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Using video modeling to teach academic skills to students with disabilities: a review of the literature

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Abstract
Video modeling is an instructional method that can facilitate therapeutic changes across a variety of student behaviors in a cost- and time-efficient manner. The majority of existing video modeling research has targeted social and functional skill development whereas few studies have used video modeling interventions to increase the academic skills of learners with disabilities. The purpose of this systematic review of the literature is to consolidate and examine the research that has been conducted on the use of video modeling to increase the academic skill repertoires of students with disabilities. This review serves as a resource for practitioners that are considering implementation of video modeling interventions to increase their students' academic skills. Furthermore, this review serves as a reference for researchers to identify existing academic video modeling studies for systematic replication in order to extend the literature base. Finally, this paper describes and analyzes the identified studies with respect to limitations and future research directions.

Keywords: Video Modeling, Video-Based Instruction, Students with Disabilities, Special Education, Instructional Methods.

1. Introduction

Video modeling (VM) is a form of instruction that involves showing a student a model engaging in a correct demonstration of a target behavior via video format. Video-based instruction applies the concepts of social learning theory in which individuals are believed to learn through a combination of observation and vicarious reinforcement (Bandura, 1997; Baker, Lang, & O'Reilly, 2009) [4, 5]. VM interventions are capable of facilitating therapeutic changes across a variety of student behaviors in a cost- and time-efficient manner (Simpson, Langone, & Ayres, 2004; Wilson, 2013) [44, 46]. The effectiveness of VM can be attributed to a variety of the intervention's attributes such as: targeted skills are modeled in relevant environments (e.g., classrooms, home, playground, cafeteria), salience of stimuli, the flexible nature of video formatting promotes individualization, increased independence (i.e., the learner does not rely on adults or peers to provide support), and the presentation of the skill being taught is consistently accurate (Baker *et al*., 2009; Wilson, 2013) [4, 46].

Three variations of VM have been identified in the literature. The first variation, video modeling other (VMO), involves creating video footage depicting peers and/or adults (i.e., anyone other than the participant) engaging in a correct demonstration of the targeted behavior (Mason, Ganz, Parker, Burke, & Camargo, 2012) [30]. VMO interventions can be used when the learner does not have the targeted behavior in his/her repertoire; therefore, a model that demonstrates competency with the skill is used in order to obtain video footage.

Video self-modeling (VSM), involves creating video footage of the learner modeling a correct target behavior his/herself (Dowrick, 1999; Hitchcock *et al*., 2003; Collier-Meek, Fallon, Johnson, Sanetti, & Delcampo, 2012) [18, 15, 25]. VSM is considered a strength-based intervention as video footage focuses on existing skills, or approximations of said skills, in order to increase the likelihood of future occurrences of the target behavior (Bellini & McConnell, 2010) [7]. VSM interventions can be used when the learner is able to demonstrate the target behavior with adult prompting. When adult prompting or modeling is used to elicit the target behavior, the footage is then edited so that the video only depicts the learner accurately demonstrating the behavior. VSM interventions are also used when the student demonstrates the target behavior in one setting, but not another. If the goal of intervention is to generalize a behavior across settings, practitioners can embed footage of the student demonstrating the target behavior in one setting (e.g., the student's home) within footage of the student in a target setting (e.g., the student's classroom). The editing techniques discussed above are referred to as feed forward VSM. Video self-modeling interventions may also be used if the student demonstrates the target behavior, but at an undesirably low frequency. Under these circumstances, the teacher would obtain footage of several demonstrations of the target behavior to then show to the student as part of an intervention. Showing the student the VSM footage could be paired with instruction and/or reinforcement in order to increase the frequency of the target behavior. Collecting and combining footage depicting optimal occurrences of the behavior is referred to as positive self-review VSM.

The third variation of VM, referred to as point-of-view video modeling (POV) involves showing the learner a first-person perspective video of a target task being completed (Shrestha, Anderson, & Moore, 2013) [41]. Essentially, POV video footage depicts the behavior occurring as the learner would see it when completing the task independently (Shrestha *et al*., 2013) [41]. POV is typically used when the target behavior involves fine motor movements, or if the student receiving intervention is distractible and would benefit from a reduction in inessential stimuli in the video (Hine and Wolery 2006; Shipley-Benamou *et al*. 2002; Mason, Davis, Boles, & Goodwyn, 2013) [24, 29, 40].

