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Teaching Addition to Students with Moderate Disabilities Using Video Prompting

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Academic performance for students with moderate to severe disabilities falls far behind their typically developing peers and puts them at risk for continued dependence after school ends. Video prompting is an evidence-based practice that has been used to teach various non-academic skills; however, few studies have focused on using video prompting to teach academic skills other than reading. This study used a delayed multiple baseline across students design to evaluate the use of video prompting to teach single- and double-digit addition to three students with moderate disabilities. Results indicated that all three students improved their accurate completion of addition problems immediately upon introduction of the video prompting intervention. In addition, all three students completely faded the use of the videos and generalized completing addition problems to another setting. Social validity of the intervention was high across all participants, their families, and their teacher.
Keywords: academics, addition, moderate disabilities, video prompting

People with significant disabilities often have considerably poorer outcomes when compared to people with less significant disabilities (Newman, Wagner, Cameto, & Knokey, 2009). For example, people with intellectual or multiple disabilities are the least likely to live independently or be engaged in employment, post-secondary education, or job training due to low functional skills (Newman et al., 2009). The Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (American Psychological Association, 2015) moves away from using an Intelligence Quotient (IQ) as a full measure of severity, but still considers scores of 36 to 49 to indicate moderate severity and less than 35 indicating severe to profound severity (Boat & Wu, 2015). The National Longitudinal Transition Study (NLTS2) found that the level of functional ability of a student when leaving school was the best predictor of post-school success. Specifically, having the ability to read and do basic math leads to more opportunity for employment and independent living. It is possible that teaching students with moderate to significant disabilities functional skills related to reading and math could ameliorate some of the challenges faced by this group.

When teaching math, addition and subtraction rely on a set of prerequisite skills called numeracy. Dougherty, Flores, Louis, and Sophian (2010) describe the following numeracy skills as necessary for success in future higher-order mathematics operations: counting with one-to-one correspondence, understanding place value, and composing and decomposing numbers. Students with even moderate disabilities require more explicit instruction to acquire these skills than their typically developing peers (Dougherty et al., 2010). When provided with this type of instruction, research shows that students with disabilities can acquire numeracy skills (Browder, Jimenez, & Trela, 2012; Browder et al., 2012; Skibo, Mims, & Spooner, 2011).

The National Council of Teachers of Mathematics (NCTM) state in *Principles and Standards for School Mathematics* (NCTM, 2000) that having high expectations and providing strong supports lead to high quality mathematics education, calling it the "Equity Principle" (NCTM, 2000). One of the supports they specifically mention is the use of technology. The authors describe technology as helping to achieve more equitable outcomes. However, high-quality instruction must accompany the use of technology to produce the outcomes needed for students with disabilities.

The Every Student Succeeds Act (ESSA) (2015) changed the requirement of No Child Left Behind (2002) from requiring the use of "scientifically-based" research to "evidence-based" research, laying out four tiers of evidence that would be compliant. Applied behavior analysis (ABA) has a long history of research and many practices have made their way into classrooms. The single subject designs used in ABA research falls under the second tier of ESSA requirements. Trump et al. (2018) identified methods such as direct instruction, self-monitoring, and specific descriptive praise statements as just a few of the applications of ABA used in schools. Modeling is another example with a long history of success. Bandura (1977) describes in his book, *Social Learning Theory*, that modeling can lead to acquisition of a wide variety of skills. His position was based on in vivo modeling, but the concept has been generalized to the use of technology. Bandura noted that the child must attend to the model for learning to take place. This can be difficult for students with disabilities.

Despite the data on outcomes and a mandate from ESSA, students with disabilities are not given instruction that helps address the deficits that can keep them from being as independent as possible. IDEA (2004) states that children with disabilities should be provided education that meets their needs and is designed to improve their future quality of life prospects, including employment and independent living.

A review of the literature shows little attention is given to mathematics interventions for students with moderate and severe disabilities. Of 36 studies included in a meta-analysis focusing on teaching mathematics by Spooner, Root, Saunders, and Browder (2019), 23 focused on numbers and operations but only four targeted addition. Because numbers and operations include prerequisite skills to addition, many of the included studies focused on counting, matching, money, and time. Knight, McKissick, and Saunders (2013) found similar results in an analysis of technology-based instruction. Of 29 included studies, none focused solely on mathematics and only three coupled a mathematics component with their language arts study. Both of these studies showed that students with more severe disabilities could learn the skills taught.

In a review of video-based interventions, Park, Bouck, and Duenas (2019) found 32 studies since 2004 that targeted the use of video-based interventions across multiple skill domains. Only three of the 32 included studies targeted an academic subject, although the subjects are not described. The majority of studies taught daily living skills (n=16). They also found 24 of the 32 studies combined the video-based intervention with other strategies, including error correction, prompting, and a system of least prompts. This is consistent with the use of systematic instruction found in the Spooner et al. (2019) and Knight et al. (2013) studies. Systematic instruction typically consists of reinforcement for correct answers, stimulus fading, the use of a system of least prompts, and error correction (Collins, 2012). Nineteen of the studies in the Spooner et al. (2019) study used systematic instruction as the teaching method. Knight et al. (2013) included five studies using technology that used all components of systematic instruction and an additional seven that included most of the components.

