaviors or to increase academic responding (Doll, McLaughlin, & Barretto, 2013). In this case, it was used for the latter. An increase can be seen in the data after the introduction of the token economy. However, the token economy was introduced (session 21) after two letters had already been in intervention. The authors recognized a correlation between the token economy and the increase in performance of the letters in intervention but they did not observe any changes in baseline levels of performance of the letters not in intervention. However, the additional variable of the token economy may question or weaken the evidence supporting the potency of the POVM intervention. It is difficult to determine which intervention had a greater effect on the dependent variable.

Secondly, the authors saw very little improvement on the letter “e” after the introduction of the POVM intervention. In fact, the participant’s performance nearly returned to baseline levels. In attempt to encourage more accurate letter production, the authors changed the criteria for success. Starting at session 33, the participant was only rewarded with a token if she wrote the letter exactly as it was seen on the video. This led to a marked difference in her score per session. Before session 33, the participant was writing the letter “e” at a score of five or below and after session 33 at a score of 20 or higher. Changing the criteria for success altered the participant’s access to reinforcement thus affecting her motivation and performance of the task. Since changing the criteria for success led to such a dramatic change in the participant’s performance data it is possible that the participant’s low performance was due to lack of motivation rather than skill deficit. Ultimately, the addition of the token economy and changing criterion for success, made it difficult to determine which treatment had the greatest impact on the dependent variable.

2.4.3 Variations of VM interventions

VM with others as models has historically been the most common form of VM used by researchers. However, the majority of authors in this review employed other variations of VM such as VSM and POVM interventions. For example, three sets of authors used VSM to teach academic skills to individuals with ASD and/or ID (Burton et al., 2013; Cihak et al., 2010; &

Lang et al., 2009). There is limited research on VSM interventions. Of the research available, most focus on teaching social skills (Buggey, Homes, Sherberger, & Williams, 2011; Victor, Little, & Akin-Little, 2011) or functional skills (Gelbar, Anderson, McCarthy, & Buggey, 2012). Relatively few studies have focused on the effects of VSM as an intervention for teaching academic skills such as math, reading, or writing (Prater et al., 2012). Despite the advancement and availability of technology and the increasing interest in using visual media interventions, a large gap still exists in the research for evaluating the effects of VSM interventions on academic skill acquisition (Prater et al., 2012; Schmidt &Bonds-Raacke, 2013). However, these three sets of authors (Burton et al., 2013; Cihak et al., 2010; & Lang et al., 2009) have shown evidence that VSM is a viable option for teaching academic skills to individuals with ASD or ID.

Another three sets of authors used POVM to teach individuals to use the spell check function on a word processor (Kagohara et al., 2012), write one's name (Moore et al., 2013), and to solve word problems involving fractions with unlike denominators (Yakubova et al., 2015). Studies published involving POVM interventions have been rarely seen in the literature. It is a fairly new approach for teaching individuals with disabilities and thus has little research to confirm or deny its effectiveness (Moore et al., 2013). All three studies yielded positive results, which extends the previous research done with VM interventions and academic skill acquisition. These results also contribute to the growing body of work that supports the use of POVM interventions in education.

The most widely reported VM intervention in the literature is VM with others as models. However, for this review, only two sets of authors used VM with others as models for their interventions (Marcus &Wilder, 2009; & Morlock et al., 2015). Despite the growing number of studies published that support the use of VM with others, it is still debatable which models are most effective (Jones & Schwartz, 2004). Some literature supports the employment of models that are similar in age, gender, race, and ability to the observer. Bandura (1977) hypothesized that children may be more inclined to engage in the behaviors they saw if the model was similar to them. Specifically, models who closely resemble the observer but who perform slightly higher than them are thought to be most effective (Buggey, 2005).

Jones and Schwartz (2004) examined the differences between peer, sibling, and adult models for individuals with ASD. They claimed that factors such as model competency, attention to the model, nature of the relationship between the model and the observer, and quality of the relationship are relevant when designing an effective modeling intervention (Jones & Schwartz, 2004). As a result of their study, they found that the participants responded quickly and positively to all of the models. However, they found that the child models were equally, if not more effective than the adult models. The models in the studies under review employed known peer models (Marcus & Wilder, 2009) and unknown models of similar age (Morlock et al., 2015). Their results appeared to be in line with the most current trends in the literature.

2.4.4 Dependent variables

The focus of this review was to evaluate the effects of a VM intervention on the acquisition of an academic skill. The scope of skills taught ranged from fundamental academic skills (e.g., writing letters, math computation, etc.) to skills needed to be successful in an academic setting (e.g., following rules, using spell check, etc.). The range of dependent variables chosen by the authors shows the depth and versatility of the intervention. For example, VM interventions have been used to teach a variety of social/play skills (i.e., Charlop & Milstein, 1989; D’Ateno, Mangialpanello, & Taylor, 2003; Hine & Wolery, 2006; Nikopoulos & Keenan, 2004), daily living skills (i.e., Pierce & Schreibman, 1994; Shipley-Benamou, Lutzker, & Taubman, 2002) and self-help skills (i.e., Shrestha et al., 2013). The research has confirmed that VM interventions can have positive effects on dependent variables pertaining to social, daily living, and self-help skills. However, evaluations of the effects of VM interventions on dependent variables of an academic nature are somewhat novel.

In terms of social significance, it can be argued that academic skills are of equal importance for individuals with ASD and/or ID to learn as functional skills. The dependent variables highlighted in the studies under review focused on academic skills that would help to increase the independence and quality of life of the individuals. For example, Burton et al. (2013) showed that students were able to use technology to independently work through the completion of a functional math problem. Specifically, they were instructed to estimate the amount of money they should use to purchase an item and the amount of money they should receive as change. Aside from providing access to the common core standard (i.e., standard 7.EE) aligned with this skill, the authors also sough to teach the students skills to protect themselves from potential unfair or dishonest treatment from vendors in real-life settings.

Kagohara et al. (2012) focused on a dependent variable that would help the individuals' function more independently in a school or work force. Their study yielded positive results for teaching individuals with ASD to find and use the spell-check function on a word processing device. The social significance of this skill is tremendous considering the importance placed on writing in higher education as well as in many professions.

Moore et al. (2013) also focused on the written word but through a different topography. They used VM to teach one individual with ASD to legibly write her name. Like Kagohara et al. (2012), they accounted for proper spelling but they also evaluated the quality of the student's work. They included quality into their analysis because of the vital nature of the skill. They claimed that students who are unable to write legibly might be at a disadvantage in classes where writing is a large part of the curriculum. Furthermore, the benefits of being able to write ones name extend beyond the classroom and into everyday life. Most forms, applications, and documents related to employment, housing, and higher education require, at the very least, the printing (i.e., written or typed) of ones name.

Morlock et al. (2015) focused on teaching a broader, more fundamental skill that would help the students read and interact with their environment more proficiently in the future. Through VM, they were able to teach three individuals with ASD to recognize and properly pronounce words that would benefit them in their natural setting as well as in a vocational setting. One student's intervention extended beyond word recognition and pronunciation and into definition. The student's VM showed him what the target word looked like, sounded like, and how it could be used in a real-world situation. The models acted out scenarios that illustrated the definition and proper use of each target word. This practice allowed the student to see the application of the target word thus increasing his conceptual knowledge of each term.

Whether the dependent variables were traditionally academic (i.e., Burton, et al., 2013; Moore, et al., 2013; Morlock, et al., 2015; Yakubova et al., 2015) or more geared toward academic readiness (i.e., Cihak et al., 2010; Kagohara et al., 2012; Lang et al., Marcus & Wilder, 2009) measures of improvement were seen across all skills. The targets, topography, and results may be different for each dependent variable but the attribute that makes them the same is their form. The target skills drawn from each dependent variable was presented in a way that was sequential and systematic. This commonalty may lead researchers to believe that VM interventions are best used with skills that can be broken down and taught incrementally.

2.4.5 Implications for practice

All of the articles under review contributed to the existing body of literature that surrounds VM interventions for individuals with ASD and/or ID. Regardless of the skill being taught, each group of authors saw an increase in performance by the participants. The intervention (in any form) may lend itself to skills that can be broken down into steps and taught sequentially. This factor does not limit the intervention to functional, daily living, or self-help skills. As evidenced by the studies under review, many skills can be broken into smaller components and taught as a sequence, including academic skills.

In practice, VM interventions can be used to teach a myriad of skills in various settings and across multiple students. The technology needed to design, produce, and present the interventions are far more accessible and cost effective than they have been in the past. The availability of hand-held devices such as smartphones, iPods®, iPads®, and Flip® video cameras help to make the process of filming and viewing less arduous for practitioners as well as students. Free software is available online (e.g., *Wondershare* video editor for MAC and PC) that can be used for importing and editing video clips. Furthermore, Charlop-Christy et al. (2000) found that VM interventions took approximately one-third of the time and half the cost to implement in comparison to in vivo procedures. These factors create a solid case for the use of VM interventions in practice. However, the barriers that prohibit teachers from trying a new technology may be greater than the curiosity encouraged by research.

Barriers that may inhibit teachers from using technology in the classroom can be broken into six categories: (a) resources, (b) knowledge and skills, (c) institution, (d) attitudes and beliefs, (e) assessment, and (f) subject culture (Hew & Brush, 2007). Resources encompass technology as well as access to technology and technical support. Schools may be equipped with computer labs and media centers but access and support for those centers determines whether they are barriers or not (Hew & Brush, 2007). Attitudes and beliefs play a large role in the integration of technology in the classroom (Hew & Brush, 2007). Attitudes reflect whether an individual likes or dislikes an idea and beliefs reflect whether the idea is felt to be true or not (Hew & Brush, 2007). These two feelings may be inline or opposing. For example, a teacher may like technology but not believe it has a place in the classroom or with a particular subject. This is also the issue with subject culture. An art teacher may believe that using a mouse to draw or paint takes away from the experience of making strokes with a brush (Hew & Brush, 2007). Thus believing technology has no place in the subject of art. This may also be true in mathematics. Some may believe that using a calculator or even statistical software (e.g., SPSS) hinders one's ability to conceptually understand the subject. Ultimately, teachers who view technology as an unnecessary addition to their subject, method, or pedagogy tend to refuse or be reluctant to use it (Hew & Brush, 2007).

Hew and Brush (2007) proposed a number of solutions for breaking down barriers in a District or school setting. Some recommendations included, increasing resources, providing professional development, and creating a shared vision and plan for technology integration. However, on a larger scale, one potential way to overcome these barriers is to continue to study the effects of technology in the classroom. Specifically, continue to evaluate the effects of VM on learning outcomes for individuals with ASD and/or ID. Further evaluation of the utility of VM interventions in school settings and with academic skills is warranted considering the results of this review. In addition to continuing the research, it may also be beneficial if the research studies were published in teacher/practitioner journals (e.g., *School Community Journal; Teacher*

Education and Practice; TEACHING Exceptional Children etc.). Giving greater access to intervention information may be beneficial for teachers and practitioners.

2.4.6 Future research

Research is needed to investigate and identify appropriate academic interventions for individuals with ASD and ID. More specifically, investigations are needed to assess the effects of instructional strategies that can be used to help individuals with disabilities be successful in inclusive settings and access the core curriculum. VM is an intervention that has been shown to have positive effects with individuals with ASD and ID. It has been widely used to teach functional skills such as cooking, cleaning, and personal hygiene. However, it can be used to teach academic skills as well.

Future VM research should continue to include work with life and functional skills but should expand to evaluate effects on the acquisition of academic skills. Some work has been done with VM and instruction in mathematics (Burton et al., 2013; Yakubova et al., 2015), spelling (Moore et al., 2013; Morlock et al., 2013), and school readiness skills (Cihak et al., 2010; Kagohara et al., 2012; Lang et al., 2009) but none has been done in the academic area of science.

Science is an academic area that is tested on both State and Alternative assessments. However, none of the articles under review focused on skills pertaining to science content. As mentioned, VM interventions tend to work well with skills that can be broken into small, sequential steps. Many areas under science content can be broken down and taught sequentially. For example, in life science, a teacher can use a VM intervention to present the different stages of a life cycle with its proper labels and relative vocabulary. A science and technology teacher could use POVM to teach about simple machines or robots. VM interventions could also be used in a laboratory setting. The video could be used to bolster instruction and provide an additional level of support for an individual in an inclusive setting.

