THE EFFECTS OF A PROGRAMMED TEACHING SEQUENCE AND RESPONSE CARD USE WITH SYSTEMATIC FEEDBACK ON THE ACQUISITION OF TIME TELLING BEHAVIOR OF 3 STUDENTS WITH INTELLECTUAL DISABILITY

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Few studies have proposed or evaluated methods to teach telling time. The purpose of this study was to evaluate the effects of differential reinforcement of student responding in the form of response cards to teach three middle school students with intellectual disability to tell time. Participants worked through six training phases. Results showed that correct responding increased from pre-assessment (range of 5.71-14.29% correct) to post-assessment (range of 85-100% correct). Preliminary evidence shows promise in the application of these procedures to teach telling time to middle school students with intellectual disability.
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By

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INTRODUCTION

A common goal when working with persons with disabilities is to increase independent functioning. Moreover, a goal of special education classrooms is to increase independent student functioning. Time management, in particular, plays an important role in an individual’s independent functioning whether or not learning differences exist. The ability to understand, predict, and prepare for events that occur in daily life, both in and out of school, contribute to a rationale for teaching skills related to time management in school classrooms.

The ability to engage in a behavior at a specific time holds both survival and social relevance. Consider the numerous time-scheduled behaviors an individual emits throughout the day: eating meals, going to and from work, participating in leisure and/or social activities, riding public transportation, and taking medication. Acquiring the ability to interpret a clock or watch face aids in predicting and/or preparing for time-scheduled events. The mastery of time-management skills is a meaningful outcome of any educational process because it allows an individual to interact more efficiently with his/her environment. The present study focused on teaching the tact relation of telling time: The verbal response emitted in the presence of a nonverbal stimulus (analog clock).

Although time-telling materials are readily available for teaching purposes, no research on their efficiency or effectiveness is available. Reisman (1971) proposed a teaching sequence based on an analysis of telling time to the minute.
Reisman also indicated common errors made by children when telling time. A total of 54 steps were indicated; however, an evaluation of the effectiveness of a teaching program based on the proposed sequence was not given.

Bachrach (1973) also proposed a teaching sequence in which students work through 5 phases of instruction accompanied by worksheets. The author reported that as a result of the sequence of instruction and activities, the students were satisfied with their progress. As with Reisman (1973), no data were presented.

The available controlled research on telling time instruction is sparse. Sowers, Rusch, Connis, and Cummings (1980) investigated the use of a device to teach adults with intellectual disability who could not tell time to perform specific independent behavior in a vocational setting. During training correct responses were reinforced with praise, and incorrect responses received reprimands, instruction, or delay/omission of the scheduled activity. Results indicated that with instruction and differential reinforcement of visual cue use, participants were able to move independently to and from lunch and afternoon breaks. The success of the participants relied on their ability to match a picture of a clock face to an actual clock. At the end of the study, the participants were still unable to tell time.

The use of prompts allowed five high school students with intellectual disability to follow a time-based schedule that changed daily (Martin, Elias-
Burger, & Mithaug, 1987). When correct responses were intermittently praised and incorrect responses were verbally corrected with the introduction of a written schedule or written schedule with pictorial prompts, the students moved independently from one work station to another within plus or minus 5 min of a selected time. The students were able to manage their work time by matching numbers or a picture of a clock to an actual clock; however, none of the participants could tell time at the end of the study.

Smeets, Lancioni, and Van Lieshout (1985) investigated the use of an experimental device for telling time and meeting appointments. A clock-agenda combination (CAC) was designed to aid four Dutch children with intellectual disability, ages 7-12, in telling time and meeting scheduled appointments. Results indicated that in 5-10 hr of training, all participants could accurately read the digital CAC to the nearest 5-min interval and meet their appointments when student responses were differentially reinforced. Correct responses were praised, and incorrect responses resulted in response interruption with verbal and/or physical guidance to emit the correct response during training. A limitation of this study is that the students were trained to respond to prompts in the form of digital numbers and letters. What the authors referred to as the acquisition of time telling was actually the participants learning to emit programmed verbal responses in the presence of the CAC’s cues. The use of the CAC acted as a prompt for telling time. This study was limited to the acquisition of programmed
responses rather than building telling time competencies. Furthermore, each participant entered into the study with the ability to tell time on the hour by looking at an analog and digital clock, however, these skills were not utilized in building a comprehensive repertoire of telling time to respond to the natural cues (clock faces) available in the environment.

