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The Effects of Video Self-Modeling on the Math Performance of Adolescents with Developmental Disabilities

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Master of Science

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ABSTRACT

The Effects of Video Self-Modeling on the Math Performance of
Adolescents with Developmental Disabilities

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The current study examined the effects of video self-modeling (VSM) via an iPad on the mathematics performance of students with developmental disabilities. The learning task was presented from the consumers' point of view; students learned to estimate the amount of money they should use to pay for a given item and the amount they should receive back to help ensure that they are treated honestly by merchants. Through VSM, video clips showing the step-by-step problem solving process were synchronized onto an iPad. Students were shown how to use the iPad and access the video clips in order to watch themselves successfully solving the story problems. Experimental effects were evaluated within a multiple baseline design. Results indicated a functional relationship between math performance and VSM via an iPad and extended previous research by demonstrating the successful acquisition of functional math skills by students with developmental disabilities. Intervention effects were maintained for three weeks following the removal of the intervention. Implications for research and practice are discussed.

Keywords: Developmental Disabilities, Autism, Intellectual Disabilities, Video-Self Modeling, Mathematics

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DESCRIPTION OF THESIS STRUCTURE

This thesis, *The Effects of Video Self-Modeling on the Math Performance of Adolescents with Development Disabilities,* is written in a hybrid format. The hybrid format brings together traditional thesis requirements and journal publication formats.

The preliminary pages of the thesis reflect requirements for submission to the university. The thesis report is presented as a journal article and conforms to length and style requirements for submitting research reports to education journals. The literature review is included in Appendix A. Appendix B is an assessment checklist used by the researcher. A curriculum-based assessment can be found in Appendix C. The worksheets used by students during the study are in Appendix D. Appendix E includes the scoring form used during baseline, intervention, and maintenance phases. Specific behavioral praise statements that could be used during the study are found in Appendix F. Scripts used by the students to create the video self-models are located in Appendix G. Appendix H includes the treatment fidelity checklist, and found in Appendix I are the social validity questionnaires given to the research assistants and participants.

This thesis contains two reference lists. The first reference list (p. 28) contains references included in the journal-ready article. The second list includes all citations used in both the journal-ready article and the section entitled “Review of the Literature.”

Background

Over the last two decades, opportunities for students with developmental disabilities, including autism and intellectual disabilities, to participate more fully in the core curriculum have greatly increased (Hardman, Drew, & Egan, 2008). In the past, students with disabilities were often described with terminology that communicated a sense of hopelessness and despair (Hardman et al., 2008). Fortunately, this is not the case today. Students with disabilities are no longer referred to by their disabilities but by their abilities. Education has moved from a "disability-centered" mindset to "person-centered" mindset. Teachers are trained, for example, to say "a child with autism" instead of "an autistic child." Focusing on the individual is an important aspect of special education.

Students with Intellectual Disabilities

To qualify for special education services, persons with disabilities must be identified with a specific educational classification. The term *intellectual disability* is a categorical definition of disability expressed in federal regulations, including the Individuals with Disabilities Education Act (IDEA), and is a commonly used term to describe the population targeted in the present research (Hardman et al., 2008). According to the American Association on Intellectual and Developmental Disabilities (AAIDD), "Intellectual disability [is] characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social and practical adaptive skills. This disability originates before age 18" (AAIDD [AAMR], 2002, p. 1). Students with developmental disabilities require highly specialized education and related services in order to benefit from their educational experience. Necessary accommodations are often not readily available in the general education environment.

Students with Autism

Students with autism are also targeted in the current research. Autism is characterized by marked impairment in reciprocal social interaction that may impact both verbal and nonverbal behavior. The disorder is manifest by developmental delay or abnormal functioning before age three and adversely affects educational performance (American Psychiatric Association, 1994). Students with autism often struggle with communication, change in routines, and self-stimulatory behavior (American Psychiatric Association, 1994).

In recent years the incidence of autism has become more prevalent (Mastropieri & Scruggs, 2010). Due to the increasing diversity of this population, research is needed to identify interventions addressing a wide variety of learning needs. For example, investigations assessing the effects of instructional strategies to help children with autism spectrum disorders (ASD) access core curriculum would be beneficial (Knight, Smith, Spooner, & Browder, 2011). In addition, there is a need to establish evidence-based practices to provide high quality instruction to students with ASD.

The Role of Special Education

Special education is defined by law as "specially designed instruction, at no costs to the parents, to meet the unique needs of a student with a disability" (United States Code, 20 U.S.C. §1401 (29)). Related services in general are "transportation, and such developmental, corrective, and other supportive services…designed to enable a child with a disability to receive a free appropriate public education as described in the individualized education program of the child" (United States Code, 20 U.S.C. §1401 (26)). Special education is a support service for schools, designed to help facilitate students' success.

Another key element of special education is to facilitate improved quality of life and promote independence for students with disabilities. The long-term outcomes for students with

developmental disabilities are a driving force in their education and individualized education plans (IEP). In addition to learning core curriculum skills, throughout their elementary and secondary schooling, students with developmental disabilities learn skills that will help them to reach the highest level of independence possible. Some of these may include functional, adaptive, daily living, and social skills.

The Influence of Recent Legislation on Educational Practice

Recent changes in federal law regarding educational opportunity for students with disabilities have additionally led to important advances in educational practice. For example, the Individuals with Disabilities Education Improvement Act of 2004 (IDEIA, U.S. Department of Education, 2004) and the No Child Left Behind Act of 2001 (NCLB, U.S. Department of Education, 2002) have placed increased emphasis on access to core curriculum as well as improved learning outcomes for students with developmental disabilities. In order to achieve the highest possible outcomes for all students with disabilities, innovative instructional methodologies are needed.

The achievement of high levels of performance is strongly linked to evidence-based practice, and single-subject research design is but one approach that may be used to establish evidence-based practices (Horner et al., 2005). Other recommended research approaches have included randomized controlled trials and quasi-experimental group studies (Odom et al., 2005). Even though a large number of effective interventions are now in use that were previously validated through scientific inquiry (Horner et al., 2005; Odom et al., 2005), there is a current need to experimentally examine the effects of instructional methods on the learning outcomes of all students (Browder & Cooper-Duffy, 2003).

Additional research is specifically needed to identify evidence-based practices to inform the teaching of academics to students with severe disabilities and to empirically examine academic core instruction for this population (Browder & Cooper-Duffy, 2003). Research is also needed to document the relationship between functional math and the core curriculum. Functional math focuses on teaching practical mathematics within real-life situations such as telling time, using money, and completing tasks related to measurement. Current research supports the idea that students with developmental disabilities need to receive instruction containing a blend of academic and functional math objectives (Browder & Cooper-Duffy).

The Impact of Technology on Education

Research has also shown that technology can increase opportunities for students with disabilities to access the core curriculum (Cihak & Bowlin, 2009). Recent advances in the use of technology in classrooms have included many new applications of video technology (Mechling, 2005). For example, video modeling has been effectively used to teach mathematics to students with learning disabilities (Cihak & Bowlin). Video modeling (VM) is an instructional technique that involves a student watching a video of a model (e.g., a peer or adult) engaging in target behaviors or skills; then the student performs those behaviors or skills (Cihak, Fahrenkrog, Ayres, & Smith, 2010).

Video self-modeling (VSM) is a specific application of video modeling, in which the individual observes himself or herself accurately and independently performing the target behaviors (Dowrick, 1999). It is a form of observational learning in which individuals view themselves performing a task at a more advanced level than they typically perform the skill (Buggey, Toombs, Gardener, & Cervetti, 1999). VSM has been used to teach a variety of skills including transitional behaviors (Cihak et al., 2010); social-communication, behavioral, and

functional/life skills (Bellini & Akullian, 2007; Buggey, 2007); perspective taking (Charlop-Christy & Daneshvar, 2003); communication, behavior, and academic performance (Hitchcock, Dowrick, & Prater, 2003). The effects of VSM have been assessed with students with emotional disturbances (e.g., Possell, Kehle, McLoughlin, & Bray, 1999), learning disabilities (e.g., Clare, Jenson, Kehle, & Bray, 2000), autism spectrum disorders (e.g., Shipley-Benamou, Lutzker, & Taubman, 2002), general education students (e.g., Hartley, Bray, & Kehle, 1998), and students with intellectual disabilities (e.g., Cihak, Kessler, & Alberto, 2007). However, no studies have been located involving the use of VSM to teach functional mathematics to students with developmental disabilities.

Video self-modeling has often been delivered through several media including (a) television and videocassette recorder, (b) laptop computer, (c) DVD, and (d) handheld device (e.g., video iPod) (Cihak et al., 2010). Handheld computers are one form of technology that has been shown to be effective for the delivery of VSM for individuals with disabilities in various settings (Cihak & Bowlin, 2009; Cihak et al., 2010).

Use of Technology to Enhance Math Instruction

A number of researchers have described specific ways in which technology can be used to support teacher instruction and improve math outcomes for students with disabilities. Examples of mathematical concepts include money skills, telling and managing time, problem solving, and computation skills (Cihak & Bowlin, 2009; Hardman et al., 2008). Schunk and Hanson (1989) used VSM to teach mathematical concepts to elementary school students identified as working below grade level in mathematics. Schunk and Hanson's study strengthens the evidence suggesting that VSM can increase students' academic performance during cognitive skill learning. Specific findings indicated that students who viewed themselves successfully

completing math problems performed at higher levels than students who did not watch the self-model. However, no studies have yet been conducted involving the use of VSM to teach mathematical skills to students with developmental disabilities.

Problem Statement

Research describes specific ways in which VM and VSM along with advances in technology have been used to support instruction and improve math outcomes for students with disabilities. Findings have additionally indicated positive effects for the use of VSM as a math intervention for students performing below grade level. However, additional research is needed to examine the use of VSM and handheld devices to teach mathematics to students with developmental disabilities.

Purpose of the Study

The purpose of the current research was to examine, in intervention and maintenance phases, the effects of VSM via an iPad on the mathematics performance of students with developmental disabilities.

Research Questions

Given specific behavioral objectives involving estimating and counting exact change, the following research questions were addressed:

1. During the intervention phase, what were the effects of VSM via an iPad on the math performance of students with developmental disabilities?
2. In the presence of similar but different stimuli (i.e., the inclusion of novel math problems during the maintenance phase), what were the effects of VSM via an iPad on the math performance of students with developmental disabilities?