Due to a gap in the literature and the need for effective practices for individuals with ASD and ID, teaching students to us VM as an instructional aide to learn science is a reasonable direction for future research. The following is a proposal for a research study aimed at addressing these issues.

3.0 THE RESEARCH STUDY

According to America's Lab Report (2006), "Most people in this country lack the basic understanding of science that they need to make informed decisions about the many scientific issues affecting their lives" (p.1). In the years between 1969 and 1999 test scores of students in grades, nine through 12 remained stagnant on the science portion of the National Assessment of Educational Progress (NAEP). Furthermore, high school students' scores on a separate NAEP science assessment came in lower in 2000 than they were in 1996. Over four years, students' scores weakened in science content rather than improved (National Research Council, 2006).

Despite the low assessment scores, educators, policy makers, and scientists agree that high school graduates need to have a basic understanding of science and technology in order to function successfully in today's job market and in society (National Research Council, 2006). Thus, science education may be as critical to an academic curriculum as it is to modern life (Brigham, Scruggs, & Mastropieri, 2011). It is the school's responsibility to provide students with access to technology and research based instructional methods appropriate for all students across academic areas including science.

Current reforms in science education support the idea that students learn science content best by "doing" and interacting with science and scientific materials (Dalton, Morocco, Tivnan, Rawson, & Mead, 1997). Content acquisition can be enriched through asking questions, manipulating materials, record keeping, making observations, and designing experiments (Dalton et al., 1997; National Science Education Standards, 1996). Thus, contemporary science curricula should encourage active, hands-on opportunities for students in science classes (Dalton et al., 1997).

Science education reform also accounts for the inclusion of students with disabilities. The National Science Education Standards (NSES, 1996) state that the standards apply to "all students regardless of age, gender, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science" and (p.2). The inclusion of students with disabilities is based on the assumption that all students are able to learn science content if they are provided access to appropriate instruction and learning opportunities (Dalton et al., 1997; NSES, 1996).

Experimentation and laboratory exercises have been a part of science education classes since the late 19th century (National Research Council, 2006). Some educators debate the value of the science laboratory experience as to whether it increases skill acquisition or conceptual understanding. However, very little research has been done to support, oppose, or guide the design or implementation of laboratory education (National Research Council, 2006). For example, the eight studies under review in this paper examined the effects of VM interventions in academic areas such as reading, writing, and mathematics. None of the authors focused on science content or lab experimentation as their academic area of study. In an attempt to ensure that students are ready to enter the workforce and navigate an ever-changing technological world, schools are integrating computer technology to support student learning (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

Similar to VM interventions, video prompting (VP) interventions capitalize on the on the strength of imitation and observational learning through modeling. However, VP interventions require the learner to watch a segment of a video and actively respond to the video prompt by engaging in a movement (Aykut, DaĞseven Emecen, Dayi, & Karasu, 2014). Unlike other VM interventions, the learner is not required to watch the entire video before responding. Rather, the learner watches the video in short clips or segments. Active responding separates the segments. The clip is shown once. Directly following the clip, the student is asked to attempt to complete the step as modeled (Cannella-Malone, Sabienly, Jimenez, Page, Miller, & Miller, 2015). The student will be able to move on to the next segment once they have completed the step modeled in the clip (Aykut et al., 2014).

Chained tasks, such as lab experiments, are complicated skills that require the learner to engage in more than one single-step behaviors (Aykut et al., 2014). Video prompting has been shown to be an effective procedure for teaching a variety of skills to students with various disabilities (Canella-Mallone et al., 2015). Video promoting interventions have been used to teach skills such as purchasing and organizing food from a grocery store (Cannella-Malone et al., 2015), geometry (Chiak & Bowen, 2009), and multiple step math skills (Kellems, Frandsen, Hansen, Gabrielsen, Clarke, Simons, & Clements, 2016). Studies employing this intervention have yielded positive results with skill acquisition and maintenance over time.

The proposed study intended to evaluate the effects of a POVM video prompting intervention with an individual with ASD and an individual with ID in an individual science setting. The POVM video prompt showed each step of the experiment in isolation. The video showed an assortment of materials with a primary focus on a pair of hands engaged in each step of an experiment. Outcome measures counted the number of movements completed as modeled without additional prompting from the PI. The teacher and students completed a survey at the conclusion of the study to assess social validity.

The following research questions guided the study:

1. What effect does a POVM video prompt intervention have on the independent completion of a multiple step science experiment with an individual with ASD or ID?
2. What effect does a POVM video prompt intervention have on the number of prompts needed for an individual with ASD or ID to complete a multiple step science experiment?
3. How socially valid is POVM video prompting for teaching an individual with ASD or ID to complete a multiple step science experiment?

3.1 METHODS

3.1.2 Ethical clearance and informed consent

Ethical approval for this study was gained through the University of Pittsburgh's Institutional Review Board (IRB). Parental and individual consent was gained in writing prior to the start of the study. Consent included permission to videotape each session with the participants.

3.1.3 The participants

Three participants were recruited for the study, however, only two students agreed to participate in the study. Both participants were in seventh grade and enrolled in a public school at the time of the study. Denny is a 13-year-old male and has a primary diagnosis of ID with a secondary diagnosis of speech or language impairment. His full-scale IQ score is 53. He attends his local school and is included in regular education classes for 1.45 hours per day. Bob is also a 13-year-old male and has a primary diagnosis of ASD. CARS scores were not made available to the PI. Bob also attends his local school and is included in general education class for 4.35 hours per day. He attends science, social studies, and chorus with a paraprofessional in general education classrooms. The participants were selected based on their age, diagnosis, their need for intensive instruction in following directions and completing multiple step procedures, and their willingness to participate.

Before selecting the participants, the PI contacted the director of special education of a school district in Western Pennsylvania. The PI asked the director of special education to review and distribute a short candidate selection survey to the teachers in the district. The candidate selection survey included questions regarding the potential candidate's interest in videos, ability to use/navigate hand held devices, manipulate various materials such as beakers and pipets, and follow multiple step directions. The survey also included questions pertaining to the student's prior experience (if any) with POVM interventions and participation in other research studies. The PI also inquired about the participant's prior participation in a science class setting, particularly their participation during lab instruction (See Appendix A).

Following the meeting with the director of special education, the PI met with two classroom teachers from the middle school. One of the teachers who answered the survey taught life skills and the other teacher taught autistic support. Each of the teachers who responded to the survey had been teaching for at least five to seven years, in special education. The teachers each chose candidates who fit the inclusion criteria, and showed an interest in participation. After meeting with the PI, they sent permission letters home with each of the potential candidates. Two of the candidates received permission from their parent/guardian and agreed to participate in the study.

3.1.4 Recruitment procedures

The PI inquired about students who demonstrated the appropriate pre-requisite skills for a POVM video prompt intervention (i.e., imitation and duration of attention). Duration of attention and ability to imitate was assessed and demonstrated prior to the start of the study. Participant selection was based on a set of seven criteria. The participants were selected because they met the following criteria:

1. Enrollment in a public school setting;
2. Diagnosis of ASD or ID based on eligibility requirement;

3. IEP goal and objective related to science, following multiple step directions, and/or task completion;

5. Ability to manipulate items such as pipets, plastic bottles, and measuring cups;

6. Parental consent to participate in the study, including videotaping; and

7. No hearing, motor, or vision impairments that may impede video instruction.

3.1.5 Screening procedures

A screening procedure was implemented prior to the start of the study. The PI conducted a two-part screening process to ensure that the student candidates met the inclusion criteria of the study and were willing to participate. Participants were screened for diagnosis identification documentation; academic goals related to science, objectives related to following multiple step directions or completing a total task and prior experience with science content and conducting experiments. During the second part of the screening process, the PI gathered information from the participants' teachers about their ability to imitate a modeled movement, complete a multiple step task, and maintain attention to a screen on a handheld device for varying durations of time. Finally, the PI conducted a short observation and interview with the individual candidates to evaluate their experience with technology and willingness to participate. See figure 1 for a summary of screening procedures.

Screening Procedures for Potential Participants	
Participant Screening Part 1	**Participant Screening Part 2**
PI will evaluate documentation for:	PI will assess the participant's ability to:
a) Official diagnosis of autism spectrum disorder or intellectual disability as defined by the *Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition* (DSM-5)	a) Imitate a series of modeled movements
b) Academic goals related to science content in the student's Individualized Education Plan (IEP)	b) Complete a multiple step task, in the correct sequence
c) Objectives related to following multiple directions or completing a total task in the student's IEP	c) Maintain attention to a screen on a handheld device
d) Prior experience with science content and conducting experiments	d) Use technology and willingness to participate in the study

Figure 1. Screening Procedures for Potential Participants

3.1.6 Setting

The study took place in an autistic support classroom in a public middle school in a Southwestern Pennsylvania. The intervention took place at a table located in the center of the classroom. Two rows of desks for students were arranged around the perimeter of the classroom. Two larger desks were located along the back wall in the classroom. The room was spacious and well lit. During study sessions, the room was quite as the teacher and PI arranged for sessions to be held during low traffic times in the classroom. Those present during baseline and intervention sessions included the classroom teacher, the teacher's aide, the participant, and the PI. Due to the participant's schedules, the PI was able to assess each participant one at a time.

3.1.7 Materials

3.1.7.1 Video content:

Each series of video clips began with the first step of the target experiment. Each clip showed the PI from the subjective point-of view, or from the perspective of the learner. A voice component accompanied each clip. The voice component provided the participants with a verbal directive in addition to the visual modeling. For example, in the first clip of the sequence, the participant heard the PI say the directive "First, hold the jar and twist the lid to the right to open it. Set the lid aside." and saw the model holding the jar and turning the lid to the right to open it.

Each step of the experiment was broken down and filmed in individual clips. The clips were digitally stored in folders on the iPad mini. The clips were presented in sequential order in accord with the experiment. Four separate sets of video clips were created for the study. Both participants used the same set of clips to complete the experiments. The experiments were placed into intervention in the same sequence (i.e., hurricane, tornado, snowstorm).

3.1.7.2 Video Equipment:

The videos were filmed with an Apple iPad Mini model MD528LL/A version 9.2 (13C75). To create the clips, the PI's assistant stood on a stool above her and used the camera feature on the iPad to film each step of the experiment from the perspective of the learner (i.e., subjective POVM). Once filmed, the clips were separated into folders and stored on the iPad® Mini with the "photos" application. The participants used the same iPad® Mini to view the intervention as well. An additional video camera was set up on a tripod on a desk adjacent to the worktable in the classroom to record each session.

3.1.7.3 Experiment Materials:

Three separate experiments were presented over the course of the study. The materials were similar but varied across experiments. Materials for the first experiment included: 8oz clear jar with a lid, warm water, opaque liquid soap, food coloring, and glitter. While materials for the second experiment included: an 8oz clear jar with a lid, water, vinegar, clear liquid dish soap, and glitter. Finally, materials for the third experiment included: an 8oz jar, warm water, baby oil, white paint, and Alka-Seltzer tablets. A fourth experiment was presented as generalization. The materials for the forth experiment included: a plastic 2-liter bottle with lid, water, food coloring, and gravel. Other general materials included: a measuring cup, measuring spoons, a bowl, a funnel, and a spoon.

3.1.8 Science content and links to Pennsylvania alternate assessment anchors

The three main experiments followed a common theme. They were all themed around naturally occurring weather phenomena. Specifically, naturally occurring storms such as snowstorms, tornados, and hurricanes. The fourth experiment, which was used to evaluate generalization of the intervention skills, was centered on recreating the characteristics of a tsunami.

Procedurally, the experiments were similar. The participants were instructed to demonstrate similar skills such as pouring, measuring, and mixing across experiments. The science experiments chosen for this study were selected based on the number of steps, similarity of movements, and their links to the PA alternate assessment anchors and eligible content.

All three of the main experiments can be linked to the Pennsylvania alternate assessment anchors S4.A.2 *Processes, Procedures, and Tools of Scientific Investigation* and S4.D.2 *Weather, Climate, and Atmospheric Processes*. Specifically, the snowstorm experiment can be linked to an assessment anchor under the nature of science (S4.A.2.1) and its eligible content (S4.A.2.1.3). The experiment is linked to the anchor that describes how to "apply skills necessary to conduct an experiment and "observe a natural phenomenon" (Pennsylvania Alternate System of Assessment, Alternate Assessment Anchors, and Alternate Eligible Content, Grade 4, 2016, p.3). The related alternate eligible content linked to the snowstorm experiment is to "observe and record change by using time and measurement (S4.A.1.3.1, 2016, p.2) and 'identify weather conditions using symbols" (S4.D.2.1.2, 2016, p.12).