VM interventions have been used with students of various ages (Clare, Jenson, Kehle, & Bray, 2000; Rickards-Schlichting, Kehle, & Bray, 2004) [13, 38] and disability types: selective mutism (Kehle, Madaus, Baratta, & Bray, 1998), [29], autism (Bellini, Akullian, & Hopf, 2007) [6], emotional/behavioral disorders (Baker *et al*., 2009; Goodwyn, Hatton, Vannest, & Ganz, 2013) [4, 20], Tourette's syndrome (Clarke, Bray, Kehle, & Truscott, 2001) [14] intellectual disabilities (Mechling & Hunnicutt, 2011) [34], and specific learning disabilities (Cihak & Bowlin, 2009) [11]. Additionally, VM has been demonstrated to be effective for teaching/increasing a variety of skills such as putting away groceries (Cannella-Malone *et al*., 2006), food preparation (Graves, Collins, & Shuster, 2005; Sigafoos, O'Reilly, and Cannella, 2005), washing dishes (Sigafoos *et al*., 2006), play and social skills (Tetreault & Lerman, 2010), independent living (Alberto, Cihak, & Gama, 2005; Hammond, Whatley, Ayres, & Gast, 2010; Le Grice & Blampied, 1994) [1, 22, 28], and on-task behaviors (Cihak, 2011; Cihak, Fahrenkrog, Ayres, & Smith, 2010; Schreibman, Whalen, & Stahmer, 2000) [10, 12].

The majority of existing VM research has focused on social and functional skill development whereas few studies have used VM interventions to increase the academic skills of learners with disabilities (Cihak & Bowlin, 2009; Prater, Carter, Hitchock, & Dowrick, 2012) [11, 37]. Baker *et al*. (2009) [4] conducted a meta-analysis of 16 studies targeting VM interventions for students with EBD. Of the 16 studies reviewed, dependent variables included appropriate peer-interactions, hitting, fidgeting, and on-task behavior; however, none of the studies targeted academic skill development for these students. All of the targeted behaviors in the Baker *et al*. (2009) [4] study are critical for building social skill repertoires, but are not sufficient for promoting future academic success for students with EBD. This is particularly problematic because according to the National Center on Inclusive Education (2013), only 40% of students diagnosed with EBD graduate from secondary establishments, and approximately 52% of students with disabilities that drop out of high school are diagnosed with EBD. Based on these data, more research should target academic skill development as well as social skill development for students with EBD. In addition to the Baker *et al*. (2009) [4] publication, other reviews of the VM literature have also found that video-based interventions have primarily targeted social, functional, and communicative skill development as opposed to academics (Hitchcock *et al*., 2003; McCoy & Hermansen, 2007; Mechling, 2005) [25, 32, 33]. Prater *et al*. (2012) [37] conducted a literature review of VSM studies targeting academic performance. The authors' review indicated that positive gains can be made for students with disabilities when practitioners utilize VSM interventions. Despite the valuable information presented by Prater and colleagues (2012) [37], some limitations were apparent. First, only studies using VSM as the primary intervention were examined. No attention was provided to the other two variations of VM intervention: VMO and POV. Furthermore, two of the eight studies reviewed by the authors measured the effectiveness of VSM for increasing on-task behaviors (e.g., eye-contact with the teacher, hand raising). Again, these task-oriented behaviors are critical social skills for students, but are not sufficient for increasing academic performance. Irrespective of the aforementioned limitations, the review conducted by Prater *et al*. (2012) [37] was informative and challenged researchers to expand the literature base of VM studies targeting academic performance improvement. This synthesis of the literature will not only include the variations of VM (VMO and POV) excluded by Prater *et al*. (2012) [37], but will examine similar studies conducted in the years following the publication of the aforementioned review.

It seems intuitive that students with academic deficits could benefit from VM based on the well-documented effectiveness and the many advantageous attributes of the intervention (e.g., salience of stimuli, reduction of distracting stimuli, and the capacity for individualization). Moreover, the advancements of modern mobile technology (e.g., tablets, netbook computers, iPods) allow practitioners to implement VM interventions that are transportable, potentially motivating, and non-stigmatizing. Further, the stage is set for practitioners to utilize video-based interventions due to the current movement of including technology in the classroom to augment academic instruction (Cihak and Bowlin 2009; Prater *et al*., 2012) [11, 37].