Methods

The following paragraphs include a description of the participants, selection criteria, and setting in which the study was conducted. Data collection procedures, the research design, and reliability measures are also explained.

Participants

Contingent on parental consent, four students given the pseudonyms of Joey, Will, Ryan, and Aaron were selected to participate in the study. They were selected based on the following criteria: (a) junior high school enrollment, (b) disability based on eligibility requirements, (c) similar assessment results from selected math subtests of the BRIGANCE® Comprehensive Inventory of Basic Skills–Revised (CIBS–R; Brigance, 1999), (d) IEP math goals and objectives similar to the learning objective for the current study, (e) parental permission to participate in the study, including videotaping, (f) no hearing or vision impairments that might impede video instruction (selection criteria adapted from Cihak & Bowlin, 2009). It was assumed all of the students had functional reading skills and would be able to read the math story problems and instructions without direct instruction. Specific student characteristics are presented in Table 1.

Ryan, Aaron, and Will received daily mathematics instruction in a self-contained special education classroom for students with intellectual disabilities. Joey received daily mathematics instruction in a resource pre-algebra math class with seven students; he also received additional functional mathematics instruction in the self-contained special education classroom. More specific information about each student is contained in the following paragraphs.

Joey. Joey was a verbal 13-year-old Caucasian student with autism. The Universal Nonverbal Intelligence Test (UNIT) indicated an IQ of 85. The UNIT is administered nonverbally and requires nonverbal responses. Joey's composite scores were in the average to low average range. During study implementation, Joey attended three resource classes (math,

reading, and writing), two general education classes (career introduction and chorus), and two life skills self-contained classes (life skills math and social skills). Joey was pleasant and compliant; he often needed several redirections and prompts to focus on an activity.

Will. Will, the second participant, was a verbal 14-year-old Caucasian student with autism. The Universal Nonverbal Intelligence Test (UNIT) indicated an IQ of 76. Will's scores were in the borderline range for intellectual disability. When the study was conducted, Will attended two general education classes (career introduction and chorus) with a paraeducator. He spent the remainder of the school day in a life skills self-contained classroom. Will had limited verbal ability and was often echolalic in his speech. Will was very compliant; he preferred to look at books or sit quietly than to interact with his classmates.

Ryan. The third participant, Ryan, was a 15-year-old Caucasian student with autism. The Woodcock Johnson III Tests of Cognitive Ability (WJ-III) indicated a full scale IQ of 61. Ryan's scores were in the very low range. Ryan also had an adaptive behavior assessment that indicated he was in the intellectual disability range. Even though the cognitive score results indicated several areas of strength, Ryan clearly qualified for special education services within the category of having an intellectual disability, based on a multidisciplinary team decision. However, parental consent for this classification was denied, and additional testing indicated he could be educationally classified as having autism. During the study's implementation, Ryan attended three general education classes (foods, peer-tutoring, and manufacturing) with a paraeducators. He spent the remainder of the school day in a life skills self-contained classroom. Ryan had a Behavior Intervention Plan (BIP) due to frequent displays of verbal and physical aggression. Despite difficulties in some social situations, Ryan enjoyed interacting with adults and peers.

Aaron. Aaron, the fourth participant, was a 13-year-old Caucasian student with autism. The Wechsler Intelligence Scales for Children IV (WISC IV) indicated a full scale IQ of 66. Aaron's scores were in the very low range. During the study, Aaron attended one resource class (reading), and three general education classes (career introduction, art, and chorus) with a paraeducator or a peer-tutor. He spent the remainder of the school day in a life skills self-contained classroom. Aaron struggled to attend and stay on task in class; he often looked around the classroom or attempted to talk to other students. Aaron was friendly and outgoing and got along well with other students in the class.

Participant Selection Measures

Two measures were used to select participants for this research study. The measures found to be appropriate include both standardized and informal assessments. Each will be discussed briefly.

Standardized assessment. The Brigance Comprehensive Inventory of Basic Skills – Revised (CIBS-R; Brigance, 1999) was used to assess potential participants. The students were assessed in the area of money using the following sub-tests: recognizes money, equivalent values of coins and the dollar bill, total values of groups of coins (adds), converts coins, and makes change. During testing the researcher used a Brigance Assessment Fidelity Checklist to ensure assessment fidelity (see Appendix B). The results of the Brigance assessment indicated an instructional need in the sub-test of total values of groups of coins (adds).

Informal assessment. To more specifically identify the current level of each student, the researcher administered a curriculum-based assessment to identify students' accuracy levels in seeing a price tag and giving exact change, using the fewest possible bills and coins. (See Appendix C for the curriculum-based assessment.) The curriculum-based assessment included

five items and five price tags. The prices listed on the curriculum-based assessment were $2.37, $19.54, $7.18, $22.07, and $12.89. Results of the curriculum-based assessment ranged from 0% to 20%, indicating a need for math instruction in the area assessed.

Setting

A junior high school in a suburban neighborhood in the western part of the United States served as the location of this study. The special education classroom had 10 students, five boys and five girls, with disabilities including autism, multiple disabilities, intellectual disabilities, other health impairment, and emotional disturbance. The classroom had one licensed special education teacher, two classroom paraeducators, and one paraeducators assigned to one student. All phases of the study including baseline, intervention, and maintenance occurred in a partitioned section of the special education classroom.

Prior to the intervention, math class consisted of individual or small group instruction based on each student's Individual Education Program (IEP) goals. Materials included manipulatives, worksheets, and learning activities. The reinforcement used in the classroom was based on a token economy that included reward charts and simulated money. One of the items on the reinforcement menu was 5 minutes of free time on the iPad. By this means, students were able to familiarize themselves with the iPad prior to the commencement of the study.

Materials

All videos were created using a Panasonic HM-TA1 flip video camcorder and Windows Live Movie Maker software. Five videos for each student were developed using video feedforward (Dowrick, 1999) to show students successfully completing five mathematic problems. The teacher turned on the video camera, presented students with a script and provided only the necessary prompts in order to ensure accurate completion of the story problem. Footage

was edited to show students independently performing mathematics problems with 100% accuracy. Each participant was required to complete five specific mathematics problems, resulting in five video self-models addressing the five math problems for each student. The length of video clips ranged from 2 to 4 minutes.

Following the editing of each video, the five videos per student were loaded onto a 16 GB Apple iPad for viewing. The screen of the iPad had a height of 9.7 in. (24.64 cm) measured diagonally. The iPad was 0.5 in. (1.27 cm) thin and weighed 1.5 lbs (.68 kg) (Apple, 2010). A cash drawer contained specified simulated money. Students were given a worksheet with story problems relating to functional math, scratch paper, and a pencil. Each worksheet consisted of step-by-step instructions and five story problems. Baseline worksheets contained the same problems for three consecutive sessions. All intervention worksheets contained the same five story problems. Maintenance worksheets varied according to pre-established criteria for each separate phase. (See worksheets in Appendix D.) Materials for the researcher included a data sheet, pen/pencil, interobserver reliability form, and treatment fidelity checklist.

Response Measurement and Data Collection

The learning task was presented from the consumer's point of view; students were learning to estimate the amount they should use to pay to purchase a particular item and the amount they should receive back in order to ensure that they are treated honestly by merchants.

The math objective taught to the participants in the current study was related to the common core state mathematics standards for seventh graders, standard 7.EE, "solve real life and mathematical problems using numerical and algebraic expressions and equations" ("Common Core State Standards for Mathematics", n.d., p. 47). The standard specifically suggests that students need to understand how to solve functional multi-step math problems, convert between

forms, and use mental computation and estimation. These essential math skills were assessed in the present study. The dependent variable was the percentage of problems completed accurately and independently by students as determined by the learning objective that follows.

Given five story problems using specific price tags ($3.49, $8.68, $14.82, $17.13, and $24.53); a cash register containing simulated money consisting of two $20 bills, four $10 bills, five $5 bills, 25 $1 bills, 10 quarters, 20 dimes, 30 nickels, and 50 pennies; scratch paper; and a pencil, students will estimate, calculate, and show the exact change with at least 80% accuracy over at least three consecutive sessions, using the following steps:

- Read the story problem or listen to the video.
- Identify the cost by circling the price.
- Estimate the amount to be paid using the smallest number of bills by writing the estimate.
- Give the money to the teacher.
- Estimate about how much change you should get back (within $0.50) by writing the estimate.
- Calculate and write the exact amount you should get back.
- Use the cash register to make exact change using the fewest possible bills and coins.

The scoring form (see Appendix E) was used to record data on the students' accuracy on each of the steps listed above for all five problems.

Interobserver Agreement

All instructional sessions were videotaped. Using the videos, reliability checks were made by an independent observer for one third of the sessions in baseline, intervention, and maintenance phases. Interobserver agreement was calculated to detect observer drift, increase

reliability of results, and ensure consistency of measurements across observers (Cooper, Heron, & Heward, 2007). Interobserver agreement was obtained for at least 33% of the sessions, for each participant, in each phase of the study. (See example of data collection sheet in Appendix E.)

To achieve consistency, the coders discussed the scoring criteria in detail and the second coder practiced the scoring procedure. The second and primary coder then independently scored three work samples, achieving an agreement index of 100%. The observer scoring records were compared item by item and an agreement was tallied if both coders recorded identical scores. Point-by-point percentage agreement (Kazdin, 1982) was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The percentage of agreement in baseline, intervention, and maintenance phases for all study participants was 100%.

Experimental Design

This study used a multiple baseline across participants design. Data were collected on the percentage of correct responses. This was the most appropriate design for this study because the target behavior is a learned behavior where withdrawal of the treatment would not be expected to result in a change in participant performance. Baseline data were gathered on the percentage of correct responses of each of the four students.

Consistent with procedures established by Tawney and Gast (1984), when all baseline data were stable with respect to level and trend, the intervention was applied to the first baseline series while baseline conditions were continued for the other participants. When the behavior of the first student reached the criterion level as defined in the behavioral objective (80% for at least three consecutive sessions), the intervention was implemented with the second student. This

procedure was followed until all of the participants received the intervention. In a multiple baseline design, a functional relationship is demonstrated when a change in each participant's performance is obtained at the time the intervention is introduced and not before (Kazdin, 1982).