In addition to the assessment anchors mentioned above, the tornado experiment can also be linked to the PA alternate assessment anchors and alternate eligible content under the physical science content. Specifically, the anchor related to identifying "basic cloud types and making connections to basic elements in weather" (S4.D.2.1.1, 2016, p.12) and eligible content related to identifying changes in motion caused by force (S4.C.3.1.1).

The hurricane experiment can be linked to the PA alternate assessment anchors and alternate eligible content under the nature of science content. Specifically, the hurricane experiment links to the anchor that refers to identifying "observations about patterns that regularly occur and reoccur in nature" (S4.A.3.3, 2016, p.4) and eligible content related to explaining how water goes through phase changes (S4.D.1.3.2) and changes in motion caused by force (S4.C.3.1.1).

3.1.9 Task components: Similarities and level of difficulty

The PI designed a task similarity rubric to evaluate the similarities and potential differences in difficulty between the three science experiments. The PI asked the classroom teachers to review and complete the rubric. The readers reviewed a detailed write-up of each experiment and completed a corresponding rubric to evaluate the similarities as well as the level of complexity between the three experiments.

The classroom teachers each completed a task similarity rubric. While they completed the forms separately, their results were strikingly similar. The teacher's answers were in agreement for 93% of the rubric. The only disagreement between the teacher's answers was in the motor skills category. One teacher included "break" as a motor skill and the other teacher did not. The results of the rubric indicated that the science experiments chosen for the study were different but similar in purpose, movement, design, and level of complexity. See Figure 2 for the results of the task similarity rubric.

	Snowstorm Experiment			Tornado Experiment			Hurricane Experiment			Tsunami Experiment		
What is the purpose of the experiment?	To follow a series of steps to complete the total task of replicating a snowstorm in a jar.			To follow a series of steps to complete the total task of replicating a tornado in a jar.			To follow a series of steps to complete the total task of replicating a hurricane in a jar.			To follow a series of steps to complete the total task of replicating a tsunami in a jar.		
What motor skills are required to complete the experiment? (e.g., pouring, dropping, pinching, etc.)	Pick up Pour Squeeze Turn Pinch/drop Break			Pick up Pour Squeeze Turn Pinch/drop			Pick up Pour Squeeze Turn Pinch/drop			Hold Pick up Pour Scoop Turn Pinch/drop Lift Rock		
Number of steps in the sequence of the task.	15			12			11			16		
Number of materials needed for the experiment.	7			7			6			8		
Level of Complexity												
Complexity Scale: 1= simple, one-step, motor movement (e.g., pinch, pick up, drop, pour, etc.) 2= simple motor movement + additional movement or level of precision (e.g., measure, stir with a spoon, squeeze 2 drops of liquid, etc.) 3= simple motor movement + additional movement or level of precision + assessment, decision making based on observation (e.g., if you see an interaction, mark the green circle, if you DO NOT see an interaction mark the red circle etc.)												
Complexity Score totals:	22			17			18			24		
Teacher 1 Responses	1's	2's	3's	1's	2's	3's	1's	2's	3's	1's	2's	3's
	6	2	1	3	3	0	4	3	0	5	3	1
Teacher 2 responses	1's	2's	3's	1's	2's	3's	1's	2's	3's	1's	2's	3's
	5	2	0	4	2	0	4	2	0	4	3	1

Figure 2. Results of the Task Similarity Rubric

3.1.10 Dependent variables

The dependent variables evaluated in the study were the number of steps completed correctly, as modeled, without additional prompting. Each experiment was made up of a similar number of steps and similar movements (e.g., measuring, pouring, pinching, dropping, mixing, etc.). The experiments were different in content but closely related in terms of theme, movements, and measurement. Student performance was measured by number of steps completed correctly (i.e., independent, on the first try), number of prompts, and length of time. A step was counted as correct if it was completed independently, as modeled and in the correct sequence of the experiment. The dependent variables included the number of steps completed correctly, the length of time it took the participant to complete the total task, and the number of additional prompts needed to complete a step.

3.1.11 Independent variables

The independent variables measured in the study were the POVM video prompt intervention and a prompt hierarchy procedure. The POVM video prompt intervention was presented as a series of clips. Clips were viewed on a handheld device (i.e., iPad mini®). Each step of the experiment was viewed in isolation, as a clip, taken from the perspective of the leaner. The PI presented a brief introduction to provide context for the experiment. Then the students were asked to locate and click on the photos application, click on the folder labeled with the target experiment, and click on the first clip to play. Each clip featured a pair of hands engaging in a movement and a voiceover. The voiceover stated a directive (e.g., pour the water into the jar). The students were able to advance to the next clip in the sequence after they completed the previous step. They did so by swiping the screen to the left to access the next video clip. After the students swiped to the new screen, they pressed the arrow on the screen to view the clip.

A verbal prompt was delivered if the student asked for help or if they did not respond to the video instruction within five seconds of the delivery. For the first prompt, the PI delivered a general verbal directive to “watch the video again”. If the student still did not engage needed further help, a second general prompt delivered. If the student initiated a correct response, no further prompts were delivered and the student had five seconds to initiate the next step. If the student did not initiate a correct response after the second general prompt, a directive + gesture prompt was delivered (e.g., “pour the water into the jar” and point to the jar.) The directive + gesture prompt was same as the directive given in the clip. If the student did not respond after the second directive + gesture prompt, the PI gently guided the student’s hand toward the material and assisted him in completing the step. All prompts were counted as incorrect.

Finally, each session was measured by time. The PI began a timer, as a count up, as soon as the POVM video prompt intervention was presented. Session times varied but only minimally. The majority of sessions took approximately the same amount of time (i.e., between 5-7 minutes). See figure 3 for a description of the prompt hierarchy.

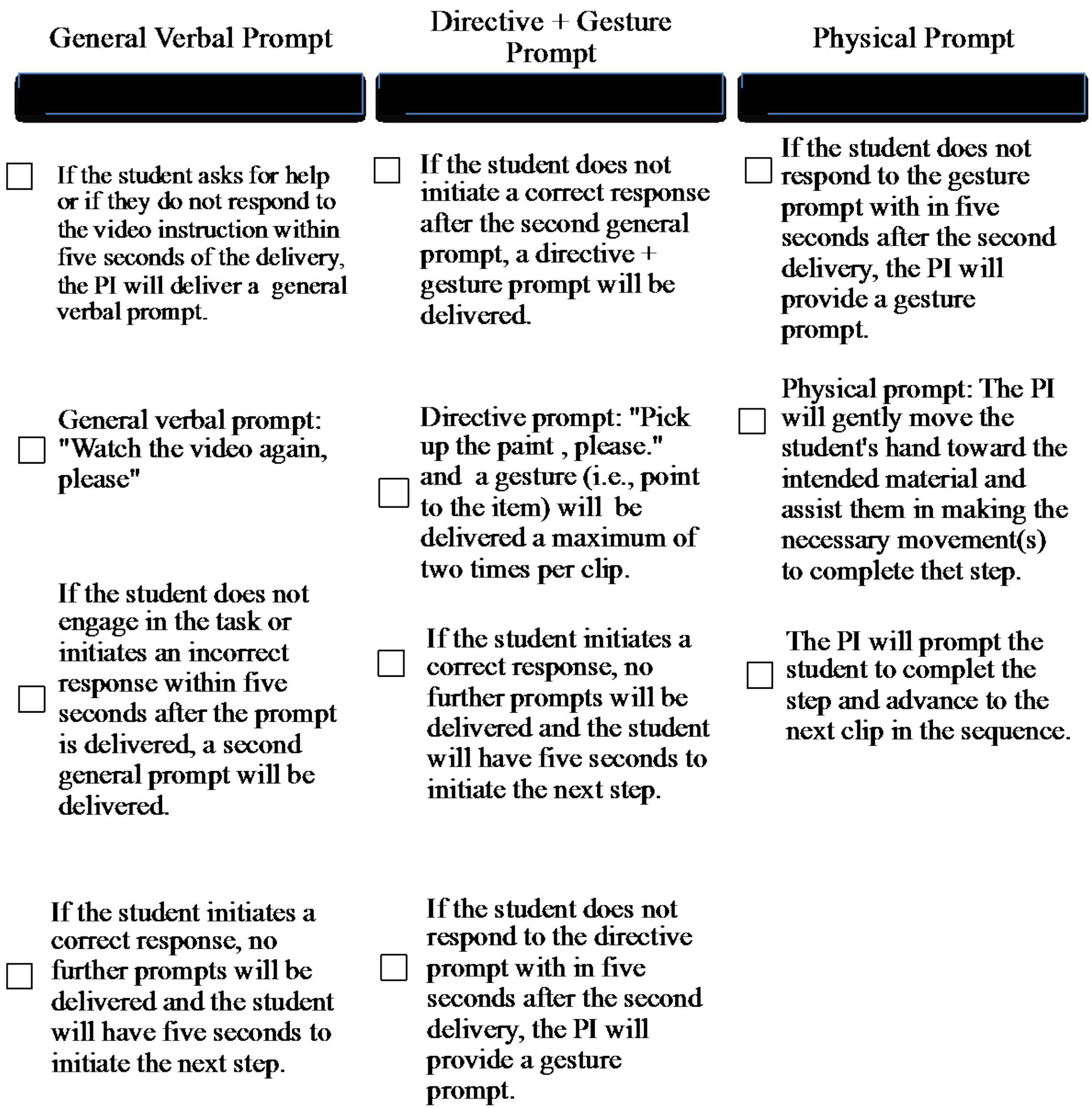

Figure 3. Prompt Hierarchy

3.1.12 Experimental design

The experimental design used for the study was a multiple base line design across experiments. This design offered a valuable option for demonstrating the effects of an intervention on skills that cannot be reversed. To begin, all three of the experiments were probed during a baseline phase. For the purpose of this study, three baseline data points were required before the intervention was introduced. Requiring only three baseline data points during the baseline phase should have limited the amount of practice the students were getting with the experiments. Less time in baseline was also meant to reduce the amount of learning that may have occurred as a product of practice during those sessions.

After three baseline data points were collected and recorded for the first experiment, the PI introduced the POVM video prompt intervention. Once the students met acquisition criterion for three consecutive days on the first experiment (all correct with one or less prompts) then the PI introduced the second experiment. The third experiment remained in baseline while the second experiment was in intervention. After the students reached acquisition criterion for the second experiment, the PI introduced the third experiment into intervention. Acquisition criterion was defined as performing all steps of the target experiment, independently, with one or less prompts, for three consecutive sessions (Cihak, Wright, Smith, McMahon, & Kraiss, 2015).

3.2 PROCEDURES

3.2.1 General procedures

Before beginning the study, the PI met with the participant's classroom teachers. During the meeting, the PI described the purpose, timeline, and procedures involved with the study. The PI provided a detailed description of the study and provided them with a written outline of the study procedures. The description explained the baseline, pretraining, and intervention phases. The PI also explained the role of the trained observer and Interobserver Agreement. Finally, the PI asked the teachers to send consent forms home with the students they had nominated for participation in the study. The consent forms required signatures from the student's parent(s)/guardian(s) and gave permission to participate as well as videotape.

3.2.2 Baseline

The PI conducted baseline probes throughout the course of the study. At the beginning of the study, the PI collected baseline data for all three main experiments and for one additional experiment used as a generalization probe. Initial baseline sessions spanned three consecutive days. Each session took place individually, in a one-to-one setting. During the baseline sessions, the participants were seated at a table with a series of materials in front of them. The PI asked the participants to complete a number of steps in order to complete a full experiment (e.g., hurricane, tornado, and snowstorm). During baseline phases, the students did not have access to the iPad mini® or any other visual aides. The PI did not provide verbal assistance or additional prompting beyond the primary directive and one prompt. All instruction was delivered verbally. If the student did not engage in the step after the first directive is delivered, the PI delivered a single verbal prompt. If the student still did not engage in the step, the PI completed the step for them and moved on to the next directive for the next step in the sequence. Data was collected on the number of steps completed correctly and independently, on the first try. After all the data was collected, the PI and the trained observer watched the videos of each session, and counted and coded the student's responses.