The study conducted by Partington, Sundberg, Iwata, and Mountjoy (1979) described one of the few controlled investigations evaluating a program to teach telling time to the nearest minute based on a task analysis. Five participants, three typically developing children and two children diagnosed with multiple disabilities served as participants. To be included in the study, participants were required to name the numbers 1-12 and count up to 30 objects. During training, correct responses were praised for all participants. The two participants classified as multiply impaired received both praise for correct responses and intermittent edible reinforcers for attending to the experimenter. Incorrect responses resulted in the experimenter telling the student the correct answer. Four of the five participants completed the program which included nine training phases comprised of 634 trials. A probe was conducted after each phase. Results indicated that the program was effective in teaching the participants to tell time to the nearest minute.

Like Partington et al. (1979), Smeets, Van Lieshout, Lancioni, and Striefel (1986) sought to evaluate a program to teach students with intellectual disability
to tell time to the nearest 5-min interval. Ages of the participants ranged from 12 to 18 years of age. The training program consisted of six phases with each phase having two or more steps. The program was successful in that all participants acquired the target behavior of telling time to the nearest 5-min interval in 14.2-19.6 hr through individual training when correct responses were reinforced with praise and a token which could be exchanged for back-up reinforcers (stickers). If participants emitted an incorrect response, the experimenter provided corrected feedback by giving instructions, pointing, or modeling and presenting the trial again. Because the language used by the participants in the study was Dutch, comparisons about program effectiveness with time telling programs that utilized English are difficult. The linguistic rules for creating telling time responses in Dutch were reported not only to be different but also more complex than English responses. Furthermore, participants of this study were selected based on their demonstrated ability to label the numbers 1-12 on an analog clock and the ability to discriminate the minute hand from the hour hand. Although participants told time to the nearest 5-min interval, they could not tell time to the exact minute.

While few studies have investigated methods to teach telling time, no studies to date have identified effective methods for teaching telling time in a group setting. A perceived limitation to group instruction is the possibility of students passively interacting with the instructional material. One finding
relevant to the discussion is that academic achievement is correlated with active responding, also referred to as the opportunity to respond (Greenwood, Delquadri, & Hall, 1984; Heward, 1994). Opportunity to respond can be defined as the “interaction between (a) teacher formulated instruction ... (the materials presented, prompts, questions asked, signal to respond, etc.), and (b) its success in establishing the academic responding desired or implied by materials” (p. 64) (Heward, 1994).

One method to increase the opportunity to respond in group instruction is the use of response cards. Narayan, Heward, Gardner, Courson, and Omness (1990) defined a response card as “an item that can be held up simultaneously by every student in class to respond to a question or problem presented by an instructor, (p. 484). In doing so, teachers can ensure that relevant student responding occurs. Response cards have multiple variations; however, the two basic forms are preprinted and write-on response cards. With preprinted response cards, a student selects one card to display from an array of cards. For example, these cards can display letters for multiple choice answers or the words true/false. The student then displays the card he/she selected. When utilizing write-on response cards, students write their answers to each question on black cards or boards with dry erase markers. Multiple studies have examined the use of response cards to increase student participation in group instruction.

Narayan et al. (1990) evaluated the use of response cards in a fourth
grade social studies classroom. When compared to hand raising, rate of student responding and correct responses increased. The average number of responses emitted by the target students during the hand-raising session was 11.6 occurrences with a range of 9.2-13.7 instances. Average number of response during the response card session was 15.6 times per session, with a range of 13.5-17.6 responses per session. Gardner, Heward, and Grossi (1994) successfully replicated Narayan’s result and extended use of response cards to science instruction. Frequency of active student response increased an average of 21.8 responses per session with a range of 5.8-28.3 responses with response cards from the average 1.5 responses with a range of 0-2.8 responses during the hand raising condition. Follow-up data also indicated that on 2 week review tests, students scored higher following the response card instruction phases.

In a study conducted by Marmolejo, Wilder, and Bradly (2004), response cards were used by undergraduate students in a psychology course. The authors compared student participation and quiz scores following use of preprinted response cards and a standard lecture format. Each response card allowed the students to answer either multiple choice or true/false questions. Quiz scores and student participation increased as a result of using response cards. The mean quiz score following response card use was 73.4% with a range of 69% - 85%. When the standard lecture format was used, the mean quiz score was 63.6% with a range of 57% - 76%. To assess the social validity of the study, all students
completed a questionnaire. Results of the questionnaire indicated the students approved response card use. Eighty-seven percent reported they would suggest response card use in other classes.