Experimental Procedures

Experimental phases included baseline, intervention and maintenance conditions. An additional procedure involved the development of the video self-model, which occurred between baseline and intervention phases. Participants received daily assessment and/or instruction in approximately 20–30 minute sessions 4–8 times per week. Behavioral reinforcements consisting of praise and classroom token economy were used in baseline, intervention and maintenance phases. Praise was given to students for engaging in appropriate behavior, but no praise for improved academic performance was provided. See Appendix F for the specific behavioral praises used. The token economy used in the special education classroom consisted of reward charts allowing students who worked to earn 5 stars prior to earning the reward of their choice. Some of the rewards students could earn included free-reading time, pretend quarters to be used in the class store, listening to music, helping the teacher, swinging, choosing a friend to sit by, and playing a game.

Baseline. The researcher trained two paraeducators in study implementation procedures, prior to the beginning of the study. The training occurred over a period of approximately one week in 5 thirty- minute sessions. During baseline, either the researcher or paraeducator worked one-on-one with each student and presented five story problems similar to the ones used during the intervention phase. The teacher directed the student to read the story problem and follow the directions. The teacher did not instruct or give feedback on the accuracy of the student's performance. The teacher collected baseline data until stable responding was achieved (a

minimum of three sessions) and then began the intervention with one student. The other students remained in the baseline phase. The procedure described above was used across all participants. The students were presented with a particular set of problems for three consecutive sessions and then moved on to a new set of problems, in order to avoid overexposure to the same problems. The teacher used the scoring form in Appendix D to record student performance.

Video development. The teacher turned on the video camera, presented students with a script (see Appendix G) and provided only the necessary prompts in order to ensure accurate completion of the story problem. The video was edited to eliminate any teacher prompts and to create five VSM videos of each student independently performing the five math problems with 100% accuracy. Each video was approximately 3–5 minutes in length.

Intervention: Math instruction via VSM. Intervention procedures occurred twice daily, four days a week. Using the video on the iPad, the student watched himself completing one problem. He could pause the video, fast-forward, or rewind as necessary. Then he solved the same problem. This procedure was followed for each of the five problems presented. The teacher used the scoring form (see Appendix E) to record student performance. Intervention procedures were repeated twice each day until criterion was reached (i.e., 80% accuracy over three consecutive sessions).

Maintenance. Maintenance consisted of six individual phases. Conditions during the first maintenance phase were identical to those of the intervention for four out of five problems with one exception: the student was required to complete one novel problem without a video prompt. In maintenance conditions 2 through 5, one novel problem was added and one VSM prompt removed for each subsequent phase. In maintenance phase 5 the students were expected to solve a total of five problems without a video prompt.

In maintenance phase 6 the student was presented with the same five problems assessed during the intervention phase. The purpose of this phase was to determine whether the student could solve the problems without the use of the video prompt, given the lapse in time (number of days it took the student to complete maintenance phases 1 through 5). Although the video prompts were removed completely visual prompts, i.e., the 7 steps needed to complete the math problems, were listed on the math worksheets used throughout the study. The goal was to allow the students to independently prompt themselves in solving the problems using the 7 steps.

Student performance was examined in weekly probes for three weeks following intervention. Probes consisted of the same problems using during intervention.

Data Analysis

A single subject multiple baseline design across four participants was used to evaluate the effects of the VSM via an iPad on the mathematics performance of students with developmental disabilities. Graphic (visual) analysis and effect size were used to interpret and summarize the data. The researcher graphed and analyzed individual student performance daily in baseline, intervention, and maintenance phases, using a line graph. Visual analysis of graphic data allowed the researcher to evaluate participant performance on a continuous basis. Changes in level, trend, and variability were carefully noted across and within conditions and were indicators of an experimental effect. Baseline, intervention, and maintenance averages were calculated and compared. The research objective was to demonstrate a functional relationship between the independent and dependent variables. Replicating the experimental effect across a minimum of three participants was necessary to show a functional relationship between the intervention and participants' math performance and to demonstrate experimental control.

Treatment fidelity. Treatment fidelity was assessed using the form displayed in Appendix H. Data were collected by the teacher on all steps of the task-analysis for each intervention session and by an independent observer during 33% of the intervention phases for all students. Treatment fidelity measures verified the teacher's use of the instructional task analysis, including providing the iPad to the student, prompting the students to activate the device, and collecting data. Additionally, measures confirmed that all materials were set up properly and that the teacher was recording data.

Social validity. Social validity was assessed using two versions of an open-ended, four-question survey developed by the researcher (see Appendix I). The surveys evaluated participants' satisfaction with goals, procedures, and outcomes of the study (Wolf, 1978). The first survey was administered to the research assistants who assisted with study implementation. The second survey was administered by the researcher to the student participants.

Results

Effects of VSM via an iPad on the math performance of students with disabilities were measured quantitatively using a single-subject multiple baseline design across four participants in baseline, intervention, and maintenance phases. The independent variable, percent of correct responses, reflected student performance during the calculation of five math problems.

Participant Scores

Figure 1 shows the effect of VSM using an iPad on the percentages of steps that each student solved accurately and independently using a worksheet containing five story problems and a list of seven steps to be used in solving the problems. Figure 1 data, including baseline, intervention, and maintenance measurements, are summarized below.

Joey. During baseline, Joey read the story problems out loud and occasionally circled the correct price, completing at the most two out of the seven steps required to solve the problem.

Baseline data were somewhat variable with a slight downward trend. The mean percentage of steps solved correctly during baseline was 24%. The median score during baseline was 26%. The range of values in baseline was 16–28%.

At the beginning of intervention, the change in level was immediate and pronounced. Intervention data were slightly variable with a consistent upward trend. The mean percentage of steps solved correctly during intervention was 98%. The increase in the percentage of steps solved correctly during intervention was 74%. The percentage of data points exceeding the median (PEM) of baseline phase was 100% (Parker, Vannest, & Brown, 2009). The range of values in intervention was 91–100%. The percentage of non-overlapping data (PND) (Tawney & Gast, 1984) in baseline and intervention phases was 100%. The improvement rate difference (IRD) or effect size was 1.00 (Parker et al., 2009).

The mean percentage of steps completed correctly for the five maintenance phases were as follows: maintenance 1 = 98%, maintenance 2 = 98%, maintenance 3 = 99%, maintenance 4 = 99%, and maintenance 5 = 100%. The mean percentage correct for maintenance phase 6 was 100%. Results of weekly probes were as follows: 100%, 100%, and 100%.

Will. During baseline, Will read the story problems out loud, completing at the most one out of the seven steps required to solve the problem. Baseline data revealed no downward or upward trend. All baseline values were 14%, thus the mean percentage of steps solved and the median score were 14%.

At the beginning of intervention, the change in level was immediate and pronounced. Intervention data were stable with no downward or upward trend. The mean percentage of steps solved correctly during intervention was 100%. The increase in the percentage of steps solved

correctly during intervention was 86%. The PEM, all data points, and PND were 100%. The IRD or effect size was 1.00.

The mean percentage of steps completed correctly for the five maintenance phases were as follows: maintenance 1 = 95.8%, maintenance 2 = 97%, maintenance 3 = 95.8%, maintenance 4 = 98%, maintenance 5 = 97%, and maintenance 6 = 90.3%. Results of weekly probes were 97%, 89%, and 91%, respectively.

Ryan. During baseline, Ryan completed zero out of the seven steps required to solve the problem. Baseline data revealed no upward or downward trend. All data points were 0%.

At the beginning of intervention, the change in level was immediate and pronounced. Intervention data were slightly variable with an upward trend. The mean percentage of steps solved correctly during intervention was 98.5%. The increase in the percentage of steps solved correctly during intervention was 98.5%. The PEM was 100%. The range of values in intervention was 97–100%. The PND in baseline and intervention phases was 100%. The IRD or effect size was 1.00.

The mean percentage correct for the five maintenance phases were as follows: maintenance 1 = 95.2%, maintenance 2 = 95%, maintenance 3 = 92.3%, maintenance 4 = 93.5%, maintenance 5 = 90.3%, and maintenance 6 = 85.8%. Results of weekly probes were 89%, 89%, and 86%.

Aaron. During baseline, Aaron read the story problems out-loud, completing at the most one out of the seven steps required to solve the problem. Baseline data revealed no downward or upward trend. All data points were 14%.

At the beginning of intervention, the change in level was immediate and pronounced. Intervention data were slightly variable with no observed difference in trend in the final three

data points. The mean percentage of steps solved correctly during intervention was 98.5%. The increase in the percentage of steps solved correctly during intervention was 84.5%. The PEM was 100%. The range of values in intervention was 94–100%. The PND in baseline and intervention phases was 100%. The IRD or effect size was 1.00.

The mean percentage of steps completely correctly for the five maintenance phases were as follows maintenance 1 = 93.6%, maintenance 2 = 90%, maintenance 3 = 92.3%, maintenance 4 = 92.8%, maintenance 5 = 94.2%, and maintenance 6 = 87%. Results of weekly probes were 82%, 80%, and 77%.

Social Validity Measures

Both paraeducators stated that they enjoyed participating in the study. Time and scheduling issues were the only challenging aspects they noted. They both reported seeing immediate progress in the students' performance during the intervention phase. One paraeducator reported, "I saw students using the iPad as a learning tool, and I saw firsthand that these students could remember each step." The other paraeducator noted, "This study was amazing to me."

All student participants said that they liked having a video made of them in class and they all stated that they enjoyed watching the video of themselves. Ryan said, "It was cool and fun." Three of the students specifically referenced the iPad with positive comments. The researcher noted that students seemed enthusiastic and excited to participate in the study each day.

Discussion

The purpose of the current research was to examine, during intervention and maintenance phases, the effects of VSM via an iPad on the mathematics performance of students with disabilities. The data demonstrated a clear functional relationship over four applications of the

intervention. Strong experimental control was demonstrated since the dependent variable changed only when the intervention was in place. Therefore, the VSM via iPad intervention resulted in the establishment of a functional relationship and clearly showed an experimental effect.

In line with previous VM and VSM research, the intervention was successful in teaching students with disabilities a new skill (e.g., Bellini & Akullian, 2007; Buggey, 2007; Charlop-Christy & Daneshvar, 2003; Cihak et al., 2010; Hitchcock et al., 2003). Results were also consistent with previous findings showing improved math functioning of students with disabilities and students at risk for failure through the use of VM and VSM (Cihak & Bowlin, 2009; Schunk & Hanson, 1989). Results confirm previous VM and VSM research demonstrating continuous improved student performance across time (Bellini & Akullian, 2007; Cihak & Bowlin, 2009; Cihak et al., 2010). In addition, the data confirm prior research involving the use of handheld computers to promote student learning (e.g., Cihak & Bowlin, 2009; Cihak et al., 2010).

