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ABSTRACT

Prior research suggests that the use of multimedia instruction along with video modeling increases the ability of individuals with intellectual disability (ID) to independently complete tasks. However, the previous research has not always included instruction of the underlying vocabulary, nor has it always resulted in skill maintenance. The purpose of the current study was to compare the effectiveness of multimedia instruction using video modeling to teach pedestrian safety signs to participants with ID to support skills needed for community. The effectiveness of the multimedia intervention was measured using a randomized control trial utilizing a pre-/posttest design. Participants' knowledge grew significantly from pre-to posttest, and there were no significant differences between the groups. Current results are similar to prior research findings indicating multimedia instruction is effective in teaching skill acquisition. We discuss practical implications of these findings as well as future research on teaching pedestrian safety to postsecondary individuals with ID.

KEYWORDS

intellectual disabilities, mobility, multimedia instruction, postsecondary, safety

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*P*ostsecondary education (PSE) programs for those with intellectual disabilities (ID) are mechanisms to increase positive post-school outcomes (Grigal et al., 2012; Marcotte et al., 2005). Individuals with ID in postsecondary programs receive continued education on topics such as independent living, job training, and other real-life experiences (Grigal & Hart, 2010). There are numerous benefits of independent living for those with ID such as increased community involvement, self-determination skills, and inclusion (Bigby & Beadle-Brown, 2018; Stancliffe et al., 2000).

Despite the efforts to increase independent living and job training, the National Core Indicators reported that only 17% of individuals with ID live independently (i.e., their own home or apartment) and 34% are employed (Human Services Research Institute [HSRI], 2018). According to the National Longitudinal Transition Survey (NLTS), independent living and employment rates for individuals with ID are significantly lower than for those with other high incidence disability groups (i.e., learning disabilities, emotional disturbance; Newman et al., 2011).

Additionally, various national and world organization (e.g., Council on Quality and Leadership, the United Nations Convention on Rights of People with Disabilities) have called for full participation and community inclusion for individuals with ID. As a result, many researchers have looked at various strategies and concepts for improving community inclusion for individuals with ID. A review by Novak Amado et al. (2013) found that while physical segregation has become less prominent, true social inclusion continues to be a challenge. As a result, research focused on identifying various strategies that help to build more inclusive community participation continues to be a high need.

Characteristics of Individuals With Intellectual Disabilities

To live independently, individuals with ID need skills to navigate their environment successfully, whether to stores, work, or to participate within their communities (Karimi et al., 2014). Unfortunately, nearly two decades of research have shown that individuals with disabilities experience a higher rate of injuries due to pedestrian collisions than their peers without disabilities (Sinclair & Xiang, 2008; World Health Organization, 2013; Xiang et al., 2005). Given these outcomes, it is critical for postsecondary programs to promote pedestrian safety skills. The purpose of this study is to evaluate the effects of two forms of safety skill instruction for individuals with ID. In the following paragraphs, we describe a critical need for this form of instruction and then describe our randomized controlled trial within a postsecondary education setting.

Skill acquisition can prove challenging for individuals with ID given the differences in intellectual functioning and adaptive behaviors (Alloway, 2010). Intellectual functioning differences typically manifest as learning difficulties related to attention, memory, language development and comprehension, self-regulation, social development, motivation, and metacognition (Alloway, 2010). As a result, much research has focused on strategies to increase skill acquisition for individuals with ID (e.g., Bowman et al., 2019; Carlson et al., 2020; van Dijk & Gage, 2018). Additionally, technology can play an important role in facilitating social inclusion for community members with ID. A recent review by Manzoor and Vimarlund (2018) found that a variety of technological tools have been promoted to successfully help those with ID integrate into the community, everything from social media apps to assistive educational technology. Manzoor and Vimarlund (2018) call for further research into various technologies aimed at promoting social inclusion for individuals with ID. One strategy that has been studied in educational settings and shown to have promising and positive effects includes types of multimedia instruction.

Multimedia Instruction

Multimedia instruction is an extension of live instruction. Multimedia videos are one instructional tool that complements traditional classroom instruction. Multimedia videos combine still images, text phrases, and audio narration to teach key concepts or facts on a central topic (Ely et al., 2014;

Kennedy et al., 2014). Instructional videos may be aligned with Mayer's (2008) Principles of Multimedia Instruction. Mayer's principles aim to make learning efficient and reduce cognitive load through practices such as highlighting essential information and efficiently pairing visuals and text. Furthermore, instructional videos can be paired with video models or brief clips, showing a person engaging in the skill paired with instruction and observational learning (Hirsch et al., 2019). Together content paired with the video model is intended to build preliminary knowledge on a topic. Videos are recorded and generally hosted via online video sharing platforms (e.g., Vimeo or YouTube) and can be viewed asynchronously. The advantages of the multimedia approach are that it eliminates time and space constraints posed by traditional class formats, enables the viewer to pause or repeat the recording to process or take notes, and preserves in-class time for more hands-on or higher-order activities (Carlisle et al., 2016).