The purpose of this review of the literature is to consolidate and examine what research has been conducted on the use of the three variations of VM to increase the academic skill repertoires of students with disabilities. Based on the relative paucity of research in the aforementioned area, this review is important as it creates a resource for practitioners that are considering VM interventions to increase academic skill for their students. Furthermore, this review serves as a reference for researchers to identify existing academic VM studies for systematic replication in order to extend the literature base.

2. Method

To identify relevant studies, a computer-based search was implemented via the search engine Galileo, using the advanced search features Academic Search Complete, ERIC, and EBSCO Host. Various combinations of the search terms "academic," "video modeling," "math," "reading," writing," and "students with disabilities" were used. After locating initial publications, an ancestral search of each study's references was conducted in order to identify related articles. This method yielded 26 data-based studies, which were then analyzed according to specific inclusionary criteria: (1) the study was data-based and published in a peer-reviewed journal, (2) the primary dependent variable was an academic task, (3) the independent variable involved any form of VM in isolation or as part of an intervention package, (4) participants in the study were identified as having a disability or academically low-performing, and (5) the article was written in English. Application of these criteria yielded 11 relevant data-based studies.

The identified studies were organized by academic areas targeted by VM interventions: reading, mathematics, writing, language arts, and science. Of the targeted studies, five focused on reading, two on mathematics, two on writing, one on language arts, and one on science. Table 1 displays summary information for all identified VM studies that targeted academic skill development. Within the table, studies are organized chronologically by publication date. For more in-depth information regarding the included studies, readers are encouraged to use the table and references section to identify and locate the original article for further reading.

3. Results

4. Participants and Dependent Variables

The 11 studies reviewed included a total of 48 participants aged 4 through 18 years who were identified as having disabilities (Burton, Anderson, Prater, & Dyches, 2013; Cihak & Bowlin, 2009; Decker & Buggey, 2014; Delano, 2007; Hart & Whalon, 2012; Hitchock, Prater, & Downrick, 2004; Marcus & Wilder, 2009; Mechling & Hunnicutt, 2011; Moore *et al*., 2013) [8, 11, 16, 17, 23, 26, 31, 34, 35] or demonstrating low academic achievement (Ayala & Connor, 2013; Dowrick, Kim-Rupnow, & Power, 2006; Schunk & Hanson, 1989) [3, 19, 41]. Academic skills targeted included reading fluency and comprehension (Ayala & Connor, 2013; Decker & Buggey, 2014; Dowrick *et al*., 2006; Hitchcock *et al*., 2004) [3, 19, 26], letter identification (Marcus & Wilder, 2009) [31], essay writing (Delano, 2007) [17], letter writing (Moore *et al*., 2013) [35, 41] language arts skills (Mechling & Hunnicutt, 2011) [34], money skills (Burton *et al*., 2013) [8] geometry skills (Cihak & Bowlin, 2009) [11] and science conceptual knowledge (Hart & Whalon, 2012) [23].

5. Reading

Five of the 11 studies indicated that VM interventions can improve reading skills of students with disabilities. Four of the studies used VM to enhance oral reading fluency (Ayala & Connor, 2013; Decker & Buggey, 2014, Dowrick *et al*., 2006; Hitchcock *et al*., 2004) [3, 16, 19, 26], one study used VM to teach reading comprehension in addition to fluency (Hitchcock *et al*., 2004) [26] and one study used VM to teach novel letters (Marcus & Wilder, 2009) [31].