3.2.3 Pretraining

After collecting the initial baseline data and before introducing the intervention, the PI conducted a brief technology pre-training session. During the pretraining session, the PI evaluated the participant's ability to navigate the iPad Mini device. Specifically, the PI asked the participants to: (a) turn the device on, (b) use the swipe function to move from one screen to the next, (c) locate the "Photos" icon on the home screen, (d) touch the photos icon and locate the videos folder, and (e) locate the video folders for each set of clips.

Both participants demonstrated proficient skills in navigating the iPad mini® device. Had they not been able to navigate the device, the PI would have implemented a Model-Lead-Test procedure to teach the participants how to use it. The Model-Lead-Test procedure (MLT) is an explicit instruction procedure that allows an instructor to model the behavior (i.e., "my turn"), do the behavior with the student (i.e., "our turn"), and let the student try the behavior on their own (i.e., "your turn").

The PI did not have to implement the MLT procedure during the pretraining session with either of the participants. Both participants were able to turn on, swipe, locate the photos icon on the home screen, access the video clips, and move from one clip to the next with 100% accuracy.

3.2.4 Intervention

During the intervention phase, the participants used a POVM video prompt. The PI videotaped each session as it occurred. The sessions took place in an autistic support classroom in a middle school in Western Pennsylvania. To suit the participant's schedules, sessions typically occurred during the morning hours. Each session lasted approximately 20 minutes for each participant.

The participants conducted three different scientific experiments. Each experiment was presented in isolation.

During the intervention phase, the PI arranged the necessary materials on the participant's worktable and included the iPad mini® as a viewing device for the POVM video prompt intervention. All of the materials needed to complete the experiment were visible and easily accessible to the student. Once the table was arranged, the PI gave the iPad mini® to the student and asked them to begin the experiment. When presented with the POVM, the students watched a series of clips, one clip at a time. Each clip featured a model, primarily their hands, as viewed from the perspective of the learner. The voiceover stated the directive for the step in the clip (e.g., pour the water into the jar). All of the clips were filmed and presented in sequential order on the iPad mini®. The students advanced to the next clip in the sequence after they completed the previous step. The students swiped the screen to the left to access the next video clip. After the students swiped to the new screen, they pressed the arrow on the screen to play the clip.

The student's work was coded as correct (C) or incorrect (IC). The PI delivered general verbal prompts, directive + gesture prompts, and physical prompts if needed. If the participants watched the clip and engaged in the movements as modeled on the first try, it was marked as correct. If they did not respond after 5 seconds or if they responded incorrectly, it was marked as incorrect. If they did not correctly complete the step on the first try, the PI prompted them to watch the video clip again. If the student watched the clip a second time and completed the step correctly, it was still considered to be prompted and thus marked as incorrect.

3.2.5 Generalization

Over the course of the intervention phase, the PI collected data on one generalization probe. A generalization probe was done with a different experiment, using different materials. During the generalization probe, the students were asked to use the iPad mini® and a POVM video prompt to complete novel experiment that was different than the experiments tested during the intervention phase. Baseline data for the generalization probe was collected at the beginning of the study. Intervention data was collected on the final day of the study.

3.2.6 Interobserver agreement

Interobserver agreement (IOA) was collected for 30% of all sessions. The PI and a graduate assistant collected and compared IOA data. To collect IOA data, both the PI and the graduate assistant watched videos of the sessions and counted the students correct and incorrect responses. The graduate assistant watched and scored videos independently across baseline and intervention conditions. IOA data was calculated by dividing the number of agreements by the total number of agreements plus disagreements, multiplied by 100% (Kennedy, 2005). IOA data was collected for 30% of the number of sessions. The results of the IOA data showed 100 % agreement for the intervention and generalization conditions and 96.5% agreement for the baseline condition. See Table 7 for a summary of IOA results.

Table 6. Summary of Interobserver Agreement Across Study Conditions

Participant	Baseline	Intervention	Generalization	
Denny	96%	100%	100%	
Bob	97%	100%	100%	
Total	96.5%	100%	100%	
				Total mean IOA 98.8%

3.2.7 Social validity

The assessment of social validity is an integral part of applied research (Yakubova et al., 2015). It provides insight into the value, effectiveness, and practicality of the intervention as perceived by the participants, teachers, parents, etc. (Wolf, 1978). In the study, social validity was evaluated through the distribution of an interview. At the conclusion of the study, the PI asked the participants a brief list of questions pertaining to their experiences with the intervention and the treatment conditions. The questions were short, informal, and required only yes/no responses. For example, the PI asked the participants if they liked watching the videos and if they would like to watch a video again to learn new skills in the future. Additionally, the PI asked the teachers if they would consider using an intervention like a POVM video prompt and whether they thought it was a realistic intervention to use in a classroom setting.

3.2.8 Data analysis

The purpose of the study was to evaluate the effects of a POVM video prompt intervention on the completion of a multiple step science experiment with individuals with ASD and ID. All sessions were videotaped. The PI thoroughly reviewed all session videos during and after the conclusion of the study. A graduate assistant also viewed the videos of 30% of the sessions. Data were collected and visually represented on a Standard Celeration Chart (SCC). The SCC is a semi-logarithmic chart that allows practitioners and researchers to make accurate data based decisions. It provides a sensitive measure of frequency (of behavior) over time. Each line on the chart represents a day and the number scale on the left side of the chart quantifies a count of behavior per minute. The measure of frequency over time provides information about the learner and their rate of fluency with the target skill.

The student's performance was evaluated based on the number of independent steps completed correctly in the sequence and the number of prompts delivered over time. The SCC allowed the PI to interpret standard slopes; see major and minor changes in behavior, and determine median level and median level changes in responses. Data was collected and analyzed on a daily basis.

4.0 RESULTS

4.1 STUDENT BEHAVIOR RESULTS

A visual display of the student's behaviors performed during science experiments can be found in Figure 4. The data are displayed on SCCs. There are a total of eight charts. If a student completed the task correctly, without prompting it was marked as correct and is represented on the SCC as a filled in circle (i.e., a dot). If the student required promoting of any kind to complete the step, it was marked as incorrect and is represented an X on the SCC. The series of four charts on the left-hand side of the figure represent Denny's baseline, intervention, and generalization data. The set of charts on the right-hand side of figure show Bob's baseline, intervention, and generalization data. All data were collected as frequency counts and calculated as count per minute based on the length of time per session. On average, baseline sessions ranged from five to 10 minutes for both participants. Sessions in intervention ranged from five to eight minutes across participants.

4.1.1 Denny's baseline results

During the baseline phase, the PI sat across from Denny at the worktable and verbally delivered the instructions of the science experiment. If Denny completed the step independently, it was marked as a correct. If Denny did not perform the step correctly, asked for help, or did not respond to the instruction, it was marked as incorrect. The PI measured Denny's median level of correct and incorrect responses across the baseline phase. Denny's overall median level of correct responses per minute during the baseline phase for the hurricane experiment was .8 (range, .7 - .9) and his median level of incorrect responses per minute for the same experiment was 1.48 (range, 1.38-1.58). His median level of correct responses per minute for the tornado experiment was .91 (range, .7 – 1.12) and his median level of incorrect responses was 1.8 (range 1.4 – 2.3). Finally, Denny's overall median level of correct responses during the baseline phase for the snowstorm experiment was .58 (range, .48 - .79) and his median level of incorrect responses was 1.2 (range, 1.1 - 1.39). A summary of these results can be found in Table 7.

4.1.2 Bob's baseline results

Baseline data collection for Bob began on the same day as it did for Denny. During the baseline phase, the PI arranged the necessary materials on the worktable, sat across from Bob, and delivered systematic verbal instructions on how to create a storm in a jar. The conditions were the same for both Bob and Denny's baseline phases. The PI also measured Bob's median level of correct and incorrect responses per minute across the baseline phase. His overall level of correct responses during the baseline phase for the hurricane experiment was .43 (range, .15 - .71) on the SCC and his median level of incorrect responses for the same experiment was 1.18 (range, 1.11 – 1.25). His median level of correct responses for the tornado experiment was .39 (range, .17- .83) and his median level of incorrect responses was 1.30 (range, 1.14 – 1.45). Finally, Bob's median level of correct responses, during baseline for the snowstorm experiment was .41(range, .22 - .60) and his median level of incorrect responses was .88 (range, .56 – 1.20) on the SCC. A summary of these results can be found in Table 7.

4.1.3 Denny's intervention results

During the intervention phase of the study, the PI arranged the necessary materials on the worktable and instead of sitting across from him; she directed Denny's attention to the iPad mini. The iPad was set up in a stand and was easily accessible to Denny. The PI instructed Denny to go to the home screen, find the photos icon, click on it and then click on the folder labeled "Hurricane Science Experiment". Once Denny found the folder, and opened it, the PI instructed him to watch the first clip, do exactly what is done in the video and move on to the next clip when he was done. Denny's first experiment in intervention was the hurricane. Denny's median level of correct responses during the intervention phase was 1.43 (range, 1.56 – 1.93) per minute; his median level of incorrect responses was .24 (range, 0 - .47). Denny's performance of correct responses with the hurricane experiment showed a x.63 median level change and a /1.24 median level change from baseline to intervention. These results indicated that Denny required less prompting once the POVM video prompt intervention was implemented. Therefore, his ability to correctly complete the steps of the science experiment was less prompted and more independent.

Denny's median level of correct responses per minute for the tornado experiment was 1.53 (range, 1.59 – 1.94) and his median level of incorrect responses was .09 (range, 0 – 0.17). His performance of correct responses showed a x.62 median level change and his performance of incorrect responses showed a /1.78 median level change between the baseline phase and the intervention phase. These results further indicated that Denny was able to accurately perform the steps of the experiment with very little additional prompting.

Finally, Denny's median level of correct responses per minute for the snowstorm experiment was 1.49 (range, 1.39 – 1.59) and his medial level of incorrect responses was .16

(range, 0 - .31). These results show a x.91 median level change and a /1.09 median level change in performance from the baseline phase to the intervention phase. Overall, these data indicated that once the intervention was in place, Denny was able to perform a multiple step science experiment with greater independence and increasingly fewer prompts from an instructor.

4.1.4 Bob's intervention results

During the first phase of intervention, the PI arranged the necessary materials on the worktable and instructed Bob to use the iPad to conduct the hurricane experiment. His median level of correct responses per minute was 1.72 (range, 1.54 – 1.90) and his median levels of incorrect responses per minute were .26 (range, 0 - .513). His performance showed a x1.29 medial level change in correct responses per minute and a /.92 medial level change in incorrect responses per minute from the baseline phase to the intervention phase.

Bob's performance during the second phase of intervention, the tornado experiment, showed his median level of correct responses per minute as 1.72 (range, 1.63 – 1.80) and incorrect responses as .19 (range, 0 -.02). His median level change from the baseline phase to the intervention phase for this experiment was x1.33 for correct responses per minute and /1.11 for incorrect responses per minute.

Finally, during the third phase of intervention, Bob's median level of correct responses per minute for the snowstorm experiment was 1.30 (range, 1.21 – 1.38) and his median level of incorrect responses per minute was .18 (range, 0 – .363). His median level change between baseline and intervention phases was x.89 for correct responses per minute and /.7 for incorrect responses per minute. Data across the intervention phases indicated that Bob performed more independently and required fewer prompts with the POVM video prompt intervention than with the verbal instruction alone.