This suggests that video-based instruction, such as video prompting, warrants further study for teaching academic subjects, including mathematics. Video prompting is a form of prompting where the student views a brief video of an individual step of a task being performed, often from the student's viewpoint, and has the opportunity to complete that step before moving on to the next videoed step. Related to video modeling, where the student views the entire task being performed, video prompting has a growing research history demonstrating its efficacy in teaching functional, social, and vocational skills to students with different disabilities.

The current study aimed to fill the gap on video-based math instruction by teaching single-digit and double-digit addition to students with moderate disabilities using video prompting. This contributes to the existing research base in both video prompting and academic instruction. Three research questions were created for this study and were (a) To what extent can students with moderate disabilities learn addition skills using video prompting? (b) How can the video prompts be faded from the instruction most effectively? and, (c) What are the implications for practice if students acquire the basic computational skills via video prompting?

Method

Students

Three elementary school students who displayed deficits in math skills, had at least one Individualized Education Program (IEP) goal to improve math, and had a diagnosis of developmental or intellectual disability at a moderate to severe level (i.e., IQ 55 or lower or similar results on a standardized evaluation) were selected for this study. All students had to be able to manipulate a handheld computer device by waking it from a sleep state and finding and opening programs. They all attended a public suburban elementary school of approximately 600 students, one of 15 in the district. The district was largely Caucasian (81.9%) with a median household income over $100,000 per year.

Brian was a 7-year-old Caucasian male diagnosed with autism. He attended full-day kindergarten and received 60% of his instruction in a general education classroom. He joined the special education classroom for reading, mathematics, and social skills instruction, and he received speech therapy and occupational therapy 30 min each, once per week. His mathematics instruction consisted of using blocks to count when presented with addition problems. This was consistent with is IEP goal of solving addition and subtraction problems up to a sum of 10 with at least 80% accuracy in three of four trials.

Claire was a 7-year-old Caucasian female diagnosed with Fragile X syndrome. She participated in an inclusive first grade classroom for 60% of her day, came to the special education classroom for mathematics instruction and social skills development, and received occupational therapy at the school for 20 min per week. Her IEP math goal was to solve problems using her known strategies with at least 80% accuracy on two-thirds of trials with one or fewer prompts. The IEP team reported that she had "much difficulty with math problem-solving" and felt that was due to "deficits with working memory" related to her diagnosis.

Allison was a 9-year-old female from India diagnosed with multiple disabilities, including autism, hearing loss, and a chromosomal microdeletion. She wore a hearing aid during all sessions. She attended second grade in an inclusive classroom for about 20% of her day, which included lunch, recess, and specials (art, music, physical education). She also received both speech and occupational therapy at school for 30 min per session twice per week. Allison's IEP reported her math goal was to "write the number to represent a given presentation of a number of objects." Allison was just beginning to use manipulatives for addition.

Setting

All baseline and intervention sessions took place in a suburban elementary school special education classroom. The classroom served children with moderate to severe disabilities and the number of children in the classroom varied throughout the day. One teacher and three paraprofessionals worked with the children in the room. The room was divided into four different areas in which the staff and students could work. Sessions were conducted at a kidney bean-shaped desk away from other students to minimize distractions for both the study participants and the other students in the classroom. Allison had a special chair at the table, recommended by the occupational therapist. Because of her comorbid disability, the chair allowed her to sit up with more support than the regular classroom chairs.

After the school year ended, the parents of all students consented to hold additional sessions in their homes. The researcher (first author) set up appointments with each family at their convenience and conducted sessions in each home. Maintenance and generalization were conducted at the dining room table in the homes of the students. Claire's family was generally present during her sessions, either in the kitchen or living room. Brian and Allison completed their sessions with family in a nearby room and out of visual sight. All other parameters remained constant.

Materials

Materials for baseline included a worksheet with 10 single or double-digit addition problems with carrying, a pencil, and an eraser. Problems for the worksheets were generated using the website "Worksheetworks.com." A total of 180 problems were created for each type of problem. After removing duplicate problems from the website-generated worksheets, problems were transferred in groups of 10 to Excel sheets to increase the font to 48 and enclose each problem in its own box. The first 50 unique problems were used to create a total of five 10-problem worksheets for each type of problem. The problems on the worksheet were arranged vertically in three rows of three with a single problem in the fourth row. The worksheets were rotated, from sheet one to sheet five, across sessions to ensure that students did not have the same worksheet each day.

A Microsoft Surface RT 64 GB tablet was used to access and view the videos. All videos were presented using the Play Video app, which allowed each student to access their own folder with videos specific to their intervention. Task analyses were created for both single-digit and double-digit addition problems. A task analysis breaks down complex skills into their component steps (Cooper, Heron, & Heward, 2007). The steps in each task analysis were derived from information provided by the NCTM and tallies were used because of their similarity to concrete manipulatives. Flores, Hinton, and Schweck (2014) described the Concrete-Representational-Abstract (CRA) sequence for teaching math and showed that marks, such as tallies, were a functional equivalent to concrete base 10 blocks. Brian and Allison completed single-digit problems and Claire completed double-digit. Steps in the task analyses were similar, with the double-digit requiring more steps. After the task analyses were created, a video for each step was created that explicitly showed each step from the student's point of view. In each video, a worksheet, pencil, and the researcher's hand were visible, and the voice of the researcher narrated each step. Descriptions of each task analysis step and the video duration for each step is shown in Table 1.