Davis and O’Neil (2004) extended previous response card research by evaluating the effects of response cards use on academic and off-task responding as compared to hand raising. Response card use was also extended to writing instruction among four resource classroom students in the seventh and eighth grades. On average students scored higher levels of accurate responding during response card conditions ($M = 91\%$) than during hand raising conditions ($M = 74\%$). Response card use had mixed results on off-task behavior as only one student’s off task behavior reliably resulted in 0 levels of off-task responding.

At this time, the literature indicates that no refinements or new controlled research on methods for teaching students with intellectual disability to tell time have been reported. Furthermore, methods for teaching telling time have not been integrated with the understanding that student acquisition and maintenance of academic achievement increases with active student responding.

In order to identify new methods of teaching telling time, the current study was conducted based on the following question: How will use of a programmed teaching sequence and response card use with systematic feedback effect the acquisition of time telling behavior for 3 students diagnosed with intellectual disability in a small group context?
METHOD

Participants

Three students with intellectual disability participated in the study. Each participant, at the beginning of the study, was between the ages of 10 and 12. All participants were recruited by flier from a public middle school self-contained special education classroom. General intellectual ability (GIA) scores were derived from the Woodcock Johnson ® III Tests of Cognitive Abilities. Each participant’s scores fell in the very low range when compared to peers the same age. Participant 1 was a 10-year-old female with GIA score of 47. Participant 2 was a 12-year-old male with GIA score of 53. Participant 3 was an 11-year-old female with a GIA score of 47. Although not a prerequisite to participate in the study, each participant could rote count to 60 by 1 (i.e., 1, 2, 3) and rote count to 60 by 5 (i.e., 5, 10, 15). The participants could also write the number when given a number 0-60. The criterion for participation was an expression of interest in learning to tell time, a provision of signed parent/legal guardian informed consent, and signed child assent.
Setting and Sessions

Small group teaching sessions took place in an unoccupied classroom in the participants’ school. The room contained 3 individual desks with chairs and a kidney-shaped table with 2 chairs at opposite ends. The three participants, the author, and the student’s regular teacher were present in all session for a total of 5 individuals. The author served as both experimenter and primary observer. The purpose of the experimenter’s presence was to present antecedent material, provide feedback, record participant responses, and monitor the students. The participants’ regular teacher served as a second independent observer to collect data for interobserver agreement and monitor the students. The participants sat at the individual desks facing the board with approximately 1 m between the desks, thus enabling the observers to record the occurrence and accuracy of all the participants’ responses on the same trial. The experimenter and second observer sat at opposite sides of the kidney-shaped table approximately 2 m apart.

Participants were allowed to miss no more than 1 hour of their daily classroom activities; therefore, sessions took place twice a day for 30 min. The first session took place 1 hr after the students arrived in their classroom, and the second session took place 1 hr before the students were dismissed from school. Sessions were timed using a digital timer that sounded an alarm at the end of 30 min. The timer was stopped for interruptions (e.g., an announcement over
the public address system) and started when instruction resumed. Starting and stopping the timer was controlled by the experimenter.

**Materials**

**General Materials**

General materials included a digital timer, 3 response cards (described below), 3 fine-tip dry erase markers, 3 work covers, facial tissue paper, an overhead projector, 1 Learning Resources 0570 overhead clock dial, 1 analog clock, and data sheets. Student work covers were created by laminating 2 manila folders together. The overhead clock dial is a transparent 11.43 by 11.43 cm analog clock face with movable hands. Hour and minute marks are printed around the clock face with the Arabic numerals 1-12 corresponding to the hour marks (see Appendix A). The overhead clock dial was placed on the overhead projector, and the image was displayed on the board. The analog clock was used for pre- and post-assessments. The face of the clock was 17.78 cm in diameter and the numbers were 1.9 cm high. Each minute on the face of the clock was marked by 0.6 cm lines extending into the clock from the perimeter of the clock face. Data sheets incorporated space for recording the session number, antecedent stimulus, and whether the participant answered correctly or incorrectly (see Appendix B).

Materials were dispensed before sessions began. Each student had a desk, chair, response card, cover sheet, dry erase marker, and a single sheet of facial tissue to erase response card answers. The
experimenter and data collector had data sheets and 2 pencils with erasers placed at their seats. The overhead projector was located on the kidney-shaped table near the experimenter. The digital timer was also placed near the experimenter.

Response Cards

Write-on response cards were utilized during this study. Response cards were created by placing 10 sheets of white 29.59 by 27.94 cm paper inside an Avery standard weight sheet protector. A final sheet of paper with two printed lines separated by a colon to write in the hour and minute was placed in the sheet protector (see Appendix C).