Research in Multimedia Videos

Video modeling is an effective method to present information in real life scenarios (Mechling, 2008) and has been found to be an effective method for teaching skills to individuals with ID (Banda et al., 2011). For example, Kanfush and Jaffe (2019) completed a single case research design, utilizing an AB (baseline – intervention) design with video modeling and video-prompting to complete a food preparation task analysis (50-64 steps). Three out of four participants completed at least 90% of the tasks independently, while the fourth completed 89% independently. The authors indicated video modeling may be a very effective and efficient method for promoting independence and self-determination for those with moderate ID (IQ range of 36-49). Another study by Randall et al. (2019) used a single case multiple baseline across participants design with a task analysis app, which provided video modeling and prompting to complete several office tasks (i.e., copying, scanning, shredding). All four participants had moderate ID and were able to complete the three office tasks with 100% accuracy using the video modeling and prompting provided by the task analysis app. Mechling (2004) examined the effectiveness of a multimedia program (e.g., Hyperstudio program) for individuals with ID to increase their overall grocery shopping fluency (e.g., reading aisle signs, locating correct item). Training sessions occurred either one- or two-times per day over four to five days, each lasting approximately 23 minutes. Findings indicated the multimedia program alone was effective in increasing the fluency of reading aisle signs and locating items, without the use of an adapted grocery shopping list.

Spivey and Mechling (2016) found video modeling with three individuals (all 21 years of age) with ID was partially effective at teaching social safety skills. Participants were able to learn and generalize their ability to verbally respond (e.g., stating "I don't have any money") to social threats (i.e., strangers requesting personal information, money, or entering personal space), but did not generalize their ability to physically respond (e.g., move away from stranger). Ayres and Cihak (2010) examined the use of computer-based video instruction on teaching the life skills of using a microwave, setting a table, and making a sandwich. Researchers broke down all the steps into a task analysis and utilized computer software that presented video models performing each skill, depicted in first person perspective of the action. Following the video instruction, participants had the opportunity for a behavioral rehearsal of the skill. Results indicated that the computer-based video instruction was effective in helping all participants master the skills.

Overall, the multimedia instruction in previous studies increased participants' ability to independently complete various tasks of interest, but skills were not always successfully maintained or generalized to other contexts (Ayres & Cihak, 2010; Spivey & Mechling, 2016). In

addition to studying video modeling and prompting, researchers may need to address methods of teaching vocabulary associated with independent living skills, particularly for knowledge and skills outside the home like recognizing signs or print when shopping or reading safety signs. Spooner et al. (2012) reviewed methods for teaching individuals with ID vocabulary terms. Results suggested task analysis and discrete response (those that consist of a single step [Collins, 2007]) were the most common method for teaching vocabulary. Using quality indicators, Spooner et al. (2012) identified both task analysis and a discrete response as an evidence-based practice. While the majority of studies in the review mainly taught sight word identification or vocabulary terms (e.g., state capitals), only a few focused on daily living skills (e.g., purchasing items). Identification of sight words does not always include comprehension instruction of the term. Individuals with ID need additional vocabulary instruction to explicitly link the term to meaningful activities resulting in more significant comprehension of the word (Courtade et al., 2010; Spooner et al., 2012). Providing meaningful contexts becomes even more critical when the vocabulary is related to independent living skills, particularly safety skills.

Video modeling is considered an evidence-based practice for individuals with ID for teaching independent living skills (National Technical Assistance Center on Transition, 2019), although a shortcoming of this work is that most video modeling studies did not include explicit instruction in or assessment of related vocabulary knowledge. Therefore, less is known about explicit instruction of pedestrian safety skills with individuals with ID in postsecondary settings, which potentially could impact ability for generalization. To address this gap, we sought to examine whether multimedia videos is as an effective instructional method for teaching individuals with ID new concepts (i.e., pedestrian safety signs). In addition, we sought to examine how individuals view the multimedia video. Using a randomized controlled research design, we posed two questions:

1. Is multimedia instruction as effective as in-person instruction at teaching pedestrian street signs to individuals with ID?
2. What are the individuals with ID perceptions regarding the use of multimedia videos to help with the acquisition of pedestrian crossing sign vocabulary?