Dependent Variables and Data Collection

There were two dependent variables for this study. The first was the number of addition problems correctly completed by the students. The second was the percentage of task analysis steps completed correctly across the entire worksheet of problems. If a step in the task analysis related to completion of the problem was incorrect, the corresponding problem was also counted incorrect. For example, if the student was adding five and three and he made nine tallies on the page, he would be procedurally incorrect as written in the task analysis. At that point, the researcher would provide error correction as described in the procedures section. This was necessary because the problem would have been incorrect if error correction had not been implemented. If the student made eight tallies, but counted nine, the problem would be counted correct, but the task analysis steps would not. The researcher also wrote contemporaneous anecdotal observations on the data sheets during each session to describe the errors that the students made during sessions. There was no analysis of those notes completed.

Table 1. *Initial Task Analysis Video Prompt Steps*
Note: Average video length was: single-digit, 10.3 s (range 8–12, sum, 31 s); double-digit, 17.4 s (range 11–22, sum, 87 s).

Task Analysis Step	Video Duration (sec)
Single-Digit	
1. Make small marks for each of numbers in the ones column	12
2. Count the number of marks	8
3. Write the number beneath the line under the ones column	11
Double-Digit	
1. Make small marks for each of numbers in the ones column	22
2. Count the number of marks	11
3. If the number is less than 10, write the number under the line. If the number is more than 10, put a 1 above the other column and the other number beneath the line.	19
4. Make small marks for each of the numbers in the tens column	16
5. Count the number of marks and write the number below the line	19

Interobserver Agreement and Procedural Fidelity

Interobserver agreement (IOA) and procedural fidelity was collected for 20% of sessions across all students and conditions by a team of trained three graduate students. Observers attended the sessions with the researcher and recorded IOA and procedural fidelity through direct observation of the researcher and the students. Agreement for both IOA and procedural fidelity was calculated using an exact opportunity agreement method (Billingsley, White, & Munson, 1980). Exact opportunity agreement is calculated by comparing the responses between the researcher and observer for each opportunity for a response. The results are reported as a percentage of correct matches against total opportunities for matches. It is the most stringent method of calculating agreement (Cooper, Heron, & Heward, 2007). Procedural fidelity was measured at the same time as IOA using the same data collection form.

Graduate student data collectors were trained using a behavioral skills training method. Behavioral skills training is a four-step teaching method that includes instruction, modeling, rehearsal, and feedback. For this study, the graduate students were given the data collection forms and an explanation of how to use them. The researcher then demonstrated how to use them during a live session with a confederate posing as a student. The graduate students then recorded their own data alongside the researcher during a live session with a confederate. After each trial, the researcher and graduate students compared their answers and discussed any discrepancies. The graduate students were considered trained when they reached at least 90% agreement during the training sessions. This took only one session for each graduate student.

Experimental Design

A variation of the multiple baseline across students design, called a delayed multiple baseline (Cooper, Heron, &

Heward, 2007), was used to assess the efficacy of the video prompting treatment. Using this approach allowed a demonstration of a functional relation between the intervention and subsequent increase in correct responding to the addition problems for each of the students, replicated across students. Each student was introduced to the baseline in a staggered format as they became available to the researcher. Maintenance and generalization data were to be collected when the students reached 95% correct on the task analysis solved for three consecutive sessions.

Procedures

Eligibility Testing

To be eligible for the study, students were tested to demonstrate their ability to complete addition problems. For intervention on single-digit addition, students were given a worksheet of 10 single-digit problems and asked to complete them without any help. Accuracy over 50% excluded the student from single-digit intervention. If the student completed more than 50% of the single-digit problems correctly, he was then given a worksheet with 10 double-digit problems and asked to complete them without any help. Accuracy over 50% on the double-digit worksheet excluded the student from the study. The 50% threshold was selected based on the probabilities of the students randomly guessing the correct answer. The number of potential incorrect answers varied by question, based on the numbers used, leaving the probability of the student recording the correct answer for any individual problem at 5.5% for single digit problems. The probability of correctly guessing all 10 problems was less than 1 percent.

Tablet Usage Training

Results of testing prior to baseline indicated that all students were able to wake the device and press an icon to open a program without prompts. Training on the specific program used to play the videos took place concurrently with baseline. In individual training sessions, students were taught to play and advance videos using a model-lead-test (MLT) methodology (Brasch, Williams, & McLaughlin, 2008; Engelmann & Carnine, 1982). The videos used in the training bore no resemblance to those used in intervention. The training videos depicted random, non-academic scenes and were used only to provide something to advance. Non-academic videos were chosen to eliminate any possible learning effects. In the current study, the researcher modeled how to play sample videos in order, advance and return to other videos, and replay a video as needed. Next, the researcher and student performed the actions together. Finally, the student performed the step independently. During this last step, errors made by the any student were corrected by resetting the device and providing either a gestural or verbal prompt, so an independent correct response was obtained prior to moving on. Claire and Allison achieved independence after one session. Brian required two sessions to reach mastery of this skill. Once the students had mastered the tablet usage, they were eligible to begin baseline assessment.