Hitchcock *et al*. (2004) [26] examined the effectiveness of VSM combined with tutoring on teaching reading fluency and comprehension to four participants (ages 6 – 7 years). Two of the participants were diagnosed with SLD, one with a Developmental Delay, and one was low-achieving in reading (this participant was referred for special education services during the course of the study). A multiple baseline design across behaviors (fluency and comprehension) was used. The design included six phases for each target behavior including: baseline, tutoring only (targeting fluency), tutoring combined with VSM (fluency), tutoring only (targeting comprehension), tutoring combined with VSM (comprehension), and a follow-up/maintenance phase for both behaviors. Participants received intervention daily for 30 min during each phase in a pull-out classroom. Two 2-minute videos were created for each participant, one depicting the student reading a 100-word instructional-level passage with adult support, and one depicting the student accurately using a story map for comprehension with adult support. During tutoring combined with VSM conditions, the participant and tutor would view the corresponding video (fluency or comprehension) prior to the tutoring session which involved reading the passage used in the video. Results indicated that reading fluency, which was measured in correct words read per minute (CWPM), doubled for three of the participants and quadrupled for the fourth by the end of eight weeks. Reading comprehension, measured in number of correct responses, reached pre-established mastery criteria for all participants. Follow-up data collected 1 and 6 months later indicated that both reading fluency and comprehension skills were maintained and generalized to the general education classroom.

Dowrick *et al*. (2006) [19] investigated the effects of VSM and tutoring on the reading fluency of 10 students (ages 6 – 7 years) identified as Low-Achieving (LA) in reading. A multiple baseline

Table 1: Description of Data-Based Studies Targeting Academic Skill Development Using Video Modeling

Reference	n	Age	Special Needs	Independent Variable	Dependent Variable	Research Design	Results
Hitchcock, Prater, & Dowrick (2004) [26]	4	6 – 7 years	SLD (n =2) DD (n = 1) LA (n = 1)	VSM combined with tutoring	Reading fluency: CWPM Reading comprehension: number of correct responses	Multiple baseline design across behaviors (fluency, comprehension)	Following intervention, fluency and comprehension increased for all participants
Dowrick, Kim-Rupnow, & Power (2006) [19]	10	6 – 7 years	LA	VSM combined with tutoring versus tutoring only	Reading fluency: CWPM	Multiple baseline across participants combined with an A-B-BC-B design (baseline, tutoring, tutoring + VSM, tutoring)	Reading fluency improved for all students following each intervention; however, fluency gains were higher during the VSM + tutoring condition for nine participants
Delano (2007) [17]	3	10 years	Asperger Syndrome	VSM combined with SRSD	Writing: Number of written words and number of functional essay elements (e.g., premise, elaboration, conclusion)	Multiple baseline across behaviors (words written and functional essay elements)	All participants increased the number of words written and number of functional essay elements included on persuasive essays following intervention

Note. SLD = Specific Learning Disability; VSM = Video Self-Modeling; VMO = Video Modeling Other; DD = Developmental Delay; LA = Low-Achieving; CWPM = Correct Words Per Minute; SRSD = Self-Regulated Strategy Development.

Table 1: Description of Data-Based Studies Targeting Academic Skill Development Using Video Modeling (Continued)

Reference	n	Age	Special Needs	Independent Variable	Dependent Variable	Research Design	Results
Cihak & Bowlin (2009) [11]	3	15 – 18 years	SLD	VMO	Mathematics: Percentage of geometry problems (calculating the perimeter of squares/rectangles, triangles/trapezoids and polygons) solved correctly	Multiple probe across behaviors (three types of geometry perimeter problems)	The percentage of accurate geometry problems completed increased to mastery level after introduction of the intervention for all participants
Marcus & Wilder (2009) [31]	3	4 – 9 years	ASD	VMO compared to VSM	Reading: Identification of novel letters	Combined multiple baseline across participants and multi-element to compare VMO to VSM	All participants demonstrated mastery of identifying novel letters during VSM condition. Only 1 participant demonstrated identification mastery during VMO condition
Mechling & Hunnicutt (2011) [34]	3	7 - 8 years	MOID	VSM, computer presentation of photographs with prepositional captions, and a constant time delay prompting procedure	Language Arts: Receptive identification of prepositions (i.e., touching a picture correlated to a verbally presented preposition)	Multiple probe design within participants across three pairs of prepositions (on/under; in/next to; in front of/behind)	All participants mastered the receptive identification of the three prepositional pairs following introduction of the intervention package

Note. ASD = Autism Spectrum Disorder; MOID = Moderate Intellectual Disability; SLD = Specific Learning Disability; VSM = Video-Self Modeling; VMO = Video Modeling Other.