This research extended the previous VSM literature in a number of respects. First, the VSM intervention incorporated innovative instructional methodologies allowing students with developmental disabilities increased access to the core curriculum. Although many evidence-based practices were previously identified (Browder & Cooper-Duffy, 2003), the current research extended the literature in academic core instruction through the use of VSM via an iPad, demonstrating that this intervention can be a highly efficient aide to instruction. Second, the study extended the research by documenting a clear relationship between functional math and the core curriculum (Browder & Cooper-Duffy). Third, this study involved the use of VSM to teach functional mathematics to students with developmental disabilities.

Limitations

The study was conducted with a limited number of participants, impacting the generalizability of the findings. Therefore, replications of the study are needed to strengthen external validity of the results.

Another potential limitation relates to the researcher assuming the dual role of classroom teacher and implementer of the intervention. Although the original intent was to involve the paraeducators as implementers of the intervention according to a set schedule, near the beginning of the study their involvement was discontinued. Even though data collection procedures did not appear to be compromised, the change was made due to concerns related to treatment fidelity. The paraeducators frequently asked the primary researcher questions about the procedures, interrupting classroom instruction. Paraeducators were only involved in approximately 20% of the total sessions, mostly during the baseline condition.

Some procedural limitations were also a factor in the research. Part of the instructions on the worksheets stated, "Read the story problem" when it should have read, "Read the story problem out loud or watch the video." Changes were made to the worksheets after day 1 of baseline. On session 2 of the intervention for Joey the researcher noticed that his VSM had a step that was incorrect. Joey was asked to pay using the fewest bills, which was one $10 bill and one $5 bill, but the VSM showed Joey paying using one $10 bill and four $1 bills. Additional filming and editing had to be done to correct the VSM for Joey. On one occasion during maintenance phases only the morning session was conducted, due to school activities during the afternoon session. Because spring break occurred the seventh week of the ten week study, the maintenance and/or follow-up phases were interrupted for all participants. The performance of

three students, Will, Ryan, and Aaron may have been adversely impacted due to the one week absence from the study.

Another limitation could be the similarities of prices in the intervention and maintenance phases. The researcher changed each price based on generalizability to one part of the problem (penny, nickel, dime, quarter, or dollar bill). The use of less similar problems may have strengthened the study. Future research would do well to address areas noted in these limitations.

Implications for Practice

The results of this study indicated a functional relationship between math performance and VSM via an iPad, clearly showing an experimental effect. The results also indicated that the participants were able to maintain the skill over a three-week period following removal of the intervention. Thus, VSM via an iPad may offer an effective option for teachers implementing academic interventions with students who have developmental disabilities. Findings of the present study have important implications for the use of VSM in teaching mathematics in all classroom settings. This study additionally addresses the current need to extend the literature base in the use of VSM intervention to teach academic skills.

Specifically, students with developmental disabilities were able to independently access the technology and prompt themselves through the completion of functional math skills without teacher assistance. These findings contain important information for teachers in terms of innovative instructional methods that may be effectively implemented without continual teacher direction. The invention is less labor intensive, and frees up teacher time, allowing the teacher to offer multiple students individualized assistance using alternative techniques. Furthermore, the invention supports independence and the development of quality work habits for all students.

The intervention is likewise simple and efficient. This is demonstrated by the fact that positive learning outcomes were attained by all participants. The learning objectives were also achieved in a short period of time and were maintained over a period of three weeks.

Students were excited to use the iPad and watch the VSM. On the social validity questionnaire, all students reported that they enjoyed the intervention. Anecdotal information indicated that students with some serious behavior issues (i.e., aggression, language, fidgeting, inattention) remained on-task to a greater extent when using this technology. Results indicated that VSM improved students' academic skills and may have increased their task engagement.

It is speculated that additional applications of the intervention could benefit students with disabilities in a number of ways, allowing learners to engage in a broad array of academic and work related tasks. The increased educational opportunity could lead to improved self-efficacy, resulting in better social and academic outcomes over the lifespan. Positive intervention effects, generalized across behaviors, contexts, and time could likewise significantly impact future educational practice.

Interventions such as the one evaluated in the present research are clearly needed to help students with developmental disabilities access the core curriculum and achieve improved long-term outcomes. Although many evidence-based practices have been identified, future research is needed to extend the literature base in academic core instruction for students with severe disabilities (Browder & Cooper-Duffy, 2003).

Implications for Future Research

Future replications of this study might include a number of variations. For example, future research questions could address the beneficial effects associated with increased on-task behavior as a result of using VSM via an iPad during math instruction. Anecdotal data suggested

that measuring students' on-task behavior during regular classroom math instruction and comparing the level of performance to students' on-task behavior during the intervention phase may provide quality findings. Assessing different math skills, such as budgeting and time management, could also provide helpful information. Additional research is also needed to examine the use of VSM via an iPad to teach students with developmental disabilities a variety of academic skills in the areas of science, reading, and writing. Future research investigating mathematics instruction using similar technology in community and post high school settings is also warranted. Generalization of the methods to involve teachers, community workers, family members, and other school professionals is an additional area deserving further investigation. The researcher anecdotally noted a residual effect of VSM via an iPad on students' behavior and academic performance that was observed following the removal of the video prompting. It is speculated that these changes may have been associated with the intervention; thus further investigation of these unplanned effects is recommended.

Conclusion

The results of this study strongly suggest that VSM via an iPad may be an effective way to teach academic content to students with developmental disabilities. Although present findings are promising, future research is needed to establish VSM as an evidence-based practice for students with developmental disabilities and for other students in a variety of academic contexts (Prater, Carter, & Hitchcock, 2011).

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Table 1

Student Characteristics

Student	Age	Grade	Disability Classification	IQ Test	Full Scale IQ
Joey	13	7	Autism	UNIT	85
Will	14	7	Autism	UNIT	76
Ryan	15	9	Autism	WJIII	61
Aaron	13	7	Intellectual Disability	WISC IV	66

Note. WJIII = Woodcock Johnson III Tests of Cognitive Ability; WISC IV = Wechsler Intelligence Scales for Children, Fourth Edition; UNIT = Universal Nonverbal Intelligence Test.

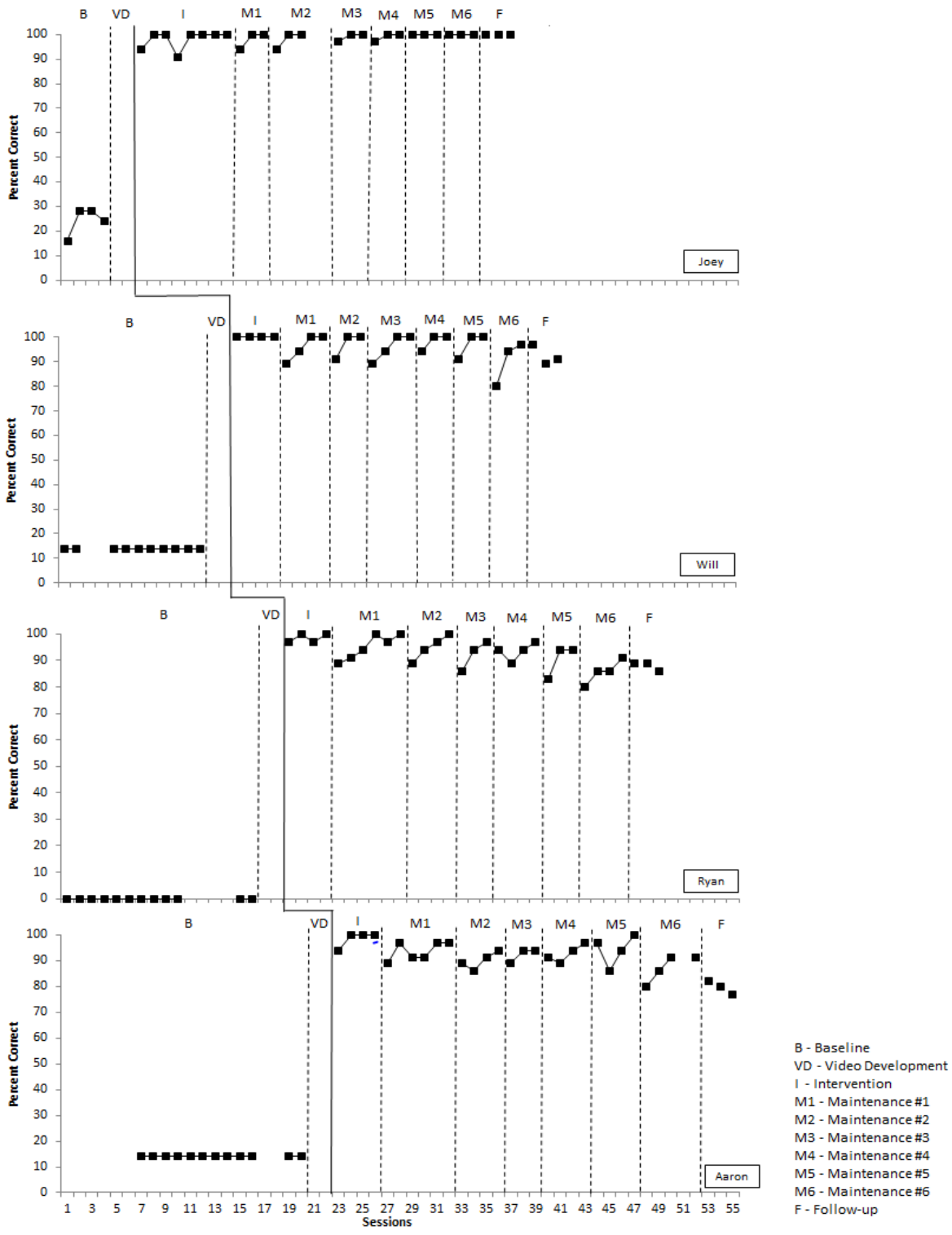

Figure 1. Percentage of math story problem steps completed accurately for all participants.

APPENDIX A

Review of Literature

The primary purpose of this review is to discuss the research in video modeling (VM) and video self-modeling (VSM) as tools to teach mathematical skills to students with developmental disabilities. Following a review of video self-modeling applications and strategies is a discussion of the ways in which the present research will add to the current literature.