Baseline

The researcher performed all baseline and intervention procedures with the students. He brought each student individually to the work area and laid out the materials on the table in front of the student. Materials for baseline included a worksheet with 10 addition problems, a pencil, and an eraser. The researcher instructed the student to start working by saying, “Let’s see how many of these problems you can do today. I’ll set my timer for one minute. Ready? Go.” When the timer went off or the student completed the questions, the researcher collected all of the materials, provided verbal reinforcement for coming to the work area, and took the student back to their previous area. The one-minute interval was chosen because Van Houten and Thompson (1976) suggested students perform more problems when using one-minute timing than a longer duration. Using explicit timing allows for repetition of the skills that leads to fluency. Repetition of practice is important for skill building, particularly for students with disabilities (Greene, Tiernan, & Holloway, 2015). None of the students required a full minute to complete the worksheet in any session. No teaching or prompting from the researcher occurred during the baseline phase.

Intervention

As in baseline, students were asked to come to the work area and presented with a worksheet with 10 problems, a pencil, and an eraser. Additionally, the students were presented with the tablet in sleep mode containing the videos. The researcher told the student “Time to do some addition problems using the tablet. Wake up the tablet, find the videos, and begin.” The student then started the tablet, found the videos, and played them to complete the questions on the worksheet. If the student made an error during any step of waking the device or finding the videos, the researcher provided prompting using a least-to-most hierarchy of verbal, gestural, or physical prompts.

If the student made an error when completing the addition problems, the researcher stopped the student, reset the scene, and directed the student to replay the video and try again. The researcher did not provide specific feedback about the error in the correction to avoid any additional teaching effects. Because videos were providing the instruction, having the researcher provide specific feedback on errors would have introduced a confound to the functional relation between the intervention and the learning. If the student made an error a second time on the same step, the researcher completed the step for the student while blocking the view of the worksheet. The view was blocked to eliminate a learning opportunity that was not from the intervention. Additionally, having the researcher complete the step after a second error kept the student from practicing errors. The researcher then instructed the student to continue to the next video. This continued until the student completed all problems on the worksheet.

When students reached 75% correct for three consecutive sessions during intervention, the instructions were changed to “Time to do some addition problems using the tablet. Wake up the tablet, find the videos, and begin. If you can do the problem without using the videos, go ahead and try.” The student was verbally reinforced by the researcher for continuing to work during the session and, at the end of the session, received a tangible item or preferred activity recommended by the teacher based on her daily preference assessment earlier in the day.

Maintenance and Generalization

All students had reached at least 90% accuracy on correct steps completed on the task analysis by the end of the school year but had not fully reached the 95% for three consecutive sessions criteria as originally set out. Because they had reached 95% and the intervention location was no longer available, the researcher made the decision to move all to the maintenance and generalization phase. Maintenance and generalization phases were conducted after the end of the school year in the students' homes. Eight more sessions were conducted with Claire, seven more with Allison, and four more with Brian. The worksheets for this phase remained the same and students were instructed to complete the problems without the videos. The tablet was available on the table if the student made an error. When the student did make an error on a maintenance problem, the scene was reset, and they were directed to watch the step in the video and complete it again. As in the intervention sessions, students were verbally reinforced for working during the session and then provided their choice of tangible or activity reinforcement based on parental report of preferences.

Setting generalization was assessed in the home of the students at the same time maintenance was probed. Each student performed the task at their family's dining room table. Although baseline and intervention were conducted at a table in the classroom, the table in generalization was different and the surrounding environment was also different. Materials were the same as baseline and intervention.

Questionnaires to assess social validity were given to the classroom teacher, each of the parents, and each of the students. The parents were instructed to help the students fill out the form. Each form contained a series of questions about the procedure that were rated on a five-point Likert scale (Strongly Disagree = 1, Strongly Agree = 5) for the teacher and parents and a "Yes/No/Unsure" scale for the students. In addition, each survey had a few open-ended questions designed to elicit feedback to enhance the procedure for future studies.

Results

Overall

All students had very low levels of correct responding in baseline. Visual inspection was employed to examine the level, trends, and variability of the data between conditions. This is the typical analysis used for single case design studies (Cooper, Heron, Heward, 2007). Analysis shows an immediate change in level from baseline to intervention across all participants for both steps in the task analysis and number of problems solved correctly. Figures 1 and 2 display the results across both dependent measures. Breaks in the lines in any phase of the graph indicates that the student did not have a session that day. Baseline trend was generally flat, although there is some variability in the data for Brian. An increasing trend in the intervention phase can be seen in all three students. Maintenance responding was high across all three students. Variability was generally low around the trend line, except for baseline data for Brian.

Visual inspection indicated the intervention had a large effect on the acquisition of the skill. A statistical effect size was calculated using Tau-U (Lee & Cherney, 2018; see Table 2). For each student, the intervention produced a positive effect on responding. The effect size was significant for each student and also when student scores were combined to create an omnibus score. Parker and Vannest (2009) suggest that any Tau-U value between +/- 0.66 and +/- 0.92 is a medium and above +/- 0.93 is a large effect. Claire and Allison showed large effects for both dependent variables. Brian showed a large effect on problems correct but only a medium effect on correct steps on the task analysis. When combined across all students, the effect of the intervention compared to baseline was large for both measures.