Method

Participants and Setting

Participants included 21 young adults with ID attending a four-year PSE. The PSE is located in the southeastern United States at a medium-sized public university with approximately 20,100 undergraduate students. The PSE program provides an integrated course of study for 40 individuals with ID to develop independent living and employment skills. Freshmen and sophomore PSE students live on-campus and as they become familiar with the area and navigate campus and the surrounding community independently. However, even with the intense instruction and guidance on proper pedestrian safety, there continued to be a variety of pedestrian safety concerns (e.g., wearing headphones and not hearing cars, crossing the road during the no-cross signal was displayed, etc.). The intervention used in this study was created to help address various pedestrian skill deficits. To be included in the study, participants needed to meet the following criteria: (a) be enrolled in the basic portion of the PSE program (freshman and sophomore years) designed for young adults with ID, and (b) have a diagnosis of mild or moderate ID (i.e., IQ of 36-70). See Table 1 for participant demographic information. Participants received intervention and control

conditions in classrooms that are used daily for classroom instruction. The classrooms were both approximately 30 X 30 feet. The room has approximately eight tables (two-by-four feet) with two individual seats at each.

Table 1. Participant Demographics

	Control % (*n* = 10)	Treatment % (*n* = 11)	Total (*N* = 21)
Freshmen	24% (5)	29% (6)	52% (11)
Sophomores	24% (5)	24% (5)	48% (10)
Females	24% (5)	33% (7)	57% (12)
Males	24% (5)	19% (4)	43% (9)
Mean Age	20.7	20.4	20.5
Mean IQ	51.4	50.4	50.85
Comorbid Diagnosis			
Down Syndrome & ID	29% (6)	33% (7)	62% (13)
Fragile X & ID	5% (1)	0	5% (1)
Autism or Asperger's & ID	10% (2)	0	10% (2)
Intellectual Disability	5% (1)	19% (4)	24% (5)

Research Design

A randomized control trial using a pre/posttest design was utilized in the current study. Participants were randomly assigned to intervention and comparison conditions and blocked by their year in the program. Participants were assessed pre- and post-intervention phases. This grouping resulted in half of all freshmen and sophomores being randomly selected for the intervention (multimedia) condition, and the remaining participants received the comparison (control) condition.

Outcome Measures

Pedestrian Sign Assessment

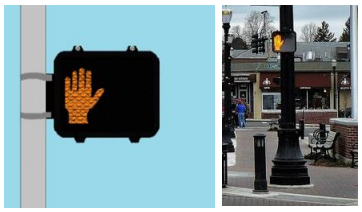
To examine participant knowledge, researchers developed measure corresponded to the critical information in the multimedia video and classroom conditions based on the Council for Exceptional Children's (CEC) Life Centered Education Curriculum (LCED; 2012). Researchers modeled the dependent measure from previous multimedia studies (Hirsch et al., 2015, 2020; Kennedy et al., 2014, 2015, 2016). We adapted the dependent measure format to support students with ID by including pictures and reading the answer choices aloud. Specifically, participants were given three choices which included pictures to answer the first two questions, which included the correct answer, a near distractor answer, and a far distractor answer (Hosp et al., 2016).

The Pedestrian Sign Assessment measure included 15 questions. Each question asked participants to (a) identify the name of the sign, (b) describe what the sign means, and (c) provided an opportunity for the participant to add any additional information about that particular sign (open-ended question). Researchers asked participants, "What is this sign?" next to two pictures of the actual street sign. Researchers then provided the participant with three answer choices (i.e., Pedestrian Crossing Signal – Do Not Walk; Sidewalk Closed Sign; Pedestrian Crossing Signal – Walk). Participants could receive a score of 1 for each correctly identified sign by either repeating

the correct sign name or by pointing to the correct answer choice. Participants were then asked, "What does the sign mean?". Participants received a score of 1 for each correctly identified sign meaning (either by repeating the correct text answer or pointing to the correct text answer or picture). Scores were totaled for each assessment, with a total of 10 points possible on each assessment. Sample items from the pedestrian sign assessment are found in Figure 1.

Figure 1. Sample Pedestrian Sign Measure Question

1a. What is this sign?



A.Pedestrian Crossing Signal – Do Not Walk
B.Sidewalk Closed Sign
C.Pedestrian Crossing Signal –Walk

1b. What does the sign mean?

A. It is safe to cross the street.

B. Do not cross the street.

C. You cannot turn left.

1c. What else can you tell me about this sign… (verbal short response answer)

_____

_____

Researchers administered the pedestrian sign assessment four separate times: (1) one week before treatment (pretest), (2) immediately after treatment (posttest 1), (3) immediately after pedestrian crosswalk walking tour (posttest 2), and (4) one month after the pedestrian crosswalk walking tour (posttest 3). Posttest 3 was considered maintenance as it was given one month after the intervention. The maintenance assessment was the same that had been given the previous three times, with identical administration procedures followed. All participants completed the maintenance assessment. A total of ten points were possible on each assessment. Internal reliability analyses indicated a Cronbach's alpha coefficient of .78.