Table 1: Description of Data-Based Studies Targeting Academic Skill Development Using Video Modeling (Continued)

Reference	n	Age	Special Needs	Independent Variable	Dependent Variable	Research Design	Results
Hart & Whalon (2012) [23]	1	16 years	ASD, MOID, and OHI (hearing impairment)	VSM	Science: Number of accurate, unprompted academic responses during science lessons (e.g., classification of organisms)	ABAB Reversal Design	The participant increased the number of accurate, unprompted academic responses during VSM intervention
Ayala & Connor (2013) [3]	10	6 - 7 years	LA	VSM	Three reading fluency measures: Decoding, Sightwords, and Nonsense Words (number correct per minute for all)	Multiple baseline across participants	All participants demonstrated an increased rate in accurate decoding skills and sight word recognition following intervention
Burton, Anderson, Prater, & Dyches, (2013) [8]	4	13 – 15 years	ASD (n = 3) ID (n = 1)	VSM	Mathematics: Percentage of steps completed accurately for solving word problems involving money skills	Multiple baseline across participants	The percentage of steps completed accurately increased immediately following intervention for each participant

Note. ASD = Autism Spectrum Disorder; MOID = Moderate Intellectual Disability; OHI = Other Health Impairment; LA = Low-Achieving; VSM = Video Self-Modeling.

Table 1: Description of Data-Based Studies Targeting Academic Skill Development Using Video Modeling (Continued)

Reference	n	Age	Special Needs	Independent Variable	Dependent Variable	Research Design	Results
Moore *et al*. (2013) [35, 41]	1	5 years	ASD	POV, backward chaining, reinforcement menu, and a token economy	Writing: independent, accurate production of letters in the participant's name	Multiple baseline across behaviors (each letter treated as a behavior)	Introduction of the intervention package resulted in increased accurate production of all handwritten letters for the participant
Decker & Buggey (2014) [16]	6	8 – 12 years	SLD	VSM versus VMO	Reading fluency: CWPM	Multiple baseline across participants	Reading fluency increased for all participants in both conditions (VSM and VMO)

Note. SLD = Specific Learning Disability; ASD = Autism Spectrum Disorder; VSM = Video Self-Modeling; VMO = Video Modeling Other; POV = Point of View Video Modeling; CWPM = Correct Words Per Minute.

across participants with a combined A-B-BC-B (baseline, tutoring only, tutoring combined with VSM, tutoring only) design was used. During the tutoring phases of treatment, participants received individualized instruction from trained adults for approximately 25 minutes a day, four days a week. Tutoring sessions involved unison reading, echo reading, and sightword drill and practice. During tutoring combined with VSM treatment phases, students were shown feed-forward videos of themselves accurately reading difficult (instructional level) text and correctly identifying sight words prior to daily tutoring sessions. The aforementioned footage was obtained from echo reading conducted during previous tutoring sessions in which the participant would imitate the tutor's reading. The footage was then edited so that only the accurate reading of the participant was depicted on the video. Results indicated that all participants' CWPM improved during treatment conditions indicating that VSM and tutoring were both effective reading fluency interventions; however, the daily rate of fluency gains was greatest during the VSM combined with tutoring condition as indicated by a greater slope in CWPM.

Marcus and Wilder (2009) [31] examined the effects of VSM compared to VMO on teaching novel letters to three participants (ages 4 – 9 years) with autism. A multiple baseline across participants design was combined with a multi-element design to compare participants' letter-identification performance in the VMO and VSM conditions. Intervention occurred at home for two of the participants and in a separate room at a preschool for one participant. The participants primary language was English, but to control for individual learning histories and incidental learning during the study, participants were taught Greek and Arabic letters. Researchers created two videos for each participant. The first video depicted a typically-developing peer providing an accurate letter-identification response following a teacher prompt (VMO). The other video showed the participant providing a correct letter-identification response following a teacher prompt (VSM); this video was created by editing out footage of the teacher providing support. For both the VMO and VSM sessions, a total of five trials, with each trial depicting a different letter or series of letters, were depicted on the video. During alternating sessions, participants were shown either the VMO or VSM videos and then asked to identify the same letters depicted in the video. Results indicated that all three participants demonstrated mastery of novel letter-identification during the VSM condition. Only one participant demonstrated mastery during the VMO condition; however, this participant reached mastery faster during the VSM condition. The authors suggested that VSM is potentially the superior intervention for teaching letter-identification to students with autism.