Brian

During testing at the beginning of the study, Brian correctly answered only one problem on the worksheet. Brian's baseline results, although highly variable, fell below chance correct responding. On the dependent variable of task analysis completion, he ranged from 12.5% to 42.5% over six baseline points and he completed a total of five (out of 30) problems correctly and zero correctly on three occasions. When the videos were introduced, he immediately increased both the number of steps of the task analysis completed correctly and problems solved correctly. Problems completed correctly averaged 6.9 during intervention and ranged from three correct on the first day to a high of nine correct. The percentage of correct task analysis steps ranged from 60.8% to 98.3% with a mean of 84.5% of steps correct. Most of Brian's errors stemmed from his difficulties with writing the marks so that he could accurately count them. That is, he would write the marks so close together that he would count multiple marks as a single mark. This led to incorrect problems and task analysis responses. These anecdotal notes were written on the data collection sheet by the researcher during sessions as they were observed. He completed some of the steps of the task analysis without the videos after several sessions.

Table 2. *Tau-U Values for Individual Students and Combined Across Students*

Problems Correct	Tau	P value	Confidence Interval (90%)
Brian	0.9848	P=0.0011	0.489< >1
Claire	1.0000	P=0.0062	0.399< >1
Allison	1.1714	P=0.0009	0.593< >1
Combined	1.0458	P=0.0000	0.727< >1
TA Steps Correct			
Brian	0.8939	P=0.003	0.398< >1
Claire	1.0000	P=0.0062	0.399< >1
Allison	1.0000	P=0.0062	0.399< >1
Combined	0.9551	P=0.0000	0.633< >1

Two weeks after the school year ended, maintenance and generalization sessions began in Brian's home. His results indicated that he maintained the skills and generalized it to a new setting. His percentage of task analysis steps completed correctly remained high, with an average of 97.2% in the maintenance and generalization phase. Also, he was able to correctly complete the addition problems at an average of 8.8 correct. He used the videos for a total of three problems during the first two maintenance sessions. During the last two sessions, Brian completed the worksheet without using any videos.

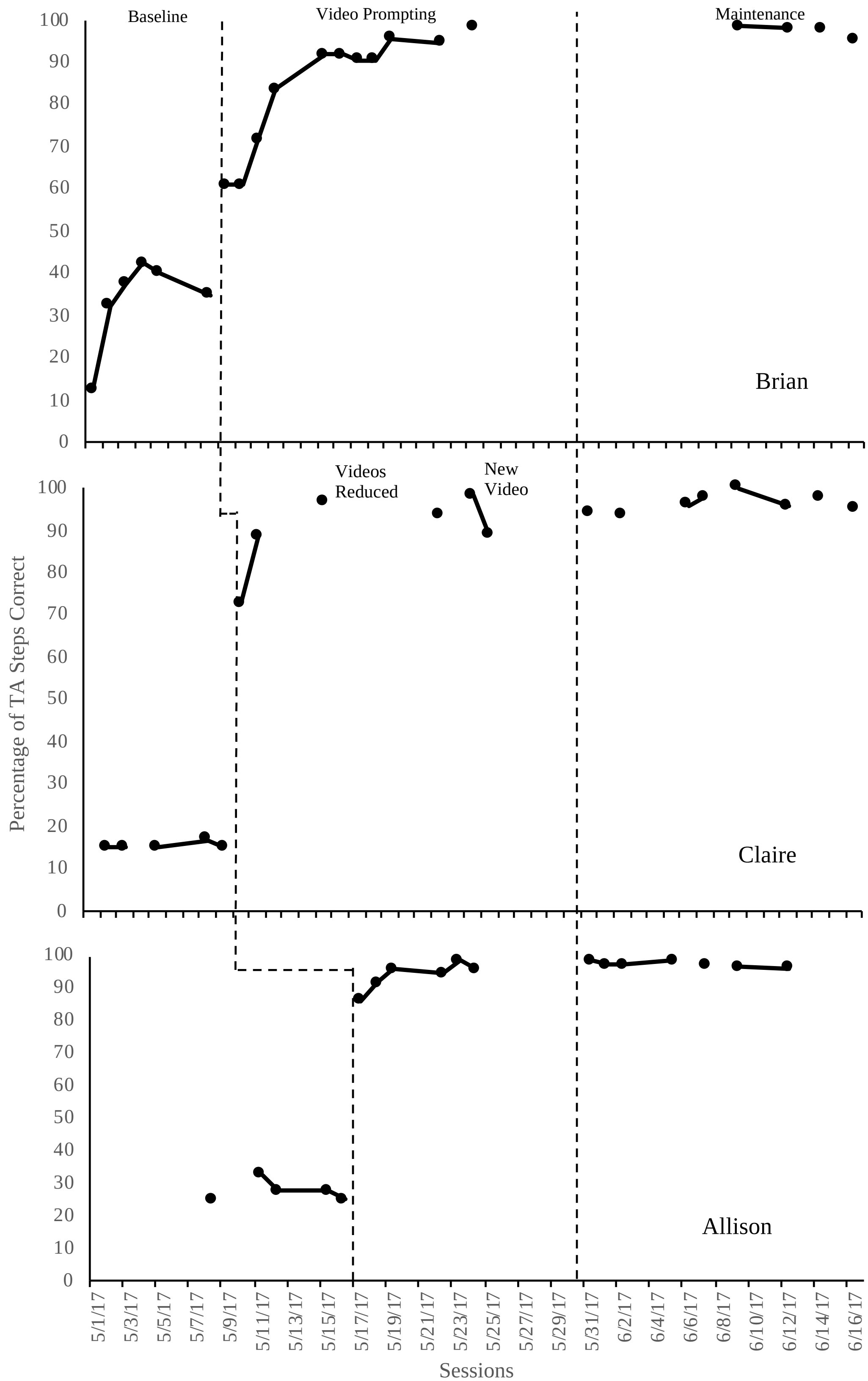

Figure 1. Percentage of task analysis steps correctly completed.