Students with Developmental Disabilities

Over the last 20 years, many changes have taken place in the education of students with developmental disabilities. In the past, students with disabilities were often described with terminology that communicated a sense of hopelessness and despair (Hardman, Drew, & Egan, 2008). Fortunately, this is not the case today. Students with disabilities are no longer referred to by their disabilities but by their abilities. Education has moved from a "disability-centered" mindset to "person-centered" mindset. Teachers are trained, for example, to say "a child with autism" instead of "an autistic child." Focusing on the individual is an important aspect of special education.

Intellectual Disabilities. For special education classification purposes, persons with disabilities must still be identified with a specific educational classification. The term *intellectual disability* is a categorical definition of disability identified by federal regulations, including the Individuals with Disabilities Education Act (IDEA), and is a commonly used term to describe the population targeted in the present research (Hardman et al., 2008). According to the American Association on Intellectual and Developmental Disabilities (AAIDD), "Intellectual disability [is] characterized by significant limitations both in intellectual functioning and in adaptive behavior as expressed in conceptual, social and practical adaptive skills. This disability

originates before age 18" (AAIDD [AAMR], 2002, p. 1). Students with developmental disabilities require highly specialized education and related services in order to benefit from their educational experience. Necessary accommodations are often not readily available in the general education environment.

Autism. Students with autism are also targeted in the current research. Autism is characterized by marked impairment in reciprocal social interaction that may impact both verbal and nonverbal behavior. The disorder is manifest by developmental delay or abnormal functioning before age 3 and adversely affects educational performance (American Psychiatric Association, 1994). Students with autism often struggle with communication, change in routines, and self-stimulatory behavior (American Psychiatric Association, 1994).

In recent years the number of children diagnosed with autism has increased (Mastropieri & Scruggs, 2010). More than ever before, research is needed to identify treatments addressing a wide variety of learning and behavioral needs for this population of students. For example, investigations assessing the effects of instructional strategies to help children with autism spectrum disorders (ASD) acquire academic skills would facilitate their inclusion in general education classrooms (Knight, Smith, Spooner, & Browder, 2011). In addition, there is a need to establish evidence-based practices to provide high quality instruction to students with ASD.

The Role of Special Education

Special education is defined by law as "specially designed instruction, at no costs to the parents, to meet the unique needs of a student with a disability" (United States Code, 20 U.S.C. §1401 (29). Related services in general are "transportation, and such developmental, corrective, and other supportive services…designed to enable a child with a disability to receive a free appropriate public education as described in the individualized education program of the child"

(United States Code, 20 U.S.C. §1401 (26). Special education is a support service for schools, designed to help facilitate students' success.

Another key element of special education is to facilitate improved quality of life and promote independence for students with disabilities. The long-term outcomes for students with developmental disabilities are a driving force in their education and individualized education plans (IEP). In addition to learning core curriculum skills, throughout their elementary and secondary schooling, students with developmental disabilities learn skills that will help them to reach the highest level of independence possible. Some of these may include functional, adaptive, daily living and social skills.

The Influence of Recent Legislation on Educational Practice

Opportunities have greatly increased for students with developmental disabilities to participate more fully in core curriculum, worksites, general education, and special education classrooms. Due to laws and recent educational reform, students with disabilities have been given greater access to the core curriculum and to achieving expected learning outcomes. The Individuals with Disabilities Education Improvement Act of 2004 (IDEIA, U.S. Department of Education, 2004) has placed increased emphasis on access to education for students with disabilities, while the No Child Left Behind Act of 2001 (NCLB, U.S. Department of Education, 2002) has placed importance on improved student outcomes. These changes in the law regarding educational opportunity for students with disabilities have led to important changes in educational practice over the last several years. Accountability has become an important issue for all students and as recently mentioned, the potential of persons with disabilities is being more fully recognized (Hardman et al., 2008). Innovative instructional methodologies are needed to promote the highest possible outcomes for students with severe disabilities.

The achievement of high levels of performance is also strongly linked to scientifically based research. Methodologies such as single-subject research (SSR) have been used to establish evidence-based practices. Single-subject research designs allow educators and researchers to determine functional relationships between independent and dependent variables. Advantages of SSR include experimental control and systematic, detailed analysis at the individual level. Thus SSR is an approach that may be used to establish evidence-based practices (Horner et al., 2005). As Horner et al. noted, "An array of effective interventions is now in use that emerged through single subject research methods" (p. 172).

Browder and Cooper-Duffy (2003) stated that additional research is needed to document ways in which students with severe disabilities can achieve competence in varied academic subjects and show progress. Browder and Cooper-Duffy also noted that best practices for students with severe disabilities as reflected in NCLB include assessment in math, reading, and science, and expectations for annual yearly progress. Both IDEIA and NCLB provide guidelines for alternative assessments and assessment with accommodations for students who cannot fully participate in state testing. In the 2002–03 school year, districts and schools in all 51 states had written guidelines for the use of accommodations in testing and the use of alternate assessments for students with disabilities (IDEIA, U.S. Department of Education, 2004).

NCLB additionally places a strong emphasis on scientifically based instruction or evidence-based strategies. There is an obvious need to hold students with developmental disabilities to high learning standards that align with the core curriculum. However, in identifying expectations for this population, it is necessary to examine the research findings that most accurately reflect students' educational needs (Bowder & Cooper-Duffy, 2003).

Browder and Cooper-Duffy (2003) noted that functional math is an area that is closely related to academic content standards. Functional math focuses on teaching practical mathematics within real-life situations such as telling time, using money, and tasks related to measurement. In a review of 28 single-subject studies addressing functional mathematics instruction, Yang, Grasso, Dipipi-Hoy, and Jitendra (2005) found moderate effect sizes for acquisition and generalization of purchasing skills and a large effect size for skill maintenance.

A second meta-analysis on teaching mathematics to students with significant cognitive disabilities provided evidence suggesting that systematic instruction may be considered an evidence-based practice for teaching functional math to students with significant cognitive disabilities (Browder, Spooner, Ahlgrim-Delzell, Harris, & Wakeman, 2008). According to Browder et al., systematic instruction includes defining a target response, teaching to mastery, prompting, giving feedback, and using explicit prompt fading. The authors also noted that teaching these skills in real-life situations (e.g., daily schedules, shopping, and time management) may be beneficial.

Although many evidence-based practices have been identified, future research is needed to extend the literature in academic core instruction for students with severe disabilities (Browder & Cooper-Duffy, 2003). The need for additional knowledge and resources is especially critical for teachers of students with significant cognitive disabilities, who must address varied domains of the core curriculum to effectively prepare students for alternative assessments (Browder et al., 2008).

A number of functional skills align directly with the core curriculum. Current research supports the idea that students with developmental disabilities can learn mathematical content. However, the NCLB requirement to address math standards does not diminish the importance of

a continued focus on functional skills (Browder & Cooper-Duffy, 2003). Browder and Cooper-Duffy also noted, "Future IEPs for students with severe disabilities will undoubtedly contain a blend of academic and functional objectives" (p. 161).

Technology

Technology refers to a broad range of materials that support instruction, including but not limited to graphics, computers, and media (Boyle & Scanlon, 2010; Swanson & Hoskyn, 1998). Technology may be advantageous because it can supplement instruction. For example, research has shown that technology can increase opportunities for students to access the core curriculum and can facilitate student learning (Cihak & Bowlin, 2009).

Recent advances in the use of technology in classrooms have had a notable impact on instructional practices for students with disabilities and have included many new applications of video technology (Mechling, 2005). Video technology provides opportunities for repetitive viewing and can easily be used across multiple settings to promote skill generalization. Video technology has also been found to heighten student interest and to align well with students' visual and auditory learning strengths. Instructor-created video recordings consisting of personalized scenarios can be meaningful to the learner and help promote skill acquisition (Mechling, 2005).

Video modeling. Video modeling or video self-modeling may be an appropriate and effective way to teach mathematics to students with developmental disabilities and to integrate technology into instruction. Video modeling (VM) is an instructional technique that involves a student watching a video of a model (e.g., a peer or adult) engaging in target behaviors or skills before the student actually performs those behaviors or skills (Cihak, Fahrenkrog, Ayres, & Smith, 2010). The student views the model demonstrating the entire task prior to performance

(Canella-Malone et al., 2006). The use of VM allows the learner to engage in repeated viewings for repeated practice of target skills across various settings. VM can be used to teach a range of skills to individuals with varying ability levels.

Observational learning or learning by observing is a key component to video modeling (Bandura, 1969). Bandura (1977) showed that children acquire many skills by observing other people perform the skills. Bandura also found that attention and motivation are essential for a child to learn from a model. A child must attend to a model in order to imitate the model's behavior. Models with similar characteristics to the observer (age, personality, race, and mood) and who function at or only slightly above the level of the observer tend to be the most effective (Bandura, 1977). Video modeling can be used with peers, siblings, adults; it can also be used with oneself as a model, as in video self-modeling (Bellini & Akullian, 2007).

Video self-modeling. Video self-modeling (VSM) is a specific application of video modeling, in which the individual observes himself or herself accurately and independently performing the target behaviors (Dowrick, 1999). Video self-modeling is a form of observational learning in which individuals view themselves performing a task at a more advanced level than they typically perform the skill (Buggey, Toombs, Gardener, & Cervetti, 1999). Most commonly, these future images of success are captured on video, edited into 2–4 min segments, and repeatedly viewed to assist the individual in learning new target skills (Dowrick, 1991) or increasing low-incidence skills.

The effectiveness of VM and VSM interventions has been demonstrated in multiple reviews of literature (Mechling, Pridgen, & Cronin, 2005; Buggey, 2005; Mechling, 2005; Hitchcock, Dowrick, & Prater, 2003) and in a meta-analysis (Bellini & Akullian, 2007). Many studies have shown VSM to be an effective strategy in working with students with emotional

disturbances (e.g., Possell, Kehle, McLoughlin, & Bray, 1999), learning disabilities (e.g., Clare, Jenson, Kehle, & Bray, 2000), autism spectrum disorders (e.g., Shipley-Benamou, Lutzker, & Taubman, 2002), general education students (e.g., Hartley, Bray, & Kehle, 1998), and students with moderate intellectual disabilities (e.g., Cihak, Kessler, & Alberto, 2007).