Table 7. Summary of Results Within Conditions

Student	Experiment	Behavior	Baseline Median Level	Intervention Median Level
Denny	Hurricane	Correct	.8	1.43
		Incorrect	1.48	.24
	Tornado	Correct	.91	1.53
		Incorrect	1.87	.09
	Snowstorm	Correct	.58	1.49
		Incorrect	1.25	.16
Bob	Hurricane	Correct	.43	1.72
		Incorrect	1.18	.26
	Tornado	Correct	.39	1.72
		Incorrect	1.30	.19
	Snowstorm	Correct	.41	1.30
		Incorrect	.88	.18

Table 8. Summary of Results Between Conditions

Student	Experiment	Behavior	Baseline to Intervention Median Level Change
Denny	Hurricane	Correct	X.63
		Incorrect	/1.24
	Tornado	Correct	X.62
		Incorrect	/1.78
	Snowstorm	Correct	X.91
		Incorrect	/1.09
Bob	Hurricane	Correct	X1.29
		Incorrect	/.92
	Tornado	Correct	X1.33
		Incorrect	/1.11
	Snowstorm	Correct	X.89
		Incorrect	/.7

Behaviors Performed During Science Experiments

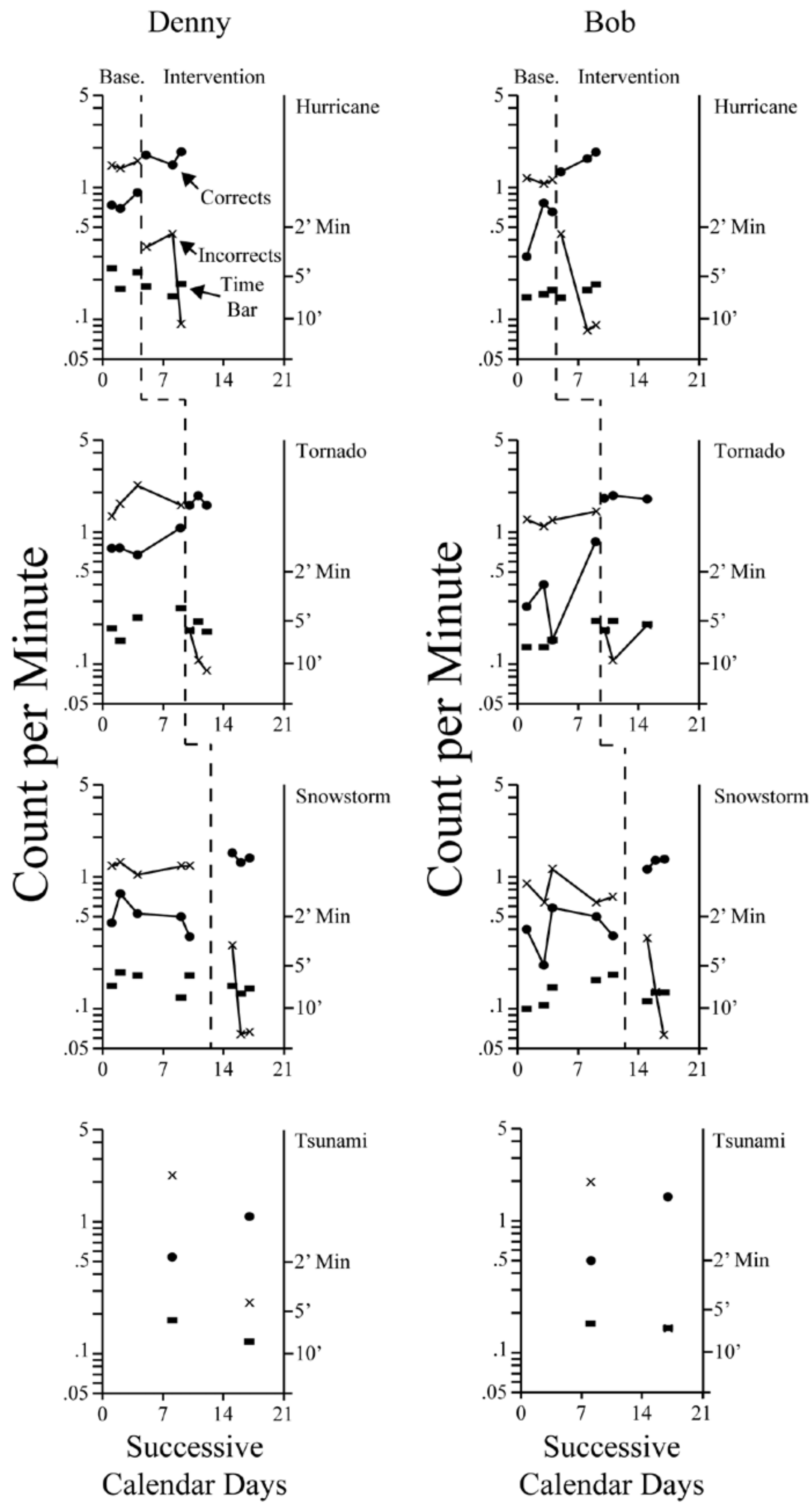

Figure 4. Behaviors Performed During Science Experiments

4.1.5 Social validity results

Social validity was data was collected qualitatively though an interview process. At the end of the study, the PI interviewed each of the student participants. The interview questions were as follows: (a) Did you like using the iPad to do science? , (b) Was it easy to use?, (c) Which type of instruction did you like better, the iPad or me?, (d) Would you use the iPad with these sort of clips to learn other things in school?, and (e) did you have fun doing science with this intervention?

Both student participants had positive reactions to the interview questions. For example, when the PI asked Bob if he liked doing science with the iPad, he said “ Yes! I loved it, it was awesome”. Denny had a similar response, he said, “This was really fun! I wish I could do this in all my classes.” Both participants said the intervention was easy to use and that they would be interested in using a video prompt to learn other subjects in school. When asked which form of instruction they liked better, Denny said, “Sorry Miss Molly but I liked the iPad better.” and Bob said, “I like you, but the iPad was awesome.”

The PI also asked the classroom teachers what they thought about the intervention, if they would consider using it, and whether they felt it was a realistic intervention to use across students and subject areas. Denny’s teachers said she thought the intervention “was cool” and “it seemed to work well for Denny” but she said, “I don’t know how it would work for some of my other students”. Bob’s teacher also said he “liked the intervention” He said, “It was cool to see how fast it worked.” When the PI asked if he thought it was a realistic intervention to use in an actual class setting, Bob's teacher said, "I'm not sure but if you had enough time to plan, it might work."

The results of the interviews indicated a high degree of social validity from the student participants and moderate degree from the classroom teachers. Overall, both the students and the teachers appeared to react positively toward the intervention.

5.0 DISCUSSION

An extensive amount of research has been done to verify best instructional practices for individuals with ASD and ID. Best practices are commonly referred to as evidence-based practices. Prior to being considered as an evidence based practice, interventions must be rigorously studied and field tested for evidence. As a result of those rigorous studies, organizations such as the National Professional Development Center on autism spectrum disorder (NPDC) have been able to devise a list of evidence-based practices for individuals with ASD. Most evidence-based practices are those that are systematic, objectively verified, used with fidelity, and customized to fit the individual needs of the learner (Simpson, 2005).

Techniques such as adult-directed interventions, differential reinforcement of desired behavior(s), peer-mediated interventions, visual supports, self-monitoring, family involvement, positive behavior support, video modeling, and moderating characteristics of tasks (Odom et al., 2003) have been found to be effective interventions for providing academic instruction to individuals with ASD. The technique of interest for this study was video modeling, specifically, point-of-view video modeling.

Research has shown that technology can improve learning outcomes and increase access to core curriculum for students with disabilities (Cihak & Bowlin, 2009; Burton et al., 2013). Video technology can be used to increase acquisition with academic skills, communication skills, activities of daily living, leisure, social skills, and transitions skills for individuals with ID and/or

ASD (Spencer, et al., 2015). A series of literature reviews (Ayres & Langone, 2005; Delano, 2007; Hitchcock, et al., 2003; Machalicek, et al., 2008; Prater, et al., 2012) and a meta-analysis (Bellini & Akullian, 2007) have shown evidence to support the effectiveness of video modeling interventions. Based on the research, video-based interventions are a viable teaching tool for individuals with disabilities, including ASD and ID. VM interventions allow students' to view themselves or others similar to them engaging in positive, successful behaviors (Dowrick, 1999; Cihak, et al., 2010).

The purpose of this study was to evaluate the effects of a POVM video prompt intervention in a public school setting, with an individual with ASD and an individual with ID, and their ability to complete multiple step science experiments. The POVM video prompt showed each step of the experiment, as a clip, in isolation. The video showed an assortment of materials with a primary focus on a pair of hands engaged in a discrete step in the experiment. Outcome measures counted the number of movements completed as modeled without additional prompting from the PI. Social validity was also evaluated qualitatively, through an interview procedure.

The following research questions guided the study:

1. What effect does a POVM video prompt intervention have on the independent completion of a multiple step science experiment with an individual with ASD or ID?
2. What effect does a POVM video prompt intervention have on the number of prompts needed for an individual with ASD or ID to complete a multiple step science experiment?

3. How socially valid is POVM video prompting for teaching an individual with ASD or ID to complete a multiple step science experiment?

5.1 EFFECTS OF THE POVM VIDEO PROMPT INTERVENTION

The results of the study appeared to be positive. Each of the students required less promoting from the instructor when the intervention was in place. During baseline conditions, the students appeared to rely heavily on assistance from the instructor. For example, both Bob and Denny would frequently ask for further clarification or assistance before trying to complete the step as instructed. However, when the intervention was in place, very little assistance was requested and neither student asked for further clarification. The data supports these claims. Both participants showed an increase in correct responses during the intervention phases of the study. The frequency of incorrect responses also decreased across experiments for both participants.

As the participants followed the model in the video more accurately, they became more independent in their ability to complete the experiments. For example, during the baseline phases, Bob would hesitate and ask for clarification even before engaging in movement. During the intervention phases, he did not verbally ask for any clarification, instead, he referenced the video. The median level change in his performance of unprompted movements during intervention phases give evidence to eh effectiveness of the POVM video prompt intervention.

Denny's data showed similar results. He did not ask for clarification as frequently as Bob but he did reference the videos if he was unsure about a step. During the baseline phases, Denny would tend to become distracted. For example, he would begin talking about topics unrelated to science or look away from the worktable and gaze out the window instead. However, during the intervention phases he appeared less distracted, continued working from clip to clip, and only commented on the experiment after it was over. Additionally, his median level change from baseline to intervention showed evidence of an increase in correct responses. The overall data for both participants indicated that the POVM video prompt intervention had an effect on the their ability to complete multiple step science experiments with fewer prompts from an instructor.

5.2 EFFECT OF THE POVM ON ADDITIONAL PROMPTING

Across experiments, the data indicated that a greater number of additional prompting was required for both participants, in the absence of the intervention. Denny and Bob both showed higher frequencies of incorrect (i.e., prompted) responses when the instructions were delivered verbally. There also appeared to be a higher degree of hesitation to act from the participants during the baseline condition. Their hesitation frequently led to a prompt for information from the PI, which resulted in an incorrect response. Data for both participants' showed evidence that fewer prompts were delivered during the intervention conditions across experiments. These data are consistent with data in the literature. These data add to the evidence that VM, specifically POVM video prompt interventions are effective techniques to use increase an individual with ASD or ID's independence in the classroom.

5.3 SOCIAL VAIDITY

The qualitative results of the answers given by the participants during the interviews indicated a high degree of social validity for the intervention. Both of the participants claimed to 'like' the intervention and reported that they would be willing to use the intervention again in the future and to learn new skills. They also reported to prefer the instruction as it was delivered through the technology rather than through the more traditional verbal, lecture delivery.

The results from the teacher interviews still indicated a degree of social validity but their comments were coupled with hints of apprehension. Both teachers claimed to like the intervention and they both mentioned the positive effects it appeared to have on their students. However, neither of the teachers expressed interest in designing a POVM or implementing a similar intervention on their own. One possible explanation is that some of the barriers found by Hew and Brush (2007) are still in existence in classrooms today. For example, the teachers may have thought the POVM video prompt intervention was too technical and would be difficult to create (i.e., knowledge and skills), or it was beyond the scope of their curriculum (i.e., attitudes and beliefs) or that it was inappropriate for the skills they taught (i.e., subject culture).

5.4 LIMITATIONS

There were several limitations in this study. To begin, only two students participated in the study. While this is acceptable within the parameters of single-subject research, it may affect the external validity of the study. The results may have indicated some success with the intervention but because of the small sample size, it less likely that this study will be replicated in the future.

It is also less likely that it will be generalized to larger groups of individuals with disabilities o r extend beyond science experiment to other areas of science content.

A second limitation of this study was that it was done in isolation, as a one-on-one, procedure. While this was ideal for controlling for possibly confounding variables, it may discourage future practitioners from using this intervention in an inclusive classroom setting. A relevant extension of this study would be to teach the students how to use the POVM video prompt intervention in isolation and then test their skills with the intervention in an actual science class during a lab activity.