Measurement

Dependent Variables

The dependent variables assessed in this study included number of opportunities to respond and frequency of correct and incorrect participant responses.

Total Opportunity to Respond

The rate at which the experimenter presented response opportunities to participants was recorded in all sessions. As in Narayan et al. (1990), a response opportunity consisted of three parts: the experimenter’s presentation of a question, participant response to the question, and the experimenter’s delivery of feedback to the participants.
**Correct Response**

During the pre- and post-assessments, a correct response was recorded when a participant accurately said his/her answer in response to the experimenter’s question, “What time is it?” During the intervention phases, a correct response was recorded after the experimenter asked the question associated with the training phase when (a) a participant accurately wrote his/her answer on a response card to the experimenter’s cue, “Write,” and (b) held up his/her response card after the experimenter’s cue, “Cards up.”

**Incorrect Response**

An incorrect response was recorded during pre- and post-assessment phases when a participant’s response did not meet the definition of a correct response to the experimenter’s question, “What time is it?” Responses such as, “I don’t know,” or “I am not sure,” were counted as incorrect responses. During the intervention phase, an incorrect response was recorded when a participant’s response did not meet the definition of a correct response to the question associated with the training phase when (a) a participant wrote his/her answer on a response card to the experimenter’s cue, “Write,” and (b) held up the card in response to the experimenter’s cue, “Cards up.” A no response and response changed after the cue, “Cards up” were also scored as incorrect.
Interobserver Agreement

A second independent observer scored the pre-assessment, all training sessions, and post-assessment for each participant. Exact agreement of the occurrence of behaviors measured on a trial by trial basis was calculated by dividing the number of agreements by the number of agreements plus disagreements then multiplied by 100 to yield a percentage. Interobserver agreement (IOA) for participant response accuracy was 100% for the pre-assessment, training phases, and post-assessment. IOA was calculated after each session ended.

Procedural Fidelity

Procedural fidelity was assessed by a fellow behavior analysis graduate student for 25% of training session trials. A checklist was conducted to record the occurrence or nonoccurrence of procedures related to session preparation and independent variable implementation during each training session (see Appendix D). The graduate student sat at the back of the classroom. Observers were instructed to place a check in a box to indicate that a task was completed and to leave the box blank if a task was not completed. For example, if the experimenter presented the response cards before the session began, the observer placed a check in the corresponding box. If the experimenter did not present the response cards before the session began, the corresponding box was unmarked. Procedural fidelity was calculated by dividing the number of
treatment steps completed accurately by the total number of treatment steps for each sampled checklist and multiplied by 100 to yield the percent of treatment steps accurately completed. Procedural fidelity was 96%. Procedural integrity was calculated after each observed session.
Procedure

General Procedures

During training phase sessions, all participants were greeted at their classroom door and led by the experimenter and the secondary observer to the unoccupied classroom wherein the experiment occurred. The students referred to the time in the experiment as the author’s “class.” Upon entering the room, participants were asked to take a seat at the individual desks. However, participants were not allowed to sit in the same seat for consecutive sessions. At the beginning of each new training session, the experimenter asked the students to stand at the desk where they sat at in the last session. Participants were then instructed to rotate one desk location to the right. If a participant sat in the farthest right desk, he/she would rotate to the farthest left most desk.

Each session was timed by a digital timer and lasted 30 min. If the timer’s alarm sounded in the middle of a trial, the trial was completed before the session was ended. Each phase’s lesson was presented within the first 10 min of the session. Participants then practiced the new material using the response card procedures for the remaining 20 min. Procedures across training phases remained the same, with the exception of the content presented during lesson presentation. If the new material was presented in less than 10 min or the session was a continuation of the previous lesson, response card procedures were used at the beginning of that session. During the response card use of
training phases, each participant responded to the stimuli presented resulting in participants having an equal number of opportunities to respond.

When the pre- and post-assessments were conducted, students were brought to the experimental room one at a time and tested individually. Upon entering the room, participants were asked to sit at the kidney shaped table with the experimenter and secondary observer. Once seated at the table, the first author stated to the participant that he/she would not need a response card. Participants were also instructed to say his/her answer, and that the first author was unable to say if the participant responded correctly or incorrectly. Participants were intermittently thanked for working hard. As soon as all trials were presented, the participant was escorted back to their regular classroom.