VSM also has been used to teach a variety of skills including transitional behaviors (Cihak et al., 2010), social-communication, behavioral, and functional/life skills (Bellini & Akullian, 2007; Buggey, 2007), perspective taking (Charlop-Christy & Daneshvar, 2003), communication, behavior, and academic performance (Hitchcock et al., 2003). Targeted settings have included the general education classroom, self-contained and resource classroom, and community and home environments.

According to Dowrick (1999), two categories exist within VSM, positive self-review and video feedforward. In positive self-review, the individual is recorded on a video performing criterion level of behavior and then shown this videotape later to remind the individual of what he or she is able to do (Dowrick, 1991). Positive self-review increases rates of performance on low frequency behaviors or behaviors that were once mastered but are no longer performed (Bellini & Akullin, 2007; Dowrick, 1999). Positive self-review may not require advanced editing of video footage, although, for low frequency behavior, extensive amounts of raw video footage may be required to capture the target behavior (Bellini & Akullin).

In contrast to positive self-review, video feedforward involves skills that have not yet been acquired or have not been performed across different contexts (Dowrick, 1999). The individual may perform some of the components of the target behavior but is not able to perform all the steps of the task in sequence or perform the steps fluently (Mechling, 2005). Video feedforward requires more technology skills, since individual steps are videotaped and then

"hidden supports" are edited to create the complete model of the target skill. For example, a student may be prompted by an adult to ask to join in a game, or the student may be prompted to respond to the invitation of a peer. The adult prompts are then edited out (i.e., hidden) so when students view the video they see themselves independently completing the skill (Bellini & Akullian, 2007). Feedforward videos can also be edited so it appears a student is performing a target skill in a different setting, or with different people (Mechling, 2005). Using video feedforward allows students to view their own *future* images of success (Dowrick, 1999; Hitchcock et al., 2003).

In a review of self-modeling, Dowrick (1999) stated that about 150 applications of self-modeling had been reported in the literature at that time. He used these studies to identify seven categories of self-modeling applications (see Table 2). Three categories use positive self-review, three use feedforward, and one category serves as a combination of positive self-review and/or feedforward.

Positive self-review. The following categories are based on the positive self-review strategies numbered 1, 4, and 7 in Table 2. Category 1, "Increasing Adaptive Behavior Currently Intermixed with Non-desired Behaviors," uses PSR to decrease children's disruptive behaviors and increase on-task adaptive behavior through the editing of video tapes and having students view themselves engaging in appropriate classroom behavior (Dowrick, 1999, p. 26). In category 4, "Improved Image for Mood-Based Disorders," self-modeling is used to edit videos for positive self-review by individuals with mild to moderate depression to display images of non-depressed behavior (Dowrick, p. 30). The researchers engaged subjects in conversations about past pleasant and enjoyable situations; as participants smiled, got excited, and expressed

Table 2

Seven Categories of Self-Modeling Applications, Designed as Positive Self-Review (PSR) or Feedforward

1. Increasing adaptive behavior currently intermixed with nondesired behaviors	PSR
2. Transfer of setting-specific behavior to other environments	Feedforward
3. Use of hidden support for disorders that may be anxiety based	Feedforward
4. Improved image for mood-based disorders	PSR
5. Recombining component skills	Feedforward
6. Transferring role-play to the real world	PSR & Feedforward
7. (Re)Engagement of disused or low-frequency skills	PSR

Note. Adapted from "A Review of Self-Modeling and Related Interventions," by P. W. Dowrick, 1999, *Applied & Preventative Psychology, 8,* pp. 23–39.

happiness in recalling these memories the researchers edited video footage to create positive mood videos.

Category 7, "(Re)Engagement of a Disused or Low-Frequency Skill," refers to skills that were once mastered but are no longer commonly used by the individual because of the lapse in time, space, or infrequent use (Dowrick, 1999, p. 33). The individual views a videotape of himself or herself performing the skill at mastery level; this can be a quick review of the necessary steps performed. An example of this would be a maintenance worker who knows how to fix an air conditioning unit but is only required to do so approximately every two years when the unit breaks. Due to the span of time, the maintenance worker may spend hours trying to remember what he needs to do to fix the air conditioning unit, or he could spend a few minutes watching the video and proceed to quickly repairing the air conditioning unit.

Video feedforward. Categories 2, 3, and 5 from Table 2 use feedforward strategies, or learning by observation of one's success. Category 2, "Transfer of Setting-Specific Behavior to Other Environments" shows skills that occur in one setting and not in another (Dowrick, 1999, p. 27). This category is most commonly used with selective mutism, where a child may speak freely at home but is mute at school. VSM can be used to edit instances of the child speaking, such that he or she appears to be speaking in context of a teacher's questions or conversations at school.

Category 3, "Use of Hidden Supports for Disorders That May Be Anxiety Based," is a type of VSM in which support is provided when a child is performing a new skill (Dowrick, 1999, p. 28). The video is later edited to cut out the hidden supports and to show the child in a feedforward situation where he or she is independently performing the skills. An example of this skill was described by Dowrick and Dove (1980) in a study in which videos were used to portray

children with spina bifida swimming at mastery level by editing out the therapist in the pool who was providing physical support.

Category 5, "Recombining Component Skills," is a category mostly used for applications in challenging sports skills, although it may also apply to social skills, academics, and areas in which the observer has no credible image of success (Dowrick, 1999, p. 31). An example of these skills can be found in Dowrick's 1999 article, citing his own work (1997). A 14-year-old girl on the high school gymnastics team was unable to master a particular floor routine; she always stumbled. Her mother combined components from other less demanding routines to produce a video of the girl successfully performing the challenging floor routine. After three viewing sessions of the video, the girl performed the floor routine without falling.

Category 6 may use either positive-self review or feedforward or both. "Transfer Role-Play to the Real World" includes partial role-playing on the part of the observer(s) along with some editing to make a successful video (Dowrick, 1999, p. 32). This type of VSM is appropriate when an individual can participate in a role-playing situation but a high level of support is needed. Instead of having the individual rehearse the role-play repeatedly, he or she can participate in a partial role-play and the footage can then be edited to create a future image of success without added supports.

The needs of the individual student and the type of video most appropriate to meet those needs must be considered when creating films using VSM. Positive self-review videos are fitting when the student can already perform the criterion level of the target behavior but needs to be reminded of that performance. In contrast, video feedforward is used to show skills that have not yet been mastered and need prompting. Video feedforward may require more technology skills

in relation to editing than PSR. It may also be helpful to reference the seven categories outlined by Dowrick (1999) in determining the type of VSM that is best for the target behavior.

Technology to deliver VM and VSM. VSM has often been delivered through several media including (a) television and videocassette recorder, (b) laptop computer, (c) DVD, and (d) handheld device (e.g., video iPod) (Cihak et al., 2010). With advances in technology, the options for delivery of VSM have vastly increased. Handheld computers are one form of technology that has proven to be effective for the delivery of VSM for individuals with disabilities in various settings (Cihak & Bowlin, 2009; Cihak et al., 2010). Researchers have noted distinct advantages of handheld computers such as portability and size. Static picture display, auditory prompt, and video clips are additional features (Cihak & Bowlin, 2009).

Studies using handheld devices have been conducted with varied populations and in a number of skill areas. Cihak et al. (2010) successfully used VSM via video iPods and a system of least prompts to improve transitional behaviors for elementary students with autism in a public school setting. Students were taught to prompt themselves by using the video iPod to make transitions between various locations within the school (e.g., bus to classroom, classroom to cafeteria, playground to classroom). Ten videos for each of the four participants were developed using positive self-review. The intervention also included teacher prompting, role-playing, and positive verbal reinforcement. Results, evaluated within an ABAB design, indicated that the mean percentage independent transitions increased from 7% during baseline to 77% following intervention.

Given the remarkable results associated with VSR and other instructional technology, researchers predict that ‘‘as technology becomes more sophisticated and user friendly, teachers

are more likely to incorporate and use instructional technology in their classrooms" (Cihak & Bowlin, 2009).

Use of technology to teach math skills. A number of researchers have described specific ways in which technology can be used to support teacher instruction and improve math outcomes for students with and without disabilities. Examples of mathematical concepts include money skills, telling and managing time, problem solving, and computation skills (Cihak & Bowlin, 2009; Hardman et al., 2008). As previously mentioned, "technology can be a great equalizer for individuals with disabilities." Specifically, "it can increase opportunities for students to interact with content knowledge and facilitate learning. The potential for technology to enhance teacher instruction can be a powerful component in improving math skills for students with disabilities" (Cihak & Bowlin, 2009, p.18).

Cihak and Bowlin (2009) examined the effectiveness of VM through the use of handheld computers to teach geometry skills to three secondary students with learning disabilities. In this research, a handheld computer was provided to each student with video clips of the teacher modeling how to find the perimeter of various shapes. Students were taught how to use the handheld computer at home to assist in completing 10 homework problems. The teacher encouraged the students to watch the video modeling as much as needed at home. Students were expected to turn in homework problems completed with 100% accuracy. If the students did not achieve accuracy levels they were required to take the homework and handheld computer home again, correct the errors, and resubmit the assignment. Students who turned in assignments meeting the 100% criterion were given a 10-question quiz which they were required to complete without the assistance of the handheld computer and VM. Students had to demonstrate 100% accuracy on three consecutive quizzes before they could move on to the next geometry skill.

Results indicated that student performance improved from a mean of 3% during baseline to a mean of 94% during the VM and handheld computer intervention phase. Findings also indicated that students demonstrated acquired skills with 86% accuracy for six weeks following the removal of the intervention (Cihak & Bowlin, 2009). In summary, VM via handheld computers increased the geometry skills of all participants and helped them maintain the skills for a period of six weeks.

In an earlier study, Schunk and Hanson (1989) used VSM to teach mathematical concepts to elementary school students who had been identified as working below grade level in mathematics. VSM was used to show students correctly adding mixed fractions with and without carrying. After watching the video, students were asked to complete two math problems. Students who viewed themselves successfully completing math problems performed at higher levels than students who did not watch a model of themselves. Schunk and Hanson's (1989) study strengthens the idea that VSM increases students' academic performance during cognitive skill learning. Future research is needed to extend previous findings by examining the use of VSM to teach functional mathematics to students with severe disabilities.