Finally, the greatest limitation to this study was time. The study began late in the school year, which affected the number of days available for data collection. With a longer period of time, the PI could have spaced out the conditions of study so as to gather more data with less risk of learning occurring through practice. Practice was one of the largest risks with this study. The more time the students spent in either condition, the more practice they had with the skills. If the study was run over a longer period of time, the PI could have controlled for the amount of practice the students were receiving with each skill while still gathering an acceptable amount of data in each condition. The more time between conditions could have limited the amount of practice the students had with the skills and while yielding a substantial amount of more data per condition. Time was also a limiting factor in terms of conducting a follow-up and/or maintenance condition. As previously mentioned, a relevant and necessary extension of this study would be to evaluate the student's abilities to use the POVM video prompt intervention during a regular education science class, with a lab partner (rather than a paraprofessional), conducting an experiment.

5.5 IMPLICATIONS FOR RESEARCH

A large body of research already surrounds VM interventions and the positive effects they can have on skill acquisition with individuals with ASD. However, there appears to be a gap in the research. VM interventions have been widely used to teach self-help skills, conversation and social skills, and functional skills with individuals with ASD and ID. However, little research has been done to evaluate the effects of VM interventions on teaching academic skills in public school settings. To date, the present study appears to be the only study that implemented a POVM video prompt intervention to teach science in a public school setting. However, given the limitations of the study, including the lack of follow-up data, further investigation is needed to replicate and potentially strengthen the results of the study.

The implications for future research that can be drawn from this study are to go beyond using VM interventions with functional, and daily living skills. VM interventions have the potential to be extremely useful and very effective for teaching a myriad of skills including academic skills to students with ASD or ID. If a skill can be broken into a series of teachable steps, it can be filmed and taught with a VM or a video prompt intervention. For example, future researchers could evaluate the effects of VM interventions on the acquisition of math skills such as multiplying and dividing single and multiple digit numbers, learning place value, or using a number line.

Lastly, due to the portable nature of the intervention and the availability of the technology, VM interventions can be easily used in any setting in a school. A student can carry a tablet or iPad with them and have access to the intervention as needed, wherever they are. However, most research, to date has studied VM in small or isolated settings. Further investigation is needed to evaluate the effectiveness of VM interventions in inclusive general education settings. VM has the potential to promote learning in inclusive classroom settings but research is needed to clarify the extent of that potential.

5.6 IMPLICATIONS FOR PRACTICE

Many practitioners, if they are familiar with VM, may think of it as a lengthy, complicated process that requires expensive equipment and copious amounts of time. This is a common misconception and as recent as 10 years ago, those assumptions may have been true. However, current technology and handheld devices make it very easy to create an effective and powerful VM intervention that can be saved, used again, and modified as needed.

For this study, The PI and one assistant created all the clips for each experiment. They used one device (i.e., the iPad mini) to film, store, and implement the complete intervention. Across the four experiments, the number of clips per experiment ranged from eight to 13. The average length of a single clip ranged from 22 seconds to 25 seconds. Production time for creating the clips ranged between 10 to 20 minutes per set of clips. The materials used for the experiments were mostly common household items. They were easy to find in the grocery store and inexpensive to purchase. Finally, the technology was easy to navigate and operate. To film, the PI and graduate assistant used the camera application on the Apple iPad. This application is a standard feature to all handheld Apple devices. The PI did not have to use any equipment beyond the iPad to film the intervention clips. Once filmed, the clips were stored in an electronic folder with the photos application. The participants used the same iPad to view the intervention as well.

The simplicity of this process was paramount. Practitioners would only need a base knowledge of how to operate a tablet or handheld device in order to create a similar intervention. Practitioners should consider the POVM video prompt intervention as a viable option for training multiple step skills and promoting independence in academic settings.

6.0 CONCLUSIONS

The purpose of this study was evaluate the effects of a POVM video prompt intervention on the completion of science experiments with two individuals with disabilities in a public school setting. Despite the limitations, the results of the study showed success and are promising for future research. Two students from middle school in Southwestern Pennsylvania were recruited and agreed to participate in the study. Over time, they conducted four separate experiments. During the baseline conditions, instruction was delivered verbally. Both participants required a high degree of promoting to the complete the steps of the experiments during this condition. Additionally, the participants asked for clarification and engaged in a higher rate of hesitation before acting in the instructions. These results indicated that the participants were less independent when conducting the experiments during the baseline conditions.

During the intervention conditions, the participants asked fewer questions, acted faster, and relied lesson feedback from the PI. Data shed large increase in correct responses while in the intervention phases for both participants. These data during the intervention conditions indicated that the students produced more accurate responses and required with less prompting, when using the intervention to complete the task.

In practice, VM interventions can be used to teach a myriad of academic skills in various inclusive settings and across multiple students. The technology needed to design, produce, and present the interventions are far more accessible and cost effective than they have been in the past. The availability of handheld devices such as smartphones, iPods®, iPads®, and tablets help to make the process of filming and viewing the intervention easier for practitioners and students. Consistent with Charlop-Christy et al. (2000) the current study found that the POVM video prompt intervention took less time to film and implement in comparison to in vivo procedures. Future research should investigate the uses of VM and video prompting interventions in other academic areas, such as math.

APPENDIX A

CANDIDATE SELECTION SURVEY

Candidate Selection Survey

Name____________________________Date___________________________________

Grade___________________________School__________________________________

I am willing to assist with a research study in my classroom: Yes No

If you feel you have a student who may be a good candidate and a willing participant for a video modeling research study, please answer the following questions. Circle "yes" if the question pertains to a particular student or students in your class and "no" if it does not. Please feel free to provide any additional information that may apply. If you would like further information about the study or you feel you have a potential candidate for the study please contact Molly Matsik by email at: mam402@pitt.edu or by phone at: 412.983.3745. Thank you for your time and consideration.

Is the student eligible for special education services?

Yes

No

Does the student have a diagnosis of autism spectrum disorder (ASD) or intellectual disability (ID)?

Yes

No

If so, please specify

____

____

Is the student interested in movies?

Yes

No

Does the student enjoy watching videos on TV?

Yes

No

If a video is on, can the student sit and attend to the video, without interruption, for an extended period of time?

Yes

No

If so, for approximately how long?

1-2 minutes

2-5 minutes

5-10 minutes

10-30 minutes

30 minutes to an hour

An hour +

Have you seen the student use a handheld device (e.g., smart phone, iPad®, iPod®, tablet etc.)?

Yes

No

Is the student able to hold a pencil?

Yes

No

If so, can they make a mark on a sheet of paper?

Yes

No

Can the student follow multiple step directions?

Yes

No

Does the student have goals related to science in their IEP?

Yes

No

Has the student participated in a science class or science lesson in a classroom setting?

Yes

No

Has the student ever participated in a research study?

Yes

No

If so, please describe ____
____
____

Has the student been previously exposed to a video modeling intervention(s) in the classroom?

Yes

No

If so, what was the intervention and how long did it last? ____
____

In your opinion, would the student be willing to participate in a research study?

Yes

No

APPENDIX B

TASK SIMILARITY RUBRIC WITH FULL DESCRIPTION OF EXPERIMENTS AND SCRIPTS

Task Similarity Rubric Results

	Snowstorm Experiment			Tornado Experiment			Hurricane Experiment			Tsunami Experiment		
What is the purpose of the experiment?	To follow a series of steps to complete the total task of replicating a snowstorm in a jar.			To follow a series of steps to complete the total task of replicating a tornado in a jar.			To follow a series of steps to complete the total task of replicating a hurricane in a jar.			To follow a series of steps to complete the total task of replicating a tsunami in a jar.		
What motor skills are required to complete the experiment? (e.g., pouring, dropping, pinching, etc.)	Pick up Pour Squeeze Turn Pinch/drop Break			Pick up Pour Squeeze Turn Pinch/drop			Pick up Pour Squeeze Turn Pinch/drop			Hold Pick up Pour Scoop Turn Pinch/drop Lift Rock		
Number of steps in the sequence of the task.	15			12			11			16		
Number of materials needed for the experiment.	7			7			6			8		
Level of Complexity												
Complexity Scale: 1= simple, one-step, motor movement (e.g., pinch, pick up, drop, pour, etc.) 2= simple motor movement + additional movement or level of precision (e.g., measure, stir with a spoon, squeeze 2 drops of liquid, etc.) 3= simple motor movement + additional movement or level of precision + assessment, decision making based on observation (e.g., if you see an interaction, mark the green circle, if you DO NOT see an interaction mark the red circle etc.)												
Complexity Score totals:	22			17			18			24		
Teacher 1 Responses	1's	2's	3's	1's	2's	3's	1's	2's	3's	1's	2's	3's
	6	2	1	3	3	0	4	3	0	5	3	1
Teacher 2 responses	1's	2's	3's	1's	2's	3's	1's	2's	3's	1's	2's	3's
	5	2	0	4	2	0	4	2	0	4	3	1

Snowstorm in a Jar Experiment:

Purpose: The purpose of this experiment is to follow a series of steps to complete the total task of replicating a snowstorm in a jar. The student will follow verbal and visual directions displayed on a screen. Directives are segmented into clips. Clips will show each directive as a discrete step. The student will use different materials as directed, in a sequence, to complete the experiment.

Grade Level: 2-4

Procedures

Directives:

1. Pick up the baby oil.
2. Pour ½ cup of baby oil into the measuring cup.
3. Use the measuring cup to pour the baby oil into the jar. Set aside.
4. Pick up the pitcher of water.
5. Pour the water into the bowl.
6. Pick up the white paint.
7. Squeeze two drops of white paint into the bowl.
8. Use the spoon to stir the water and white paint together in the bowl. Stir until it is well mixed. This will make white water.
9. Pour the white water into the jar.
10. Hold the jar still as the glitter and water settle at the bottom of the jar.
11. Pick up a piece of the Alka-Seltzer tablet.
12. Drop a piece of the Alka-Seltzer into the jar.
13. Drop a piece of the Alka-Seltzer into the jar.
14. Drop a piece of the Alka-Seltzer into the jar.
15. Observe the effects of the Alka-Seltzer as it mixes with the liquid

Complexity Score	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
Total Score:	

Total 1's	
Total 2's	
Total 3's	

Materials

1. A jar with a lid
2. Measuring cup
3. Spoon
4. Baby oil
5. White paint
6. Water
7. Alka-Seltzer Tablets

Script

"Hello! It's cold outside, which means its wintertime. Winter is typically the coldest season of the year. It's a season associated with dropping temperatures and in some parts of the world, snow. Snow is actually an accumulation of loosely packed ice crystals that fall from the atmosphere (National Snow and Ice Data Center, NSIDC). Did you know that snow could have different characteristics? For example, most snow is white because it reflects sunlight rather than absorbs it. However, some snow can look blue. As light waves travel into the snow, the ice grains scatter a large amount of light. The more light is scattered, the more likely it is to appear to have a

Tornado in a Bottle Experiment:

Purpose: The purpose of this experiment is to follow a series of steps to complete the total task of replicating a tornado in a jar. The student will follow verbal and visual directions displayed on a screen. Directives are segmented into clips. Clips will show each directive as a discrete step. The student will use different materials as directed, in a sequence, to complete the experiment.