Social Validity Measure

At the conclusion of the experiment (after Posttest 2), six of the twelve participants from the intervention condition (2 freshman and 4 sophomores) were invited to participate in semi-structured interviews. Due to the type of interview (semi-structured oral interview), six participants who were recommended by classroom instructors to be able to provide verbal responses were selected to be interviewed. The six were chosen because the research team believed that they were the best representatives for the intended audience for which the intervention was designed and had the verbal skills to answer the questions. The purpose of these interviews was to gather student feedback and perception of the intervention. Additionally, researchers interviewed both participants' classroom teachers to gauge their perceptions of the intervention and any resulting difference in student pedestrian sign knowledge. The open-ended interviews were formed using semi-structured format included the following questions: (a) *What did you think about the multimedia videos that you watched*? (b) *What did you like about the multimedia videos?* (c) *What didn't you like about the multimedia videos?* and (d) *Was there anything that could be added to make the multimedia videos better?* The lead researcher conducted the interviews and transcribed the information. Transcriptions were then member-checked by reading them to participants for review before analyzing the data.

Procedures

The study took place within the first month of the fall semester. The PSE classroom teachers did not teach any of the study content (i.e., pedestrian safety signs). After obtaining approval from the university's institutional review board, we obtained consent from all of the participants, and parents were provided copies of consent forms. Prior to the administration of the pedestrian sign assessment, those giving the test (a classroom teacher and the first author) received a brief training on the testing procedures to ensure accuracy of scores. Additionally, an observer sat through each assessment to ensure that testing procedures were followed as planned. Participants were assessed individually as the assessment was read aloud to participants, by either a teacher or a researcher. This testing protocol was repeated each time participants were given the pedestrian signs assessment. Participants were then asked to report to either the comparison (PowerPoint lecture) or intervention classroom. Intervention and comparison lessons took place during regularly scheduled class periods. Following the instruction, comparison or intervention, participants were again given the pedestrian sign assessment. Using a researcher created checklist, we collected treatment fidelity during the comparison, intervention, and pedestrian sign walk phases. All sessions introduced and named each of the five pedestrian signs, what individual signs represented, and what the participant should do when they encountered each sign. Treatment fidelity was collected by another teacher and a teacher's aide. Treatment fidelity was 100%.

Intervention Group

The intervention group brought their laptops and headphones to the designated classroom. Once in the classroom, a teacher and researcher helped all participants to log onto (link removed for peer review process) to find the appropriate multimedia video. Researchers created the multimedia video using Adobe Spark, and included the following accessibility features: audio descriptions, audio control, minimized extraneous information, and segmented content. The video adhered to

the following multimedia principles (Mayer, 2008): coherence (contains only relevant content), pretraining (provides an advanced organizer), signaling (cues or highlights essential information), redundancy (only carefully selected content is highlighted), spatial contiguity (on-screen text and pictures are close to each other), temporal contiguity (text and audio correspond), personalization (human voice and conversational style).

The 4 min 24 s "*Pedestrian Road Crossing Multimedia Video*" covered five pedestrian crossing signs or situations. For each crossing sign, images of the sign are shown, along with verbal instruction on sign name and meaning. A video of appropriate pedestrian behavior was included for all, but the sidewalk closed and detour sign. Content from the video was created to model the CEC LCED, Objective 1.9.38.1 (i.e., objectives A:1 and A:2; LCEC, 2012). Objectives included "Identify pedestrian safety sign and use" (A:1) and "Be aware of typical signs and signals" (A:2). Participants' teachers choose the pedestrian signs that were most relevant to their students and would be used mostly on the campus. See Figure 2 for signs and definitions used for both intervention and comparison groups. Posttest 1 was administered 10 to 60 minutes after watching the video.

Figure 2. Safety Signs and Definitions

Comparison Classroom Instruction Group

The comparison group received the same content regarding the pedestrian crosswalk signs in a live lecture that included a PowerPoint presentation. The lecture modeled the participants' typical classroom instruction. The PowerPoint presentation included the same pictures included in the multimedia videos along with the same definitions (found in Figure 2). The PowerPoint contained 12 slides and lasted 15 minutes. Researchers created the PowerPoint deck including a title slide with a corresponding picture, followed by a slide with some descriptive text and additional supporting pictures. The lecture content was delivered in its entirety by the participants' teacher,

a certified special education teacher with four years of experience teaching students with ID in a PSE. Posttest 1 was administered 10 to 60 minutes after watching the video.