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APPENDIX B

Assessment Fidelity Checklist

Brigance Comprehensive Inventory of Basic Skills – Revised (CIBS-R)

Student: _____ Date: _____
Assessor: _____ 2nd Assessor: _____

Materials:

- Comprehensive Inventory of Basic Skills – Revised
- Student Record Book for each student being assessed
- Pencil or pen, depending on the assessment

Before Assessment begins:

- ☐ Be sure to have a *Student Record Book* for each student being assessed.
- ☐ Read through the information on each assessor page(s) before beginning the assessment. Note discontinue rule and timing.
- ☐ Gather any necessary materials (ex. Scratch paper, pencil)
- ☐ Fill in demographic information in the Student Record Book.
- ☐ Read bolded directions to student as administering the assessment.
- ☐ Circle skills that have been mastered.
- ☐ Underline instructional objectives.
- ☐ Each time you assess follow the guidelines for the pencil or color ink indicated to track progress.

From Armour, L. (n.d.). *Brigance Diagnostic Comprehensive Inventory of Basic Skills – Revised* [PowerPoint Slides]. Retrieved from http://www.curriculumassociates.com/professional-development/

APPENDIX C

Curriculum-based Assessment

Name:_____ Date:_____

Directions: Use the given money in the cash register to give exact change for the 5 items listed below.

#1

$2.37

#2

$7.18

#3

$12.89

#4

$19.54

#5

$22.07

APPENDIX D

Worksheets for Students

Baseline #1

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I just bought a new pair of winter gloves for $2.29.

2. A rollercoaster ticket for $7.39.

3. I am going skiing and I need a winter hat for $15.21.

4. I wore a hole in my jeans and I need a new pair of pants for $18.95.

5. I made the track team and I want to buy a watch with a timer, the watch costs $23.37.

Baseline #2

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am starting a comic book collection, I bought my first comic book for $4.12.

2. It is my brother's birthday this week and I want to get him an action figure for $8.77.

3. My friends and I are going boating on the lake, I bought new sunglasses for $15.95.

4. A new school year is starting and I need a backpack for $18.15.

5. It is getting cold outside and I need a new jacket, I bought one for $23.99.

Baseline #3

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. We are having a class party and I bought a bag of treats to share for $4.12.

2. We bought pizza for dinner tonight; it cost $7.37.

3. For school I need a new reading book; it costs $14.97.

4. Tomorrow is my mom's birthday. I am buying her a gift for $18.54.

5. I have grown out of my shoes and I need new ones. They cost $24.96.

Baseline #4

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. We are going on a field trip so I need to buy a bus pass for $3.26.

2. My friends and I are going to play laser tag. It costs $8.05.

3. The PTA is selling school shirts. I bought one for $15.54.

4. I made a workspace in my room but I need a lamp to see my notes. The lamp I bought costs $17.66.

5. This weekend my best friend and I are going to the amusement park. My ticket will cost $24.80.

Baseline #5

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. We are having a family party and we wanted a new game to play. We bought playing cards for $4.21.

2. The school baseball team is having a game. I bought a ticket for $7.45.

3. My favorite band just released their new CD. I bought it the day it was released for $14.99.

4. It is the 4th of July and my family is getting some fireworks to celebrate. They cost $18.27.

5. I have been saving my allowance to buy a remote control car. I finally saved enough money and bought the car for $22.82.

Baseline #6

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I just got a new iPad and I need some music for it. I bought a couple songs on iTunes for a total of $3.92.

2. I want to try out for the basketball team this year. I bought a new basketball so I can practice after school. The ball costs $8.50.

3. It is getting cold outside so I need to buy a long-sleeved shirt. It costs $16.17.

4. I like animals so I want to go to the rodeo this week. It costs $18.23.

5. I am going on a trip and want to take some pictures. I bought a camera for $24.95.

Baseline #7

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. My favorite football team just won and they interviewed them in the magazine. I bought the magazine for $3.25 so I could read the interview.

2. My mom said I needed to get a haircut. I walked down to the local shop and paid $9.10 for a haircut.

3. I'm out of school lunch money and had to pay $15.43 for the next week.

4. I'm trying out for the football team and wanted to practice my throw. I bought a football for $18.23.

5. We lost the pieces to our board game so we had to buy a new one for $22.87.

Baseline #8

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I just started a new science class and need a notebook to stay organized. I bought the notebook for $3.07.

2. I went camping and accidently got my pillow all wet and ruined. I needed to buy a new one for $8.18.

3. I have a hockey game next week but my hockey stick broke. I had to buy a new one for $16.43.

4. It is Christmas time and I wanted a new skateboard. My parents bought me one for $19.88.

5. I have been growing and my baseball glove is too small for me now. I bought a new one for $23.11.

Baseline #9

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. My mom sent me to the store to buy milk for $3.33.

2. I joined the yo-yo club at school and need a yo-yo. It costs $6.73.

3. I went to the local college basketball game. My ticket cost $14.27.

4. I played a round of golf with my dad for $18.25.

5. I bought a basketball jersey of the college team, and I wore it to the game. It cost me $23.82.

Baseline #10

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I learned a new way to do my hair but I needed some hair gel. I bought it at the grocery store for $3.86.

2. I am going to visit my friend who moved and I need a train ticket. It costs $9.30.

3. It is Mother's Day and I bought some flowers for my mom. I paid $15.26.

4. My friend is on the football team and I wanted to go support him. I bought one ticket for $17.59.

5. I want to start a summer business selling snow cones. I bought a snow cone maker for $24.92.

Baseline #11

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I just bought a new pair of winter gloves for $2.29.

2. It is my brother's birthday this week and I want to get him an action figure for $8.77.

3. For school I need a new reading book. It costs $14.97.

4. I made a workspace in my room but I need a lamp to see my notes. The lamp I bought costs $17.66.

5. I want to start a summer business selling snow cones. I bought a snow cone maker for $24.92.

Baseline #12

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I just bought a bag of chips for $2.29.

2. It is my sister's birthday this week and I want to get her a doll for $8.77.

3. For church I need a new book. It costs $14.99.

4. I just organized my room and I need a bin to put all my shoes in. It costs $17.66.

5. I want to start a summer business selling popsicles. I bought a cooler for $24.92.

Baseline #13

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I went to the store to buy apple juice. It cost $3.33.

2. I joined the Frisbee club at school and I needed a Frisbee; it cost $6.72.

3. I went to the local college soccer game. My ticket cost $14.31.

4. I played a round of mini-golf with my brother for $18.86.

5. I bought a football jersey of the college team and I wore it to the game. It cost me $24.19.

Intervention #1

Name: _____ Date: _____

Watch the video for each problem and use the steps on the video or listed below to complete each problem.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am at a fast food restaurant and I want to buy a hamburger that costs $3.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My favorite shirt just went on sale for $14.82. I am headed to the mall to buy the shirt.

4. I am having my friends over this weekend for a party. I went to the store to buy a DVD for the party, and it cost $17.13.

5. I just made the basketball team and went to the department store to buy new basketball shoes for $24.53.

Maintenance - #1

Name: _____ Date: _____

Watch the video for problems 1-4 and use the steps on the video or listed below to complete each problem. Problem 5 does not have a video.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am at a fast food restaurant and I want to buy a hamburger that costs $3.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My favorite shirt just went on sale for $14.82. I am headed to the mall to buy the shirt.

4. I am having my friends over this weekend for a party. I went to the store to buy a DVD for the party, and it cost $17.13.

5. I just bought a new video game for $24.28.

Maintenance - #2

Name: _____ Date: _____

Watch the video for problems 1, 2, and 4, use the steps on the video or listed below to complete each problem. Problems 3 and 5 do not have a video.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am at a fast food restaurant and I want to buy a hamburger that costs $3.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My friend and I are going to a basketball game tonight. I bought the tickets for $14.87.

4. I am having my friends over this weekend for a party. I went to the story to buy a DVD for the party, and it cost $17.13.

5. I just bought a new video game for $24.28.

Maintenance - #3

Name: _____ Date: _____

Watch the video for problems 1 and 2, use the steps on the video or listed below to complete each problem. Problems 3, 4, and 5 do not have a video.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am at a fast food restaurant and I want to buy a hamburger that costs $3.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My friend and I are going to a basketball game tonight; I bought the tickets for $14.87.

4. I went out to dinner with my friends and I paid. The bill came to $17.23.

5. I just bought a new video game for $24.28.

Maintenance - #4

Name: _____ Date: _____

Watch the video for problems 2 use the steps on the video or listed below to complete each problem. Problems 1, 3, 4, and 5 do not have a video.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I went to a taco shop and bought a meal that cost $4.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My friend and I are going to a basketball game tonight. I bought the tickets for $14.87.

4. I went out to dinner with my friends and I paid. The bill came to $17.23.

5. I just bought a new video game for $24.28.

Maintenance - #5

Name: _____ Date: _____

Use the steps below to complete the following problems.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I went to a taco shop and bought a meal that cost $4.49.

2. My friends and I are going to the water park for the day. I bought a ticket for $8.69.

3. My friend and I are going to a basketball game tonight. I bought the tickets for $14.87.

4. I went out to dinner with my friends and I paid. The bill came to $17.23.

5. I just bought a new video game for $24.28.

Maintenance #6

Name: _____ Date: _____

Watch the video for each problem and use the steps on the video or listed below to complete each problem.

- Read the story problem or listen to the video
- Identify the cost by circling the price
- Estimate the amount to be paid using the smallest number of bills by writing the estimate
- Give the money to the teacher
- Estimate about how much change you should get back (within $0.50) by writing the estimate
- Calculate and write the exact amount you should get back
- Use the cash register to make exact change using the least amount of bills and coins

1. I am at a fast food restaurant and I want to buy a hamburger that costs $3.49.

2. My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68.

3. My favorite shirt just went on sale for $14.82. I am headed to the mall to buy the shirt.

4. I am having my friends over this weekend for a party. I went to the store to buy a DVD for the party, and it cost $17.13.