Grade Level: 2-4

Procedures

Directives

1. **Hold the jar and turn the lid to the left to remove it from the jar.**
2. **Pour 2 cups of water in to the measuring cup.**
3. **Pour the water into the jar.**
4. Drop one teaspoon of vinegar into the jar.
5. Squeeze one teaspoon of dish soap into the jar.
6. Drop a ½ teaspoon of glitter into the jar.
7. Place the lid on top of the jar
8. Hold the jar and turn the lid to the right to close the jar.
9. Pick up the jar
10. Move the jar in a circular motion (left to right) to swirl the water in the jar.
11. Put the jar on the table
12. Observe a vortex like a tornado form in the center of the jar

Complexity Score	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
Total Score:	

Materials

1. A jar with a lid
2. Measuring cup
3. Measuring spoons
4. Water
5. Vinegar
6. Clear liquid dish soap
7. Glitter

Total 1's	
Total 2's	
Total 3's	

Script

"Hello! Have you ever seen a thunderstorm? Did you know that there are four main types of thunderstorms? They are orographic, air mass, frontal, and supercell. Orographic thunderstorms are caused by air that is forced up by a mountain or hillside. Air mass thunderstorms are the result of air being pushed up in one space in an unstable air mass. An air mass is a body of air over a large area of land or water. Frontal thunderstorms are those that occur along the boundaries of weather fronts, like a cold front (The National Center for Atmospheric Research, National Science Foundation). Finally, supercell storms are storms with a deep rotating up draft, called a mesocyclone. A mesocyclone is a precursor to a tornado and can range between 2 and 6 miles wide. Once a mesocyclone forms, it is likely to develop into a tornado within approximately 30 minutes. A tornado is a powerful rotating column of air that reaches down out of a thundercloud to the ground. It looks like a huge, swirling tope of air, dirt, and debris. Wind speeds in a tornado can range between 200 and 300 miles per hour. Small tornados may only last for a matter of minutes and cover less than a mile of ground but big tornados can cause a lot of damage, they can remain on the ground for hours and cover more than 90 miles of ground. Today we are going to do an experiment. We are going to use these materials to make a small tornado in a jar. Let's see what a tornado looks like up close! "

Hurricane in a Jar Experiment:

Purpose: The purpose of this experiment is to follow a series of steps to complete the total task of replicating a hurricane in a jar. The student will follow verbal and visual directions displayed on a screen. Directives are segmented into clips. Clips will show each directive as a discrete step. The student will use different materials as directed, in a sequence, to complete the experiment.

Grade Level: 2-4

Procedures

Directives

1. **Hold the jar and turn the lid to the left to remove it from the jar and set it aside.**
2. Pour 1 cup of soap into the measuring cup.
3. Use the measuring cup to pour soap into the jar.
4. Pour 2 cups of water into the measuring cup.
5. Use the measuring cup to pour the water into the jar.
6. When the water reaches the top, keep it running until all the bubbles overflow and are gone.
7. Find the blue food coloring.
8. Squeeze two drops of food coloring into the jar.
9. Drop ½ teaspoon of glitter into the jar.
10. Place the lid on the top of the jar and turn it to the right to close the jar tightly.
11. Move the jar in a circular motion, counterclockwise to mimic a hurricane.
12. Put the jar on the table.
13. Observe the reaction between the soap, water, food coloring, and glitter

Complexity Score	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
Total Score:	

Total 1's	
Total 2's	
Total 3's	

Materials

1. A jar with a lid
2. Measuring cup
3. Measuring spoons
4. Opaque soap that contains Glycol Stearate
5. Food coloring (blue)
6. Glitter

Script

"Hello! Have you ever traveled to a beach near an ocean? The beach is a great place to swim, play in the sand, and hang out with your family and friends. However, if you plan on heading to a beach along the Atlantic Ocean this summer be sure it's not during hurricane season. A hurricane is a huge storm. It can span up to 600 miles across and winds that range between 75 to 200 miles per hour. A hurricane usually lasts for a week or a little longer. It moves over the open ocean at approximately 10-20 miles per hour. In the Northern Hemisphere, hurricanes rotate in a counter-clockwise direction around the "eye" which is the calmest part of the storm. It gathers heat and energy from the warm ocean waters. In fact, hurricanes only form over ocean water that is 80 degrees (F) or higher! The warm water provides energy for the hurricane and causes more evaporation, which makes humid air and clouds. When a hurricane comes onto land, its strong winds, heavy rains, and large waves

Tsunami in a Bottle Experiment:

Purpose: The purpose of this experiment is to follow a series of steps to complete the total task of replicating a tsunami in a bottle. The student will follow verbal and visual directions displayed on a screen. Directives are segmented into clips. Clips will show each directive as a discrete step. The student will use different materials as directed, in a sequence, to complete the experiment.

Grade Level: 2-4

Procedures

Directives

1. Hold the bottle and turn the lid to the left to remove it from the bottle and set it aside.
2. Pick up the funnel and place it on top of the bottle.
3. Pick up the tablespoon scoop.
4. Use the tablespoon to scoop gravel in to the bottle.
5. You may need to shake the funnel if the gravel becomes stuck.
6. Stand the ruler next to the bottle to measure the height of the gravel.
7. Continue adding gravel until you measure two inches of gravel in the bottle.
8. Pour two cups of water into the measuring cup.
9. Pour the water from the measuring cup into the bottle.
10. Drop two drops of food coloring into the bottle.
11. Place the cap on the top of the bottle and turn to close and tighten.
12. Pick up the bottle with both hands.
13. Slowly lower the neck of the bottle, so it rests in your right hand.
14. Hold the bottom, larger end of the bottle in your left hand, so the bottle is laying horizontally.
15. Gently lift the neck of the bottle in your left hand.
16. Continue lifting and lowering the bottle until you see a wave effect in the bottle.

Complexity Score	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
Total Score:	

Materials

1. A bottle with a lid
2. Water
3. Measuring cup
4. Ruler
5. A tablespoon
6. Funnel
7. Food coloring
8. Gravel

Total 1's	
Total 2's	
Total 3's	

APPENDIX C

SOCIAL VALIDITY INTERVIEW QUESTIONS FOR STUDENTS

Interview Questions for Participants

1. (Student's name) did you like doing science experiments?
2. Did you like using the iPad to do science?
3. Did you like using the video to help you learn?
4. Would you use the iPad with these sort of clips to learn other things in school?
5. Was it easy to use?
6. Which type of instruction did you like better, the iPad or me?, and
7. Did you have fun doing science with this intervention?

Interview Questions for Teachers

1. Mr./Mrs. it was a realistic intervention to use across students and subject areas?
2. Have you noticed any changes in his/her behavior?
3. Is this an intervention you have thought about using?
4. Would you use this intervention in the future?

BIBLIOGRAPHY

Acar, C. & Diken, I. H. (2012). Reviewing instructional studies conducted using video modeling to children with autism. *Educational Sciences: Theory & Practice, 12*(4), 2731-2735

Al-Dahri, M., McLaughlin, T.F., Derby, K.M., Belcher, J., & Weber, K.P. (2013). An evaluation of the direct instruction model-lead-test procedure and rewards in rote counting, number recognition and rational counting with a preschool student with developmental delays. *International Journal of basic and Applied Science, 2*(1), 98-109

Allen, R. (2011). Can mobile devices transform education? *Education Update, 53*(2)

Aykut, C., DaĞseven Emecen, D., Dayi, E., & Karasu, N., (2014). Teaching chained tasks to students with intellectual disabilities by using video prompting in small group instruction. *Educational Sciences: Theory and Practice, 14*(3), 1082-1087.

Ayres, K. M. & Langone, J. (2005). Intervention and instruction with video for students with autism: A review of the literature. *Education and Training in Developmental Disabilities, 40*(2), 183-196.

Bandura, A. (1965). Influence of models' reinforcement contingencies on the acquisition of imitative responses. *Journal of Personality and Social Psychology, 1*(6), 589-595.

Bellini, S. & Akullian, J. (2007). A meta-analysis of video modeling and video self-modeling interventions for children and adolescents with autism spectrum disorder. *Exceptional Children, 73*(3), 264-287.

Bellini, S. & McConnell, L.L. (2010). Strength-based educational programming for students with autism spectrum disorders: A case for video self-modeling. *Preventing School Failure, 54*(4), 220-227. doi: 10.1080/10459881003742275

Binder, C. (1993). Behavioral fluency: A new paradigm. *Educational Technology,* 33, 8–14.

Brigham, F.J., Scruggs, T.E., & Mastropieri, M.A., (2011). Science Education and students with learning disabilities. *Learning Disabilities Research and Practice, 26*(4), 223-232.

Buggey, T. (2005). Effectiveness of video self-modeling to promote social initiations by 3-year-olds with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, *27*(2), 102-110. doi: 10.1177/1088357612441826

Burton, C. E., Anderson, D.H., Prater, M.A., & Dyches, T.T. (2013). Video self-modeling on an iPad to teach functional math skills to adolescents with autism and intellectual disability. *Focus on Autism and other Developmental Disabilities, 28*(2), 67-77. doi: 10.117/1088357613478829

Calkin, A.B., (2005). Precision Teaching: The standard celeration charts. *The Behavior Analyst Today, 6*(4), 207-213.

Cannella-Malone, H.I., Sabielny, L.M., Jimenez, E.D., Page, E.J., Miller, M., & Miller, O., (2015). Use of continuous video prompting to teach a student with a significant disability. *Journal of Developmental and Physical Disabilities, 27*(6), 745-754. doi: 10.1007/s10882-015-9448-y

Center for Disease Control and Prevention. (November 2015). *Prevalence of autism spectrum disorder among children aged 8 years – Autism and developmental disabilities monitoring network, 11 sites, United States, 2010* (CDC 63(SS02)). Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6302a1.htm

Charlop-Christy, M. H. & Daneshvar, S. (2003). Using video modeling to teach perspective taking to children with autism. *Journal of Positive Behavior Interventions, 5*(1), 12-21. doi: 10.1177/10983007030050010101

Charlop‐ Christy, M. H., Le, L., & Freeman, K. A. (2000). A comparison of video modeling with in vivo modeling for teaching children with autism. *Journal of Autism and Developmental Disorders, 30*(6), 537-552. doi: 0162-3257/00/1200-0537$18.00/0

Cihak, D.F., & Bowlin, T. (2009). Using video modeling via hand held computers to improve geometry skills for high school students with learning disabilities. *Journal of Special Education Technology, 24,* 17-29.

Cihak, D., Fahrenkrog, C., Ayres, K. M., & Smith, C. (2010). The use of video modeling via a video iPod and a system of least prompts to improve transitional behaviors for students with autism spectrum disorders in the general education classroom. *Journal of Positive Behavior Interventions, 12*(2), 103-115 doi: 10.1177/1098300709332346

Cihak, D.F., Wright, R., Smith, C.C., McMahon, D., & Kraiss, K. (2015). Incorporating functional digital literacy skills as part of the curriculum for high school students with intellectual disability. *Education and Training in Autism and Developmental Disabilities, 50*(2), 155-171.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* 2nd ed. Upper Saddle Ridge, NJ: Pearson Education, Inc.

Corbett, B. A. & Abdullah, M. (2005). Video modeling: Why does it work for children with autism? *Journal of Early and Intensive Behavior Intervention, 2*(1), 2-8.

Council for Exceptional Children Standards for Evidence-Based Practices in Special Education, 2014.

Dalton, B., Cobb Morocco, C., Tivnan, T., & Rawson Mead, P.L., (1997). Supported inquiry science: Teaching for conceptual change in urban and suburban science classrooms. *Journal of Learning Disabilities, 30*(6), 670-684.

D'Ateno, P., Mangiapanello, K., & Taylor, B.A. (2003). Using video modeling to teach complex play sequences to a preschooler with autism. *Journal of Positive Behavior Interventions, 5*(1), 5-11.

Delano, M. E. (2007). Video modeling interventions for individuals with autism. *Remedial and Special Education, 28*(1), 33-42.

DeLeon, I. G. & Iwata, B. A. (1996). Evaluation of a multiple stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*(4), 519-533.

Diament, M. (2015, May). As more with autism near adulthood, clues to success emerge. *Disability Scoop.* Retrieved from http://www.disabilityscoop.com/2015/05/14/as-autism-adulthood-clues/20299/

DiJulio, L., Hallett, R., Neyman, J., McLaughlin, T.F., & Cole, M. (2015). The effects of a direct instruction model, lead, test reading procedure with reading mastery plus contingent rewards on sight word recognition by a middle school student with intellectual disabilities. *International Journal of Multidisciplinary Research and Development, 2*(4), 111-115

Drahota, A., Wood, J. J., Sze, K. M., & Van Dyke, M. (2010). Effects of cognitive behavioral therapy on daily living skills in children with high-functioning autism and concurrent anxiety disorders. *Journal of Autism and Developmental Disabilities 41*, 257-265. doi: 10.1007/s10803-010-1037-4

Horner, R.H., Carr, E.G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*, 165-179.

Hume, K., Loftin, R., & Lantz, J. (2009). Increasing independence in autism spectrum disorders: A review of three focused interventions. *Journal of Autism and Developmental Disorders, 39*(9), 1329-1338. doi: 10.1007/s10803-009-0751-2.