Claire

Initial testing showed that Claire was currently able to correctly complete all 10 single-digit addition problems without prompting, but she wrote random numbers for answers for all 10 problems when presented with the double-digit worksheet.

Claire completed double-digit addition problems for the intervention. During baseline, she wrote numeric answers, but none of them were correct across five sessions. Her percentage correct on the task analysis ranged from 15.0% to 16.7%. Once the intervention was applied, she responded to the videos and completed certain steps in the task analysis without using the video. After three sessions in intervention, all videos except the third were removed from her folder and she was directed to use that video when the sum of the numbers in the ones column was greater than 10. She did this but still struggled to add the three numbers in the tens column together. A new video was added after five intervention sessions that showed the researcher adding the first two numbers together, writing the total next to a small arc connecting them, and then adding that sum to the last number in the column. This change increased her average percentage of task analysis steps correct from 90.7% to 97.0% and her average correctly answered questions from 7.4 to 8.4.

After a one-week break at the end of the school year, Claire had her first maintenance and generalization session. She had already faded the use of the videos to a single video to show adding the tens column with the carried number. During the maintenance phase, that video was faded completely. The video was available to her but not used. Her errors during these sessions were addition errors rather than procedural errors. These errors were counted as incorrect for the problems completed but correct for following the task analysis.

Allison

Initial testing showed that Allison was unable to perform simple single-digit addition problems. She could read the problems correctly but was not able to complete any of the 10 problems accurately. Instead, she wrote random numbers. During baseline, Allison answered no more than two questions correctly and followed no more than 32.5% of task analysis steps without training. However, Allison quickly increased the number of problems answered correctly to an average of 7.1 (range: 6–9) correct. Her use of the task analysis increased to 93.9% of steps done correctly with the videos. Like Brian, she sometimes made her marks too close together and counted incorrectly. She, too, performed some of the steps without the use of the video, but would often play the video for the step she just performed as part of the routine.