5. I just made the basketball team and went to the department store to buy new basketball shoes for $24.53.

APPENDIX E

Participant Scoring Form

Student: _____ Date: _____

Teacher: _____ 2nd Teacher:_____

Time: _____

Phase: Baseline, Intervention, Maintenance Worksheet #: _____

Prices					
Read the story problem or listen to the video					
Identify the cost by circling the price					
Estimate the amount to be paid using the smallest number of bills by writing the estimate					
Give the money to the teacher					
Estimate about how much change you should get back (within $0.50) by writing the estimate					
Calculate and write the exact amount you should get back					
Use the cash register to make exact change using the least amount of bills and coins					
Steps Correct/ Steps	/7	/7	/7	/7	/7
Percentage	%	%	%	%	%
Number of times video was watched during the intervention phase only					

+ = Step completed correctly
- = Incorrect or did not complete step

Total steps corrects/ Total steps	/35
Total Percentage	%

Comments:

APPENDIX F

Behavioral Praise Statements

- Thanks for working hard.
- I like the way you are following directions.
- Great working.
- Thanks for following directions the first time.
- Thank you for keeping your hands to yourself.
- Thank you for having your eyes on your work.
- Thank you for being ready to work.
- Thank you for using a quiet voice tone.
- Thank you for being so polite.
- You tried hard.
- What a good listener.
- I like the way you are working.
- I appreciate you staying focused.
- You did a great job of reading the instructions and following the directions.
- I appreciate the way you worked today.
- I appreciate the way you remembered the classroom rules.
- I appreciate the way you came in and took your seat.
- You're doing a great job working.
- Thanks for coming over the first time you were asked.

APPENDIX G

Video Development Script – Intervention Story Problem #1

Step 1: Read the story problem

"I am at a fast food restaurant and I want to buy a hamburger that costs $3.49."

Step 2: Identify the cost by circling the price

Circle the price in the story problem

Step 3: Estimate the amount to be paid using the smallest number of bills by verbally stating and writing the estimate

"What bill or bills should I use?"

"I will give the cashier four one-dollar bills."

Write how many bills you will give on the worksheet

- 4 - $1.00

Get four one-dollar bills out of the cash register

Hold up the bills for the camera

Step 4: Give the money to the teacher

Give the bills to the teacher.

Step 5: Estimate about how much change you should get back (within $0.50) by verbally stating and writing the estimate

"About how much change should I get back? I should get about 50 cents back."

Write about how much change you should get back on the worksheet

- $0.50

Step 6: Calculate and write the exact amount you should get back

"Now I will calculate exactly how much change I will get back."

Use the worksheet and write down:

$4.00

- $3.49

_____

Do the subtraction problem. Your answer should be $0.51

Write your answer on your worksheet

- $0.51

“I should get 51 cents back.”

Step 7: Use the cash register to make exact change using the least amount of bills and coins

“What will 51 cents look like using the least amount of coins?”

Get two quarters and 1 penny from the cash register.

“My change should be two quarters and one penny.”

Video Development Script – Intervention Story Problem #2

Step 1: Read the story problem

"My friends and I are going to see the new movie that just came out. I need to buy my movie ticket for $8.68."

Step 2: Identify the cost by circling the price

Circle the price in the story problem

Step 3: Estimate the amount to be paid using the smallest number of bills by verbally stating and writing the estimate

"What bill or bills should I use?"

"I will give the cashier one five-dollar bill and four one-dollar bills"

Write how many bills you will give on the worksheet

- 1 - $5.00
- 4 - $1.00

Get one five-dollar bill and four one-dollar bills out of the cash register

Hold up the bills for the camera

Step 4: Give the money to the teacher

Give the bills to the teacher.

Step 5: Estimate about how much change you should get back (within $0.50) by verbally stating and writing the estimate

"About how much change should I get back? I should get about 30 cents back."

Write about how much change you should get back on the worksheet

- $0.30

Step 6: Calculate and write the exact amount you should get back

"Now I will calculate exactly how much change I will get back."

Use the worksheet and write down:

$9.00

- $8.68

_____

Do the subtraction problem. Your answer should be $0.32

Write your answer on your worksheet

- $0.32

“I should get 32 cents back.”

Step 7: Use the cash register to make exact change using the least amount of bills and coins

“What will 32 cents look like using the least amount of coins?”

Get one quarter, one nickel, and two pennies from the cash register.

“My change should be one quarter, one nickel, and two pennies.”

Video Development Script – Intervention Story Problem #3

Step 1: Read the story problem

"My favorite shirt just went on sale for $14.82. I am headed to the mall to buy the shirt."

Step 2: Identify the cost by circling the price

Circle the price in the story problem

Step 3: Estimate the amount to be paid using the smallest number of bills by verbally stating and writing the estimate

"What bill or bills should I use?"

"I will give the cashier one ten-dollar bill and one five-dollar bill"

Write how many bills you will give on the worksheet

- 1 - $10.00
- 1 - $5.00

Get one ten-dollar bill and one five-dollar bill out of the cash register

Hold up the bills for the camera

Step 4: Give the money to the teacher

Give the bills to the teacher.

Step 5: Estimate about how much change you should get back (within $0.50) by verbally stating and writing the estimate

"About how much change should I get back? I should get about 20 cents back."

Write about how much change you should get back on the worksheet

- $0.20

Step 6: Calculate and write the exact amount you should get back

"Now I will calculate exactly how much change I will get back."

Use the worksheet and write down:

$15.00

- $14.82

_____

Do the subtraction problem. Your answer should be $0.18

Write your answer on your worksheet

- $0.18

“I should get 18 cents back.”

Step 7: Use the cash register to make exact change using the least amount of bills and coins

“What will 18 cents look like using the least amount of coins?”

Get one dime, one nickel, and three pennies from the cash register.

“My change should be one dime, one nickel, and three pennies.”

Video Development Script – Intervention Story Problem #4

Step 1: Read the story problem

"I am having my friends over this weekend for a party. I went to the story to buy a DVD for the party, and it cost $17.13."

Step 2: Identify the cost by circling the price

Circle the price in the story problem

Step 3: Estimate the amount to be paid using the smallest number of bills by verbally stating and writing the estimate

"What bill or bills should I use?"

"I will give the cashier one ten-dollar bill, one five-dollar bill, and three one-dollar bills"

Write how many bills you will give on the worksheet

- 1 - $10.00
- 1 - $5.00
- 3 - $1.00

Get one ten-dollar bill, one five-dollar bill, and three one-dollar bills out of the cash register

Hold up the bills for the camera

Step 4: Give the money to the teacher

Give the bills to the teacher.

Step 5: Estimate about how much change you should get back (within $0.50) by verbally stating and writing the estimate

"About how much change should I get back? I should get about 90 cents back."

Write about how much change you should get back on the worksheet

- $0.90

Step 6: Calculate and write the exact amount you should get back

"Now I will calculate exactly how much change I will get back."

Use the worksheet and write down:

$18.00

- $17.13

_____

Do the subtraction problem. Your answer should be $0.87

Write your answer on your worksheet

- $0.87

“I should get 87 cents back.”

Step 7: Use the cash register to make exact change using the least amount of bills and coins

“What will 87 cents look like using the least amount of coins?”

Get three quarters, one dime, and two pennies from the cash register.

“My change should be three quarters, one dime, and two pennies.”

Video Development Script – Intervention Story Problem #5

Step 1: Read the story problem

" I just made the basketball team and went to the department store to buy new basketball shoes for $24.53."

Step 2: Identify the cost by circling the price

Circle the price in the story problem

Step 3: Estimate the amount to be paid using the smallest number of bills by verbally stating and writing the estimate

"What bill or bills should I use?"

"I will give the cashier one twenty-dollar bill and one five-dollar bill."

Write how many bills you will give on the worksheet

- 1 - $20.00
- 1 - $5.00

Get one twenty dollar bill and one five dollar bill out of the cash register

Hold up the bills for the camera

Step 4: Give the money to the teacher

Give the bills to the teacher.

Step 5: Estimate about how much change you should get back (within $0.50) by verbally stating and writing the estimate

"About how much change should I get back? I should get about 50 cents back."

Write about how much change you should get back on the worksheet

- $0.50

Step 6: Calculate and write the exact amount you should get back

"Now I will calculate exactly how much change I will get back."

Use the worksheet and write down:

$25.00

- $24.53

_____

Do the subtraction problem. Your answer should be $0.47

Write your answer on your worksheet

- $0.47

“I should get 47 cents back.”

Step 7: Use the cash register to make exact change using the least amount of bills and coins

“What will 47 cents look like using the least amount of coins?”

Get one quarter, two dimes, and two pennies from the cash register.

“My change should be one quarter, two dimes, and two pennies.”

APPENDIX H

Treatment Fidelity Checklist

Teacher: _____ Date:_____

Student: _____ Time: _____

Phase	Step Implemented	YES	NO
Set-up	Privacy screen is set-up		
	Cash register with specified money		
	Worksheet, scratch paper, and pencil for student		
	Data collection sheet and pen/pencil for teacher		
	Start video-camera		
Baseline	Present student with the worksheet containing the five story problems (same story problems can only be used for 3 sessions)		
	Instruct student to read the story problems and follow the directions		
	Collect data		
	Behaviorally praise, no academic praise		
	Graph student data		
Video Development	Present student with a script for each story problem		
	Provide the minimum number of prompts to ensure accurate completion of the problems		
	Film all 5 intervention story problems		
	Behaviorally praise, no academic praise		
	Edit videos to create 5 VSM		
Intervention	Present student with the worksheet containing the five story problems		
	Present iPad to student and assist the student as necessary in accessing the first video		
	Direct student to watch the VSM video for the first story problem		
	Following the first video direct the student to complete the first story problem		
	Collect data		
	*** Repeat the above steps for story problems 2-5.		
	Behaviorally praise, no academic praise		
	Graph student data		

Maintenance	Present student with the worksheet containing the five story problems		
	Instruct student to read the story problems and follow the directions		
	Collect data		
	Behaviorally praise, no academic praise		
	Graph student data		
	Determine if a booster session is needed		

Booster Session	Present student with the worksheet containing the five story problems		
	Present iPad to student and assist the student as necessary in accessing the first video		
	Direct student to watch the VSM video for the first story problem		
	Following the first video direct the student to complete the first story problem		
	Collect data		
	*** Repeat the above steps for story problems 2-5.		
	Behaviorally praise, no academic praise		
	Graph student data		
	Once student reaches 80% accuracy for three consecutive sessions, go back to maintenance		

APPENDIX I

Paraeducator Social Validity Questionnaire

Please answer the following questions about the study related to VSM and an iPad to teach counting exact money amounts.

1. Did you enjoy participating in this study? Why or why not?

2. What was the most challenging aspect for you in this study?

3. Did you see progress in the students and feel that this benefited their learning?

4. Any additional questions, comments, or concerns?

Participant Social Validity Questionnaire

Answer the following questions about the video made of you in your math class.

1. Did you like having a video made of you in class? Why or why not?

2. Did you like watching the video of yourself? Why or why not?

3. Did watching the video of yourself help you understand how to look at a price tag and count out the exact change?

4. What was your favorite part about learning how to count exact change?