Ayala and Connor (2013) [3] utilized a multiple baseline across participants design to investigate the effects of VSM and adult tutoring on three reading fluency measures (decoding, sight word recognition, and nonsense word decoding) for 10 students (ages 6 – 7 years) who were identified as LA in reading. Intervention occurred for all participants in a one-to-one setting with an adult tutor in a private room. First, researchers created VSM footage by taping sessions in which the tutor prompted students to accurately respond on decoding, sight word, and nonsense word decoding tasks. Next, the footage was edited by removing tutor prompting and modeling so that the video depicted the student "independently" providing accurate responses. Students viewed the videos at least four times per week prior to routine tutoring sessions. Results indicated all participants demonstrated increased rates of accurate decoding, sight word recognition, and nonsense word decoding following the introduction of intervention. A 2-week posttest maintenance assessment showed retention or increases in the targeted skill areas for seven of the 10 participants.

Decker and Buggey (2014) [16] used a multiple baseline across participants to examine the effects of using VSM compared to VMO on the reading fluency (CWPM) of six students (ages 8 – 12 years) with SLD. Data collection occurred during three phases in this study: baseline, intervention, and follow-up/maintenance. Participants were assigned to either a VSM (n = 3) or VMO (n = 3) group. Researchers created video footage for the VSM group using footage of the students during echo reading tutoring sessions; all prompting and modeling was edited out so that only accurate reading footage of the participant was depicted. During intervention, participants viewed their video once daily in a one-on-one instructional format before a reading probe was administered. During the maintenance condition, VM intervention was withdrawn, and measures of reading fluency were collected similarly to the previous conditions. Results indicated that CWPM increased for all participants in both conditions proving that both VSM and VMO are potentially effective reading fluency interventions for students with SLD; however, two of the participants more than doubled their reading fluency rates during intervention in the VSM group. Follow-up data indicated that all participants maintained increased fluency rates after intervention was withdrawn.

7. Math

Two of the 11 studies indicated that VM interventions can effectively teach/enhance mathematics skills of students with disabilities. One study used VM to teach geometry skills (Cihak & Bowlin, 2009) [11], and one study used VM to teach problem solving skills involving money (Burton *et al*., 2013) [8].

Cihak and Bowlin (2009) [11] investigated the effectiveness of using VMO (with a teacher model) to teach geometry skills (finding the perimeter of: squares/rectangles, triangles/trapezoids, and polygons) to three students (ages 15 – 18 years) with SLD. A multiple probe across behaviors (the three types of geometry perimeter problems) design was used. Intervention occurred daily prior to the beginning of the school day during a tutoring program. Videos were created of the teacher providing verbal step-by-step directions while completing the steps necessary to accurately calculate the perimeter of squares/rectangles, triangles/trapezoids, and various polygons. After the construction of the videos, participants were taught how to operate handheld computers and access the instructional videos. During daily sessions, participants were instructed to watch a specified video of one of the targeted tasks, and then complete a corresponding 10-problem assignment independently. If participants made errors, they were instructed to view the video again and make corrections to the assignment. Once a participant demonstrated mastery in one behavior (e.g., calculating the perimeter of squares/rectangles), the student would move to the next video depicting a different target skill (e.g., calculating the perimeter of triangles/trapezoids). Results indicated that the percentage of accurately completed geometry problems increased to mastery levels almost immediately following the introduction of the intervention for all three participants.

Burton, Anderson, Prater, and Dyches (2013) [8] used a multiple baseline across participants design to investigate the effectiveness of using VSM and a token economy to teach mathematics problem solving skills to four participants (ages 13 – 15 years). Three of the four participants were diagnosed with ASD, and one was diagnosed with ID. All intervention sessions occurred twice daily for four days week in a partitioned section of the resource room in which the participants typically received instruction. Feed forward VSM videos were created by presenting participants with a script for a seven-step task analysis used for calculating amounts of change when presented with word problems involving money. During videotaping sessions, the classroom teacher prompted participants to read the steps and solve the word problem. The teacher provided prompting and modeling to ensure that the participants correctly solved the word problem. Participants were prompted through five word problems involving money, resulting in five individualized videos for each participant. Researchers then edited the videos so that no adult prompting was contained in the footage. Videos depicting the participants reading the task analysis and accurately completing the steps were approximately 3 to 5 min in length.