Pedestrian Walking Tour

The day following the pedestrian sign instruction, all participants (21) went on a walking tour with the lead researcher and teaching assistant. A pre-planned route had been established to ensure PSE participants encountered the five pedestrian signs. As the group approached each pedestrian crossing sign, the researcher would review with the participants the name of the sign, what it meant, and what the participant should do at the sign. Participants then practiced behaviors appropriate for the sign (e.g., waiting at the crosswalk when a red hand was shown). The walk lasted approximately 45 minutes. The walking tour was taken for several reasons. First, it was part of the typical curriculum the program used to teach pedestrian safety by providing hands-on experience regarding the learned pedestrian signs. Researchers wanted to ensure that typical instruction was provided to the participants. Second, it was possible that the multimedia or lecture presentation could impact the effectiveness of the walking tour. As a result, the dependent measure (pedestrian sign assessment; Posttest 2) was given immediately following the walking tour to identify any impact to participants' scores.

Procedural Integrity

To ensure researchers covered all content we also recorded procedural fidelity of the intervention and comparison conditions. A teaching assistant participated as a silent observer in the comparison lecture group to ensure that all sign names, definitions, and corresponding participant behaviors for the sign were followed taught. In likewise fashion, the multimedia video was reviewed by a researcher and the sophomore teacher to ensure all sign names, definitions and behaviors were included in the multimedia videos.

Data Analysis

All assessment data were entered into SPSS (v. 24.0) for analysis and descriptive data. To answer the first research question, whether the intervention improved participant pedestrian sign knowledge, a repeated measure univariate analysis of variance (RM-ANOVA) with simple and repeated contrasts was conducted to detect group differences on the knowledge measure at each time point. To answer the second research question, how participants responded to the intervention, student interviews were analyzed using frequency counts and emergent themes.