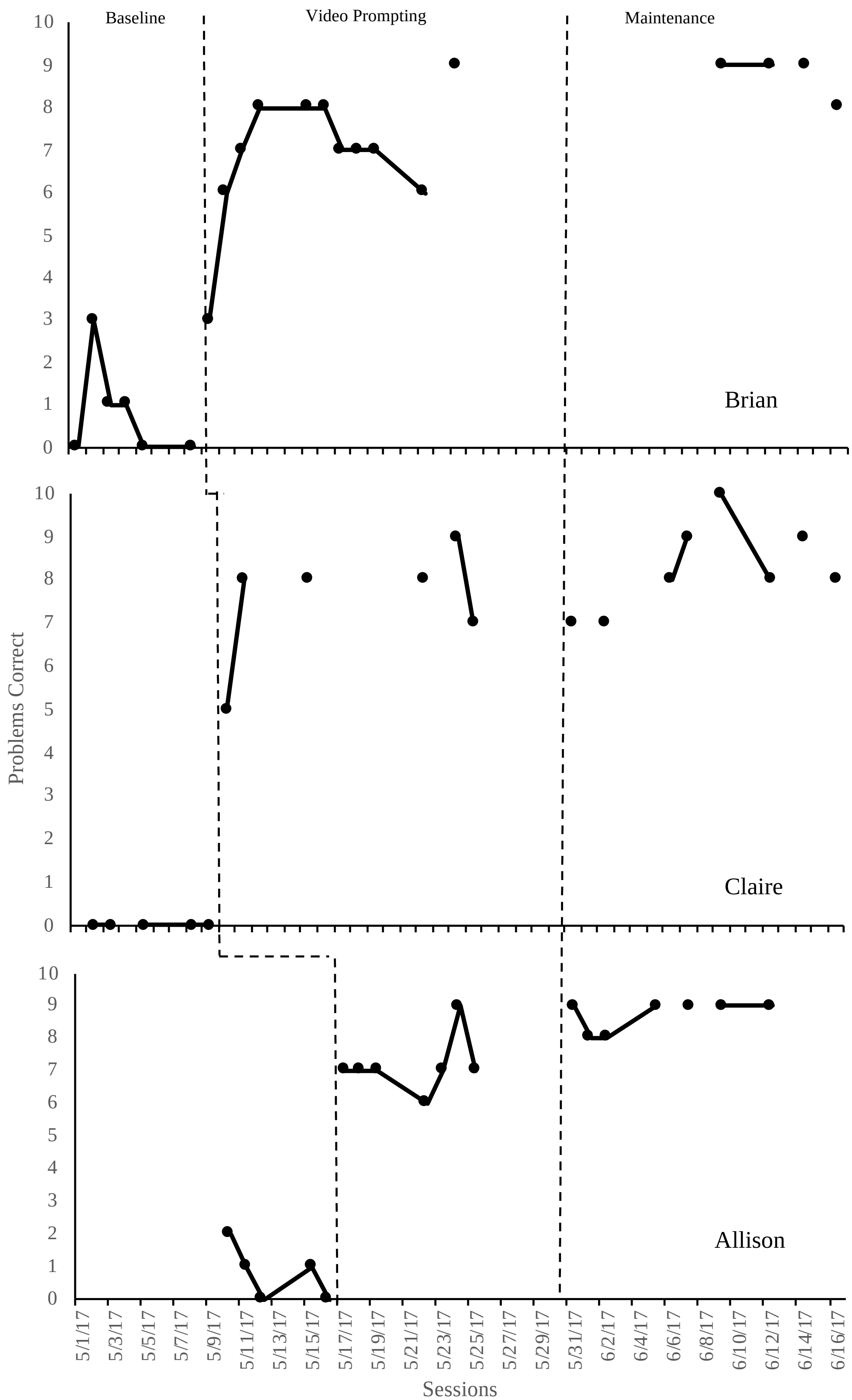

Figure 2. Number of problems completed correctly

A week passed from the end of school to the beginning of Allison's maintenance and generalization sessions at her home. Her percentage of task analysis steps completed correctly averaged 97.3% and she averaged 8.7 correct problems. The instructions continued to be for Allison to try and do the problems without the videos if she felt she could, but she still used them during the first two sessions despite completing the steps while the video was playing. The videos were then withdrawn and not available to her, except for error correction, for the remaining four sessions. Without the videos, she continued to complete the problems and task analysis steps correctly.

Interobserver agreement and procedural fidelity

Overall agreement was 98.4% (range: 83.3–100%) across all sessions and students. Interobserver Agreement for Brian and Allison was 100% across all sessions. Claire's data showed a disagreement on two steps during one baseline measure resulting in 83.3% agreement that day. This dropped her individual IOA to 97.2% across all sessions. Overall procedural fidelity was 95.6% (range: 66.7–100%) across all sessions.

Social Validity

An analysis of the mean scores of the questions from the parents showed they felt the intervention was appropriate for their child (4.7/5), helped their child learn the task (5/5), and could be used at home for further teaching (4.7/5). All three students indicated they liked using the videos and felt they helped them do math. The classroom teacher strongly agreed that the intervention was something she could use in her class, the students enjoyed using the videos, and the strategies were appropriate for her students. Table 3 shows the results for all questionnaires.

Discussion

The videos were successful in increasing the accuracy of responding for all three students. Single-digit addition was more amenable to using videos for teaching the basic concepts of addition. This is likely because several parts of the double-digit task analysis include the specific skills being taught in single-digit addition. The repetition for double digit is not necessary for the entire task. Focusing on the specific differences between single- and double-digit addition should be sufficient once a student has mastered single-digit addition.

Both Brian and Allison had been using manipulatives for addition and the methods in the task analysis of making marks was a similar concept. For both students, introduction of the videos led to a significant increase in correct problem solving. This offers promise for classroom teachers. Bandura (1977) wrote as part of his social learning theory that children learn through watching others. He also said that models that are displayed by some form of televised mechanism are powerful at capturing the viewer's attention. It then followed that attending to the model was critical to acquiring the skills. Because of the prevalence of videos in the lives of children today, using a video model or prompt in the classroom can provide a consistent model for them to see. Additionally, using video prompting for instruction can free the teacher up for more intrusive prompting for specific students rather than attending to everyone at once.

Table 3. *Social Validity Questionnaire Data*

Teacher Social Validity Questions	Mean Sco
1. As a result of this strategy, the target students were able to complete more math problems	4
2. I would not be interested in implementing this strategy on my own	1
3. I saw the students using the techniques in the study in other settings	4
4. The strategies used with the students were something I could use in class	5
5. The students enjoyed using the videos to do math	5
6. The amount of time required to use this strategy was reasonable	5
7. I feel the strategies used were appropriate for the students	5
8. I would need ongoing consultation to keep implementing this strategy	3
9. Implementation of this strategy would require considerable support from other school staff	2
10. I am motivated to use this strategy	4
11. I understand the procedures of this strategy	4
12. I would use this strategy with other students	4
Parent Social Validity Questions	
1. My child needed help completing math problems	5
2. My child works well with one-to-one teaching	5
3. Videos hold my child's attention	4.7
4. Having consistent instruction is important to my child	4.3
5. I noticed my child improving his/her addition	5
6. Children can learn effectively using videos	4.7
7. I feel the strategies used were appropriate for my child	4.7
8. Students learn better from teachers than videos	3.3
9. This strategy could be used at home to help with homework	4.7
10. My child needs prompting to complete tasks	4
Student Social Validity Questions	
1. Did you like using the videos to do math?	1
2. Did the videos help you do math easier?	1
3. I like to do math problem	1
4. The videos were easy to understand	0.7
5. The videos helped me know what to do	1
6. I don't need to use the videos to do math	0
7. Math is hard for me to do	1

For Teacher and Parent: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor disagree, 4 = Agree, 5 = Strongly Disagree. For Student: 1 = Yes, 0 = No

Double-digit addition, at least for Claire, did not require as intensive a task analysis or video prompting. She did not enjoy the videos, possibly because they showed the single-digit steps in which she was already proficient. She easily performed the single-digit addition in each column when presented with two numbers. However, the two steps of carrying and adding all three numbers in the tens column caused many errors for her. When it was determined that she could not add a column of more than two numbers at a time, the video was adapted to show an alternative method for adding the tens column. Once this change was made and she viewed the video a few times, she no longer needed the video. This consistent video prompt was able to teach her a method for adding three numbers together in the context of a double-digit addition problem.