Iovannone, R., Dunlap, G., Huber, H., & Kincaid, D. (2003). Effective educational practices for students with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 18*(3), 150-165.

Johnston, J. M., & Pennypacker, H. S. (2009). *Strategies and tactics of behavioral research* (3rd ed.). New York: Routledge. ISBN: 9780805858822

Jones, C.R.G., Golden, H., Simonoff, E., Baird, G., Happé, F., Marsden, A.J.S., Tregay, J., Pickles, A., & Charman, T. (2009). Reading and arithmetic in adolescents with autism spectrum disorders: Peaks and dips in attainment. *Neuropsychology, 23*(6), 718-728.

Jones, C. D., & Schwartz, I. S. (2004). Siblings, peers, and adults: Differential effects of models for children with autism. *Topics in Early Childhood Special Education, 24,*187-198. doi:10.1177/02711214040240040101

Kagohara, D.M., Sigafoos, J., Achmadi, D., O'Reilly, M.O., & Lancioni, G. (2012). Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders 6*, 304-310.

Kanner, L. (1949). Problems of nosology and psychodynamics of early infantile autism. Paper presented at the Annual Meeting in a session on "Psychopathological Conditions in Childhood".

Katsioloudis, P., Fantz, T.D., & Jones, M. (2013). A comparative analysis of point-of-view modeling for industrial and technology education courses. *Journal of Technology Education25*(1), 70-81.

Kellems, R.O., Frandsen, K., Hansen, B., Gabrielsen, T., Clarke, B., Simons, K., & Clements, K. (2016). Teaching multiple step math skills to adults with disabilities via video prompting. *Research I Developmental Disabilities, 58,* 31-34.

Kennedy, C.H. (2005). *Single-case designs for educational research.* Boston, MA: Allyn and Bacon.

Kinney, E.M., Vedora, J., & Stromer, R. (2003). Computer-presented video models to teach generative spelling to a child with an autism spectrum disorder. *Journal of Positive Behavior Interventions, 5*(1), 22-

Knight, V., McKissick, B.R., & Saunders, A. (2013). A review of technology-based interventions to teach academic skills to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 43,* 2628-2648. doi:10.1007/s10803-013-1814-y

Kubina, R. M., Morrison, R., & Lee, D. L. (2002). Benefits of adding precision teaching to behavioral interventions for students with autism. *Behavioral Interventions, 17,* 233–246.

Lai, M.C., Lombardo, M.V., & Baron-Cohen, S. (2014). Autism. *The Lancet, 383,* 896-910.

Lang, R., Shogren, K.A., Machalicek, W., Rispoli, M., O'Reilly, M.O., Baker, S., & Regester, A. (2009). Video self-modeling to teach classroom rules to two students with Asperger's. *Research in Autism Spectrum Disorders 3*, 483-488.

LeBlanc, L. A., Coates, A. M., Daneshvar, S., Charlop-Christy, M. H., Morris, C., & Lancaster, B. M. (2003). Using video modeling and reinforcement to teach perspective-taking skills to children with autism. *Journal of Applied Behavior Analysis*, *36*(2), 253-257. doi.org/10.1901/jaba.2003.36-253

Lowy Apple, A., Billingsley, F., & Schwartz, I. S. (2005). Effects of video modeling alone and with self-management on compliment-giving behaviors of children with high-functioning ASD. *Journal of Positive Behavior Interventions, 7*(1), 33-46.

Marcus, A., & Wilder, D.A. (2009). A comparison of peer video modeling and self-video modeling to teach textual responses in children with autism. *Journal of Applied Behavior Analysis, 42*(2), 335-341.

Marder, T. & Fraser, D. (2012). Evidence-based practice for special educators teaching students with autism. *New Horizons for Learning, Special Edition: Focus on Autism*, *5*(2). Retrieved from the World Wide Web: http://education.jhu.edu/PD/newhorizons/Journals/specialedjournal/MarderandFraser

Machalicek, W., O'Reilly, M.F., Beretvas, N., Sigafoos, J., Lancioni, G., Sorrells, A., Lang, R., & Rispoli, M. (2008). A review of school-based instructional interventions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *2* 395-416. doi: 10.1016/j.rasd.2007.07.001

Mason, R. A., Davis, H. S., Boles, M. B., & Goodwyn, F. (2013). Efficacy of point-of-view video modeling: A meta-analysis. *Remedial and Special Education*, *34*, 333-345. doi: 10.1177/0741932513486298

Mason, R. A., Ganz, J. B., Parker, R. I., Burke, M. D., Camargo, S. P. (2012). Moderating factors of video-modeling with other as model: A meta-analysis of single-case studies. *Research in Developmental Disabilities 33*, 1076-1086. doi:10.1016/j.ridd.2012.01.016

Matson, J., Rivet, T.T., Fodstad, J.C., Dempsey, T., & Boisjoli, J.A. (2009). Examination of adaptive behavior differences in adults with autism spectrum disorders and intellectual disability. *Research in Developmental Disabilities 30*, 1317-1325.

Mayton, M. R., Wheeler, J. J., Menendez, A. L., & Zhang, J. (2010). An analysis of evidence-based practices in the education and treatment of learners with autism spectrum disorders. *Education and Training in Autism and Developmental Disabilities, 45*(4), 539-551.

McCoy, K. & Hermansen, E. (2007). Video modeling for individuals with autism: A review of model types and effects. *Education and Treatment of Children, 30*(4), 183-213.

Mechling, L. C., Ayres, K. M., Bryant, K. J., & Foster, A. L. (2014). Comparison of the effects of continuous video modeling, video prompting, and video modeling on task completion by young adults with moderate intellectual disability, *Education and Training in Autism and Developmental Disabilities*, *49*(4), 491-504.

Miltenberger C. A. & Charlop, M. H. (2015). The comparative effectiveness of portable video modeling vs. traditional video modeling interventions with children with autism spectrum disorders. *Journal of Developmental and Physical disabilities*, *27*(3), doi:10.1007/s10882-014-9416-y

Minshew, N.J., Goldstien, G., Taylor, H.G., & Siegel, D.J. (1994). Academic achievement in high functioning autistic individuals. *Journal of Clinical and Experimental Neuropsychology*, *16*(2), 261-270.

Moore, D.W., Anderson, A., Treccase, F., Deppeler, J., Furlonger, B, & Didden, R. (2013). A video based package to teach a child with autism spectrum disorder to write her name. *Journal of Developmental and Physical Disabilities, 25*(5), 493-503.

Müller, E., Cannon, L.R., Kornblume, C., Clark, J., & Powers, M. (2016). Description and preliminary evaluation of a curriculum for teaching conversational skills to children with high-functioning autism and other social cognition challenges. *Language, Speech, and Hearing Services in Schools,* 1-8.

National Center for Education Statistics; NCES (2010). *Educational Technology in U.S. Public Schools: Fall 2008.* (NCES Publication 2010-034). Retrieved fromhttp://nces.ed.gov/pubs2010/2010034.pdf

National Research Council (2006). America's lab report: Investigations in High School Science. Committee on High School Science Laboratories: Role and Vision, S.R. Singer, M.L. Hilton, and H.A. Schweingruber, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Nikopoulos, C. K., Canavan, C., & Nikopoulou-Smyrni, P. (2009). Generalized effects of video modeling on established instructional stimulus control in children with autism. *Journal of Positive Behavior Interventions, 11*(4), 198-107, doi: 10.1177/1098300708325263

Nuernberger, J.E., Ringdahl, J.E., Vargo, K.K., Crumpecker, A.C., & Gunnarson, K.F. (2013). Using a behavioral skills package to teach conversation skills to young adults with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7,* 411-417.

Odom, S.L., Brown, W.H., Frey, T., Karasu, N., Smith-Canter, L.L., & Strain, P.S. (2003). Evidence-based practices for young children with autism: Contributions for single-subject design research. *Focus on Autism and Other Developmental Disabilities, 18*(3), 166-175.

Oehler, K. (2013). Pease don't make me write! *Autism Asperger's Digest.* Found online at: http://autismdigest.com/write/

O'Malley, P., Lewis, M.E.B., Donehower, C., & Stone, D. (2014). Effectiveness of using iPads to increase academic task completion by students with autism. *Universal Journal of Educational research, 2*(1), 90-97. doi: 10.13189/ujer.2014.020111.

O'Malley, P., Jenkins, S., Wesley, B., Donehower, C., Rabuck, D., & Lewis, M.E.B. (2013). Effectiveness of using iPads to build math fluency. Paper presented at 2013 Council for Exceptional Children Annual Meeting in San Antonio, Texas.

Painter, K. K. (2006). Social skills groups for children and adolescents with Asperger's Syndrome: A step-by-step program. London: Jessica Kingsley Publishers.

Payne, D., Cannella-Malone, H.I., Tullis, C.A., & Sabielny, L.M. (2012). The effects of self-directed video prompting with two students with intellectual and developmental disabilities. *Journal of Developmental and Physical Disabilities, 24*(6), 617-634

Pennsylvania Alternate System of Assessment, Alternate Assessment Anchors and Alternate Eligible Content, Grade 4, 2016.

Pierce, K., & Schreibman, L. (1994). Teaching daily living skills to children with autism in unsupervised settings through pictorial self-management. *Journal of Applied Behavior Analysis, 27*(2), 471-481.

Prater, M.A., Carter, N., Hitchcock, C., & Dowrick, P. (2012). Video self-modeling to improve academic performance: A literature review. *Psychology in Schools, 49*(1), 71-81. doi: 10.1002/pits.20617.

Rayner, C. S. (2010). Video-modeling to improve task completion in a child with autism. *Developmental Neurorehabilitation, 13*(3), 225-230. doi:10.3109/17518421003801489

Roschelle, J.M., Pea, R.D., Hoadley, C.M., Gordin, D.N., & Means, B.M., (2000). Changing how and what children learn in school with computer-based technologies. *Children and Computer Technology, 10*(2), 76-101.

Schunk, D.H. & Hanson, A.R. (1989). Self-modeling and children's cognitive skill learning. *Journal of Educational Psychology, 81*(2), 155-163.

Shipley-Benamou, R., Lutzker, J.R., & Taubman, M. (2002). Teaching daily living skills to children with autism through instructional video modeling. *Journal of Positive Behavior Interventions, 4*(2), 166-177.

Shrestha, A., Anderson, A., & Moore, D. W. (2013). Using point-of-view modeling and forward chaining to teach a functional self-help skill to a child with autism. *Journal of Behavioral Education 22(*2), 157-167. doi: 10.1007/s10864-012-9165-x

Simpson, R. (2005). Evidence-based practices and students with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 20*(3), 140-149. doi: 10.1177/10883576050200030201.

Tetreault, A.S. & Lerman, D.C. (2010). Teaching social skills to children with autism using point-of-view video modeling. *Education and Treatment of Children, 33*(3), 395-419.

Van der Meer, L., Achmadi, D., Cooijmans, M., Didden, R., Lancioni, G.E., O'Reilly, M.F., Roche, L., Stevens, M., Carnett, A., Hodis, F., Green, V.A., Sutherland, D., Lang, R., Rispoli, M., Marschik, P.B., & Sigafoos, J. (2015). An iPad-based intervention for teaching picture and word matching to a student with ASD and severe communication impairment. *Journal of Developmental and Physical Disabilities, 27*, 67-78.

Wang, H. & Koyama, T. (2014). An analysis and review of the literature and a three-tier video modeling intervention model. *Research in Autism Spectrum Disorders, 8*, 746-758. http://dx.doi.org/10.1016/j.rasd.2014.03.010

West, E. A. (2008). Effects of verbal cues versus pictorial cues on the transfer of stimulus control for children with autism. *Focus on Autism and Other Developmental Disabilities, 23*(4), 229-241. doi: 10.1177/1088357608324715.

Wolf, M.W. (1978). Social validity: The case for subjective measurement *or* How applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, *11*(2), 203-214.

Wu, P.F., Cannella-Malone, H.I., Wheaton, J.E., & Tullis, C.A. (2016). Using video prompting with different fading procedures to teach daily living skills: A preliminary examination. *Focus on Autism and Other Developmental Disabilities*, *31*(2), 129-139.

Yakubova, G., Huges, E.M., & Hornberger, E. (2015). Video-based interventions in teaching fraction problem-solving to students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45* 2865-2875 doi: 10.1007/s10803-015-2449-y