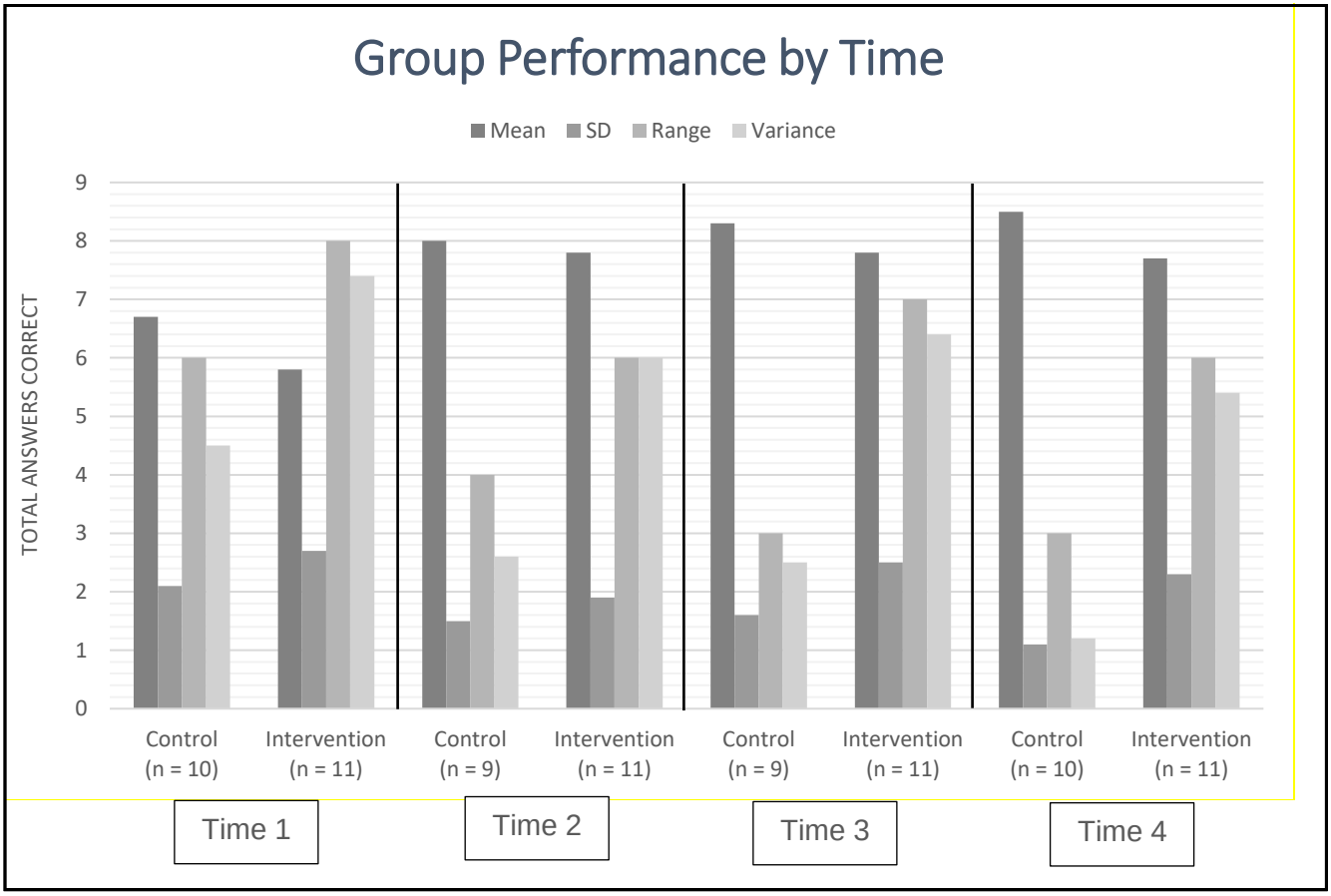
Results

Descriptive Statistics

An independent samples *t*-test was conducted to detect any group differences at pretest. Results indicated no significant group differences $t(19) = 0.83$, $p = .42$. At pretest, both groups had similar scores (intervention $M = 5.8$, $SD = 2.7$; comparison $M = 5.7$, $SD = 2.1$). At posttest 1 after the intervention, both groups grew on the knowledge measure after instruction. Comparison participants appeared to slightly outscore participants in the intervention condition (intervention

M = 7.8, *SD* = 1.9; comparison *M* = 8, *SD* = 1.5). At posttest 2, after the pedestrian crosswalk walking tour, both groups appeared to maintain their scores from posttest 1, although comparison participants outperformed intervention participants (intervention *M* = 7.8, *SD* = 2.5; comparison *M* = 8.6, *SD* = 1.2). For the final assessment, the maintenance phase, scores stayed relatively the same as at posttest 2 (intervention *M* = 7.6, *SD* = 2.3; comparison *M* = 8.5, *SD* = 1.1). Additional descriptive statistics can be found in Figure 3.

Figure 3. Descriptive Statistics



Note. Time 1 = Pretest, Time 2 = 1st Posttest, Time 3 = 2nd Posttest, Time 4 = Maintenance

Intervention Effects

We conducted an RM-ANOVA to determine the effect of the intervention on participants' scores on the knowledge assessment. Mauchly's test was not significant $\chi^2(5) = 0.55$, $p = .99$, therefore sphericity was assumed. Using Pillai's trace, there was a significant effect of time on participant scores $F(3, 15) = 10.60$, $p = .001$, but there was no significant time x group interaction effect, indicating that any growth in scores was attributed to the passage of time and possibly incidental learning rather than a direct effect of the intervention. Both groups of participants (intervention and comparison) grew on the outcome measure but did not significantly differ as a result of the intervention. Because this is an exploratory study, we investigated growth in student scores between testing occasions to better assess whether participants in the intervention demonstrated

any significant learning and how this could hold promise for future work. The RM-ANOVA was conducted on each experimental group separately with a series of simple and repeated contrasts. Both groups grew significantly from pretest to posttest 1 (intervention $F(1) = 12.22$, $p = .006$; comparison $F(1) = 11.07$, $p = .01$;). However, was not significant growth from posttest 1 to posttest 2 or from posttest 2 to posttest 3 for either group.

Social Validity Results

Six participants (2 freshman and 4 sophomores) who were part of the intervention group participated in semi-structured interviews. In total there were six positive statements made regarding the multimedia video. There were no negative statements given regarding the multimedia video. Three participants provided suggestions of how to make the multimedia better.

Positive Statements and Purpose of Multimedia Videos

All six participants provided positive statements in response to the semi-structured questions. Participants stated that the multimedia video was "fine," "good," or "awesome." Two participants stated that they "liked" the video, while one student said they "loved" the multimedia videos. As a follow-up question, participants were asked what in particular they enjoyed about the multimedia videos. Participants provided a variety of responses, including providing 8 positive statements. One student stated, "I liked the pictures," while another student provided more detail regarding what they specifically liked:

> I liked that it went from one topic to another. Then I could grasp one thing and then it would be the back-end of one [pedestrian sign] and then into the start of the next one [pedestrian sign]. I could easily tell what you [the multimedia videos] was talking about. It made sense to me – I could tell what they [the multimedia videos] were talking about.

Many participants included statements regarding the purpose of the multimedia videos that described the format of the multimedia videos or what the student had learned from watching the multimedia videos. Participants noted that there were videos and pictures included, both of which they enjoyed. For example, one participant said, "Well, I loved the different videos [video modeling] that were in the multimedia videos." Several participants described what they learned. One stated, "When you walk you have to wait for the cars at the crosswalk." Another stated:

> It [the multimedia videos] went over safety and like how to cross the road. [I liked] the different signs. [The multimedia videos] telling you the meanings of the different signs and all of that.