The new video that Claire used showed the carrying and then two separate addition problems within the tens column. Using this new video, Claire immediately improved her accuracy. By providing video prompts for only the steps with which she struggled, Claire was successful in learning double-digit addition. This strategy can be used after initial training with video prompting to teach single-digit addition.

Both Brian and Allison enjoyed the videos and wanted them available even when they weren't needed. Because both had reached over 90% accuracy on following the task analysis prior to the maintenance phase, the reason for them wanting the videos is unclear. In both cases, they would complete the step before watching the video.

Sigafoos et al. (2007) suggested that video prompts could be faded by combining them together into larger "chunks" until the videos were merged into a single video encompassing the task. This was considered for the current study; however, because there were only three videos, it was determined that simply withdrawing the videos would be a better solution. Sigafoos et al. (2005) demonstrated that students can maintain the skill with immediate withdrawal of the videos once mastery criteria have been met. In the present study, Brian and Allison maintained the task analysis steps after the videos were withdrawn.

The results of the social validity questionnaires indicate that this was a valued and successful intervention. The teacher felt she could implement it in her classroom with a minimal amount of support after training. She also said that she saw "some improvement and motivation by my students in their abilities to complete addition problems" in the open-ended question section. One parent commented that she would like to see more interventions like this in the classroom. All parents said they noticed improvements in their child's ability to do math problems.

Limitations

Although the intervention was successful in addressing the skill deficits for the participants, there are several limitations that should be addressed in future studies of this topic. First, the sample size was only three participants. Two of the students learned single-digit addition problems and the other learned double-digit addition problems. While all students improved their mathematics skills, having all students working on the same skill would have given more strength to the efficacy of the intervention.

Second, this skill taught was just one way to help students with addition problems. Others, such as touch math or the use of a number line, could also be taught using the same methods. Depending on the skills of the participants, alternative methods might be more appropriate. For this sample, tally counts were appropriate and did lead to skill acquisition. As mentioned previously with the CRA teaching sequence, tallies can present a similar form to the concrete manipulatives previously used (Flores, Hinton, & Schweck, 2014).

Brian had difficulty generalizing the actions in the video to the worksheets for the first two intervention sessions. He wanted to write what he observed in the videos instead of attending to the worksheets. The videos were created using the same worksheets the students used. Although the other two students were able to generalize, it is possible the narration in the videos caused some problems for Brian. While this was a problem only with Brian, it may be important to differentiate the materials used in the video from the ones used in the intervention in the future, allowing the salient features of the video prompts to be clear to the viewer.

Future Studies

Both single-digit and double-digit addition were the targets for the students and focus of the study. Future studies should examine other techniques for teaching both single-digit and double-digit addition. Comparing this method to other available methods, such as touch math, can identify which method is more effective for use in the classroom. Also, future studies should look at other math skills, such as subtraction, multiplication, or division. These basic math skills are important for future independence of the students and are skills used in functional living and vocational tasks as the students age. Because they can also be broken down into task analyses, they are amenable to use with video prompting.

Also, video modeling could be as effective as video prompting due to the small number of steps in the task analysis for single-digit addition. The combined duration of the videos for single-digit addition was 31 seconds. This is a short enough duration that students should be able to attend for the duration of the video. Matson and Smiroldo (1999) suggest that reducing the cognitive load required to complete a task, students with disabilities could acquire skills faster. This is based on Bandura's (1986) theory that learning takes place when the student is attending to the material and is retaining the material in memory. A study comparing the two methods on the same task could demonstrate the utility of each in teaching academic skills.

As Claire's response to the videos showed, focusing the videos used in the intervention on those steps where the student specifically struggled could be all that is required for a similar student in the future. By studying the effect of faster chunking of videos or removal of unnecessary videos compared to showing only videos of specific steps, researcher could examine the most effective teaching method for students with some of the skills required to complete the task. This not only applies to teaching mathematics, but to any skill taught by video prompting.

Finally, the first author conducted the sessions with the students during all phases. Since this intervention taught an academic subject, it would be relevant to explore how the results may differ when taught by classroom staff instead of a researcher. Having the teacher or other classroom staff provide the intervention could help validate the method as an appropriate technique for teaching addition.

Conclusion

This intervention was an attempt to further the research into the use of video prompting to teach students with moderate to severe intellectual disabilities. Previous research has focused on vocational skills, daily living skills, and play skills. Because of the societal focus on academic outcomes for this population, an extension of the use of video prompting to this area is important. Knight, McKissick, and Saunders (2013) found no studies that directly targeted math in a literature review of technology used for teaching academic subjects. Broadening the range of studies that use video prompting to teach academic subjects other than reading would be a good extension of research.

In summary, this study attempted to show that video prompting could be an effective teaching method for addition to early students. Data show the intervention led to rapid acquisition of the skill which maintained over time and with the withdrawal of the prompts. While more studies are needed on this topic, the research base on video prompting has been extended to another skill domain and the efficacy of video prompting as a teaching method for students with moderate to severe disabilities has again been demonstrated.

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