During intervention, the participants would view one of the VSM videos via an iPad, and then complete the same problem on paper. Students were allowed to view the video as often as necessary in order to solve the word problem. This sequence was used for five word problems. During intervention, the teacher did not provide assistance on the math word problems. Results indicated that the percentage of steps completed accurately increased to near-mastery levels immediately following intervention for each participant. During follow-up sessions, the number of video models used was gradually reduced, yet participants maintained mastery-level responding on the word problems.

8. Writing and Language Arts

Three of the 11 studies indicated that VM interventions can be effective for teaching writing and language arts skills such as: essay writing (Delano, 2007) [17], receptive identification of prepositional phrases (Mechling & Hunnicutt, 2011) [34], or letter writing (Moore *et al*., 2013) [35, 41].

Delano (2007) [17] investigated the effectiveness of using VSM, Self-Regulated Strategy Development (SRSD) and goal setting to teach written composition skills to three participants (age 10 years) with Asperger Syndrome. A multiple baseline across behaviors (total words written and functional essay elements included) was used to evaluate the effects of the intervention. All intervention sessions occurred in a room separate from each participant's classroom in a one-on-one format. Data were collected on the number of words written per session as well as the number of functional essay elements included in each participant's written response to a persuasive essay topic. Researchers created two feed for ward VSM videos for intervention. The first video contained footage of each participant reading a self-management script that included the following strategies: counting the number of words in a student-created essay, graphing the number of words on a chart, determining if their goal was met, and setting a goal for next time. After participants increased their total number of words written by 10%, that intervention was faded. The second video showed footage of the participant modeling the TREE strategy (note the Topic sentence, note Reasons, Explain each reason, not the Ending) for writing a persuasive essay. Results indicated that all participants increased the number of words written and number of functional essay elements included on persuasive essays following the introduction of intervention. Maintenance data, obtained 1 week and 3 months following intervention, indicated that written performance decreased from treatment levels for each participant, yet remained higher than baseline levels.

Mechling and Hunnicutt (2011) [34] examined the effectiveness of using an intervention package consisting of feed for ward VSM, computer presentation of photographs with captions, and a constant time delay procedure to teach receptive identification of prepositions to three students (ages 7 – 8 years) with MOID. Intervention sessions occurred in a one-on-one format, within a self-contained classroom, one to two times a day, four to five days a week, and were 5 – 15 min in length. Researchers created VSM footage by prompting students to position themselves or objects according to target prepositions (on/under, in/next to, in front of/behind). After the footage was obtained, the researchers edited out any teacher assistance so that participants only saw themselves engaging in the accurate prepositional positioning. Pictures were also taken of the participants or objects in the prepositional positions. During intervention, students were shown three photographs on a computer. Initially, the instructor asked participants to touch the picture representing a specific preposition and immediately provided a gestural prompt to the correct picture (0-sec time delay procedure). After touching the correct photograph, a video would play showing the student modeling the corresponding preposition. After the student had demonstrated mastery at the 0-sec delay level, the instructor used a 3-sec delay and error correction if necessary. Results indicated that all participants mastered the receptive identification of the three prepositional pairs following introduction of the intervention package.

Moore *et al*. (2013) [35, 41] examined the effectiveness of using POV, backward chaining, and reinforcement to teach a participant (age 5 years) with ASD to write her name. A multiple baseline across behaviors (writing each letter was treated as a behavior) design was used. Intervention occurred within the participant's home twice a day, four times a week, and sessions were 15 – 25 min in length. During intervention, researchers used a video that depicted the first four letters of the participant's name (her name contained five letters) and a first-person perspective model of the last letter being written. After the participant demonstrated mastery writing the final letter of her name, a new video was used that showed only the first three letters of her name and a first-person perspective model of the last two letter being written in. This sequence continued until each letter was faded and the participant was required to write her name with no letters (backward chaining). The videos ranged in length from 1 – 4 min based on the number of letters written in the video. Additionally, a reinforcer menu and token economy (flower stickers with Velcro backs and a laminated chart) were introduced during the intervention when diminishing productivity from the participant was observed. Results indicated that the intervention was successful for teaching the participant to write her name accurately and independently.