Participants were asked what they didn't enjoy about the multimedia videos, and all six stated there was "nothing really," that they didn't like. Participants were asked a follow-up regarding what could be changed to make the multimedia videos better. Suggestions from the participants included, "I would like more video examples," "add a safety rule about only using one headphone/earbud," "add other safety steps for being safe when walking." One participant provided a very specific suggestion:

> There might need to be an example of what might happen if people didn't follow the sign (like the hand sign [pedestrian crosswalk sign – do not walk]). It could be very dangerous.

Discussion

Despite the ubiquitous nature of technology in daily life, scholars have called for additional research into the use of technology specifically to increase the social and community inclusion of individuals with ID (Manzoor & Vimarlund, 2018). Previous research suggests that multimedia instruction and video modeling increases the ability of individuals with ID to independently complete tasks (Ayres & Cihak, 2010; Kanfush & Jaffe, 2019; Mechling, 2004, 2008) but has not always taught the underlying vocabulary related to skills nor has it always resulted in skill maintenance. The purpose of this study was to compare the effectiveness of multimedia instruction (i.e., video modeling) for teaching pedestrian safety signs to participants with ID as a way to support skills needed for community inclusion while evaluating the social validity of the multimedia video. The effectiveness of the multimedia intervention was measured using a randomized control trial utilizing a pre-/posttest design. Overall participants' knowledge grew significantly from pre-to posttest, and there were no significant differences between the groups. Although the intervention group did not significantly outperform the comparison group, the 4 minute and 24 second multimedia video produced the same effects as the 14-minute live lecture. This finding indicates the potential effectiveness of a shorter and portable intervention time that could be viewed in any setting (e.g., classroom, home, community) and viewed multiple times. Current results reflect past research finding multimedia instruction is effective in teaching skill acquisition (Ayres & Cihak, 2010; Kanfush & Jaffe, 2019; Mechling, 2004)

The lack of significant results could be due to the study being underpowered. Previous studies (i.e., Kanfush & Jaffe, 2019) found significant results using a single case research design with a small number of participants, so perhaps a larger sample is necessary in order to detect intervention effects in a group design. While the intervention did not produce significant growth in knowledge of safety signs compared to the comparison condition, participants in the intervention still made significant growth in their learning from pretest to posttest 1. The multimedia video was a third the length of the PowerPoint presentation, so if the two instructional methods both produce growth in learning, the multimedia video could be a more efficient way of presenting information, which could theoretically free up instructional time for more hands-on activities and demonstrations. Alternatively, developing a longer video or presenting it multiple times -- in other words, increasing the dosage of the video -- may be necessary to see a significant intervention effect. Researchers found individuals with ID required multiple viewings of video modeling and video prompting to complete tasks or acquire skills, therefore dosage is a key variable in increasing learning with students with ID (Kanfush & Jaffe, 2019; Mechling, 2008; Spivey & Mechling, 2016).

It is possible that the pedestrian walking tour produced the growth in both groups. Previous work has posited that teaching vocabulary in isolation is not enough to see deep understanding and application (Spooner et al., 2012). While it is possible that the action of linking the content from the video and lecture to real-life examples of safety signs helped participants learn, and both groups took the tour which could explain the lack of group differences at posttest. However, if the walking tour was the key instructional practice, we would expect to see significant growth from posttest 1 (immediately after intervention) to posttest 2 (immediately after walking tour) in both groups and this was not the case.

While the multimedia intervention did not produce significant group differences in the knowledge at posttest, participants in the intervention condition generally enjoyed the video. Participants reported feeling confident and understanding what the video was trying to teach them

regarding pedestrian safety signs. Perhaps the multimedia video method is an engaging way to deliver content to participants with ID in postsecondary educational settings.

Implications for Practice

Using multimedia video instruction as an educational intervention to teach pedestrian crosswalk signs and meanings has the potential to connect individuals with ID to their community. Lack of community inclusion and high rates of social isolation have been well documented in the ID population (Novak Amado et al., 2013), so effective methods for teaching individuals with ID to navigate their physical community can provide the opportunity to develop truly inclusive community environments (Gomez, 2013). The results of the current study indicate that multimedia technology offers an efficient and effective method to teach important daily living skills and vocabulary to individuals with ID and provides an adaptable way to target skill acquisition and generalization of skills that can ultimately lead to greater independence and community inclusion (Hirsch et al., 2020; Kanfush & Jaffe, 2019; Kennedy et al., 2014; Mechling, 2004). People who work with individuals with ID should continue to evaluate various technologies and methods for increasing community inclusion. Results from this study have the potential to enable individuals with ID to have more inclusive interactions with their community and answer the call by many researchers to identify and evaluate various technologies aimed at increasing social inclusion (Manzoor & Vimarlund, 2018; Novak Amado et al., 2013).