9. Science

One of the 11 studies indicated that VSM interventions can have positive effects on science performance for students with disabilities (Hart & Whalon, 2012) [23].

Hart and Whalon (2012) [23] used an ABAB reversal design to examine the effects of feedforward VSM on the number of accurate, unprompted academic responses during science lessons of one participant (age 16 years) with ASD, MOID, and a hearing impairment. Intervention occurred in a group setting of 18 students in a resource classroom four days a week. Video footage was obtained of the participant being asked science questions from the teacher (e.g., “give me an example of a reptile”) and then being prompted to provide an accurate response (e.g., “snake”). This process was repeated in order to obtain footage of the participant answering a variety of science-related questions. Researchers then removed the teacher verbal prompts from the video and had the participant viewed the edited 1-minute video three times prior to the beginning of science class. Results indicated that the participant increased the number of accurate, unprompted academic responses during both VSM intervention conditions and decreased responses when VSM was withdrawn (i.e., indicating a functional relation between the VSM intervention and the increased independent academic responses during science lessons).

10. Conclusion and Recommendations

The majority of current empirical literature utilizing VM has targeted functional living skills or social skills improvement; consequently, there is a dearth of research targeting academic skill development using video modeling (Burton *et al*., 2013; Cihak & Bowlin; Prater *et al*., 2011) [8, 11]. This review of the literature presents compelling evidence that the use of VM interventions can yield positive effects on the academic skill development of students with disabilities. Horner *et al*. (2005) [27] provided the following indicators for an intervention to be determined an evidence-based practice in single-case design research: 1) the intervention has been documented in a minimum of five single-case design studies meeting acceptable methodological criteria, demonstrating experimental control, and publish in peer-reviewed journals 2) the studies targeting the intervention have been conducted by at least three independent researchers across at least three different geographical locations 3) the five or more studies targeting the intervention have included a total of at least 20 participants. Based on aforementioned indicators, using VM to teach academic skills meets the criteria for an evidence-based practice with a total of 11 peer-reviewed single-case studies, 10 independent groups of researchers, and a total of 48 participants.

Regardless of the evidence base corroborating the effectiveness of VM for teaching academic skills, some limitations in the reviewed research are apparent. First, the existing peer-reviewed studies using VM to enhance academic skill repertoires have targeted only a small number of the academic tasks in which students with disabilities are required to demonstrate competency. Future research should apply the variations of VM to various academic skill sets in mathematics (e.g., computation, conversions, patterns, and algebraic functions), written expression (e.g., paragraph and sentence formation across different genres), reading comprehension (e.g., vocabulary), science (vocabulary, chemistry equations, formulas), and history (e.g., vocabulary, themes, critical dates).

Researchers should also investigate the effectiveness of VM interventions to teach academic tasks across a variety of populations. The majority of studies in this review utilized VM with students with SLD, ASD, ID, or who demonstrated low-achievement in an academic area. Future studies should seek to use VM interventions to enhance the academic skills in other disability areas such as EBD and ADHD.

The majority of studies reviewed herein are limited primarily to elementary-age students (i.e., 5 – 12 years). of the 12 reviewed studies, only three targeted students in secondary settings (Burton *et al*., 2013; Cihak & Bowlin, 2009; Hart & Whalon, 2012) [8, 11, 23]. Academic success is paramount for students with disabilities at all levels; therefore, research should extend the literature to include the effectiveness of VM interventions on the academic skill repertoires of adolescent students with disabilities.

Many of the studies in this review implemented intervention in analog environments (i.e., one-to-one formats in a separate room outside of the participants’ regular classroom). Though the VM interventions were effective in facilitating skill acquisition in the controlled settings, the question remains regarding the effectiveness of the intervention in the participants’ natural learning environments. Future researchers should implement VM supports within group settings and the students’ natural environments to increase the social validity and reliability of the targeted interventions.

Furthermore, modern mobile technology has become progressively more advanced over the course of the past decade; therefore, future research should seek to utilize compact mobile technology and VM in order to maximize student academic success using transportable, potentially motivating, and non-stigmatizing devices (e.g., iPads, iPods, and netbook computers).

Despite some limitations and a need for continued research, the results of this review of the literature provide convincing evidence of the potential utility of VM as a valuable strategy for improving the academic performance of students with disabilities.

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