Limitations and Future Directions

While differences between groups were not significant, participants in the comparison group needed more time and instruction (14-minute lecture) to show similar growth to that of the intervention group (4 minutes and 24 seconds) who appeared to make the same amount of growth in a third of the time. Future research should focus on determining if the multimedia intervention has potential as a more efficient and effective way to deliver the same information as a traditional lecture. Replication and further study are necessary to determine whether modifications to the length or format of the multimedia videos. Specifically, researchers should study whether adding active responding (opportunities to respond) increases participant knowledge. Future multimedia research could use actual video of individuals' environments, which has shown to be effective at increasing academic and functional skills in individuals with ID (Hitchcock et al., 2003; Prater et al., 2012).

Another potential limitation of this work is we only measured knowledge to determine the effect of the intervention. Our measure did not measure the participants' generalization of the skills (e.g., ability to perform the skill in the natural context), and previous studies have found mixed results regarding generalization of skills from video modeling (Ayres & Cihak, 2010; Spivey & Mechling, 2016), so it will be critical that we evaluate participant performance in the community in future iterations of this work (see McMahon et al., 2015). Additionally, social validity measures were designed and used with participants who had verbal abilities. Future research should include adapted social validity measures focused on participants with ID who may have limited verbal ability. In this way, a clearer picture of participant perceptions can be gathered. Another limitation included the relatively homogeneous similar participants in the current study. Future studies examining the impact of multimedia instruction could also include more diverse participations (e.g., low vision, deaf or hard of hearing, etc.).

Limitations of this study should be considered when interpreting results. A major limitation was the small sample size. The ideal sample size with sufficient power to detect a large intervention effect size of at least d = .70 was n = 34 participants (Dong & Maynard, 2013). It is difficult to determine what a reasonable detectable effect size would be given the overall lack of research in this area and primarily single case studies conducted with participants with ID. Previous studies using multimedia instruction with students with learning disabilities (e.g., Kennedy et al., 2014) found large effects (mean d = 1.21) on student performance, while single case studies of multimedia instruction with students with ID (Rivera et al., 2017, 2013) found a large percentage of non-overlapping data (100%) indicating a large intervention effect. The underpowered study limited our ability to detect significant intervention effects.

Future research should evaluate the use of Mayer's 12 instruction design principles including the segmenting principle. The segmenting principle suggests dividing content into smaller segments or chunks (Mayer, 2008). In a multimedia video, this would be achieved by prompting the listener to pause at various points in the recording to reflect, take notes, or answer questions. The research team decided to forgo inserting pauses into the video because of its short length (4 minutes). Inserting pauses or embedding reflection questions would have broken up the main idea and we were concerned that participants would lose focus or need considerable time and support to take useful notes or reflect. It is possible that including planned pauses or questions in the video in future iterations could impact student performance and produce meaningful differences. Finally, the researcher-created video might be too short or require repeated viewings for participants to show significant growth compared to the lecture condition. Perhaps a longer video with embedded pauses or simple reflection questions would produce significant results. The aforementioned video was produced in 2018. Future researchers should consider adding alternative text and closed captioning to increase accessibility. As described previously, the walking tour did not produce significant results, it does however have the ability to influence assessment results of posttest 2 and posttest 3. As a result, the walking tour should be taken into consideration when examining the findings. It may be advisable in future studies to use a walking tour or a practical application activity as a maintenance activity after posttesting is complete.

Additionally, while participants were randomly assigned to the control or intervention group, the control group did have the most diverse participants including those with ID, or ID comorbid with down syndrome, Fragile X, and Autism. Participants in the intervention group all had either ID or ID comorbid with down syndrome. As a result, the control group may have participants who had more language difficulties resulting in less verbal ability. Future research should examine how varying disabilities or comorbidity may impact individual achievement using multimedia instructional methods.

Summary

More individuals with ID are enrolling in PSE settings and traveling independently through the community. Therefore, pedestrian safety skills are a priority yet there few studies have evaluated methods of teaching individuals with ID using multimedia packages in PSE settings. Our findings indicate that multimedia and lecture are both promising methods of instruction for students with ID on safety skills in PSE settings. However, the multimedia option is portable and shorter in length. We encourage other researchers to continue to explore how multimedia video instruction can be used to efficiently teach concepts and skills to postsecondary students with ID.

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