**Pre- and Post- Assessment**

Pre-assessment and post-assessment phases consisted of 35 trials presented in random order (see Appendix E). Twelve trials consisted of telling time to the hour (e.g., 1:00-12:00). Eleven trials consisted of telling time to the nearest 5 min (i.e., 3:40, 7:55, 11:15). Twelve trials required the participants to tell time to the exact minute (i.e., 6:02, 8:53, 12:46).

Rather than testing every possible time to the exact hour and minute, telling time to the nearest 5 min and to the exact minute were sampled. Sampling for telling time to the nearest 5 min was determined by placing the numbers 1-12 in a cup. The numbers 1-11 were placed into a second cup. The
hour was from the first cup. The number drawn from the second cup was multiplied by 5 to obtain the minute. The two numbers were combined to form the trial. For example, if the number 4 was selected from the hour cup and the number 6 was selected from the minute cup, the trial was then 4:30. Once a number was drawn, it was placed aside. If all numbers were drawn from a cup, they were placed back in the corresponding cup to be selected from again.

Trials that required the participant to tell time to the exact hour and minute were selected in the same manner as the nearest 5 min with the addition of the numbers 1-4 inside a third cup. Once a time was created to the nearest 5-min interval, a number was drawn from the third cup. This number was added to the time. For example, if the number drawn from the first cup was 9, the number drawn from the second cup was 3, and the number with the third cup was 2, the trial time was 9:17. As each number was drawn from a cup, it was placed aside. If all number were drawn from a cup, they were placed back in the corresponding cup to be selected from again. Four trials were 1 min after a 5-min interval, four trials were 2 min after a 5-min interval, four trials were 3 min after a 5-min interval, and four trials were 4 min after a 5-minute interval.

The experimenter and secondary observer were the only two individuals in the classroom when the assessments took place. The participant sat next to the experimenter and the secondary observer sat approximately 2 m opposite of the experimenter. All time trials were generated following the aforementioned
process. The experimenter then set the clock according to the trial and asked the participant, “What time is it?” The participants’ responses were recorded as correct or incorrect according to definition. Participants were given 30 s before a no response was recorded and the experimenter presented the next trial. No consequences were programmed for correct or incorrect responses.

**Pretraining**

Pretraining was conducted to introduce answering questions with response cards. Each participant was provided with a response card as described in the Materials section. Participants also had a dry erase marker and a facial tissue to erase their answers. Before beginning the first response card phase, a 5 min training session was conducted. Participants were taught to respond to the experimenter’s question by writing their answer on their response cards. Examples the experimenter asked during training included, "What is your favorite number?" "Write the number n" and "What is your favorite letter?" After presenting a question, the experimenter said, "Write." After 10 s, according to a digital watch, the experimenter instructed the students to raise their cards above their heads by saying, "Cards up," so he and the secondary observer could see their responses. The experimenter provided feedback by reading each participant’ responses to the group. For example, if the question was, "What is your favorite number?" the experimenter would say, “I see your favorite number is $n$.” After providing feedback, the experimenter said, “Cards down, erase.” The
participants were instructed to lower their cards and erase their response, thus, preparing them for the next question. Participants were also instructed to write the hour in the space left of the colon and the minute in the space right of the colon on the response card.

Training Phases Overview

Based on the participants’ abilities to rote count by 1s and 5s upon entering the study, a task analysis indicated 6 components of time telling. Breaking the task of telling time into small sequentially ordered tasks allows shaping to occur. Training consisted of 6 phases. Phase I targeted hour- and minute-hand discrimination. Phase II targeted identifying the hour. The purpose of Phase III targeted identifying the hour with and minute hand discrimination. Phase IV targeted identifying the time to the exact hour. Phase V targeted identifying the time to the exact hour and 5-min interval. Finally, the purpose of Phase VI targeted identifying the time to the exact hour and minute. A script of each teaching lesson can be found in Appendix B. The lesson number correlates to the phase number (e.g., Lesson I was presented in Phase I). Trials were generated prior to training sessions. Feedback was given after each opportunity to respond. Correct responses received praise, and an error correction procedure followed incorrect responses.
**Phase I**

Hour- and minute-hand discrimination trials were generated by putting the letters M and H into a cup. The numbers 1-12 were placed into a second cup. A letter was drawn from the first cup, and a number was drawn from the second cup. The letter indicated which clock hand the experimenter would ask the question about, and the number indicated where the clock hand would point. For example, if the letter H and the number 2 were drawn, the hour hand would point to the 2-hour mark. Conversely, if the letter M and the number 3 were drawn, the minute hand would point to the 3-hour mark. After the letter cup was empty, the letters were placed in the cup and drawn again. As the number cup emptied, it was refilled in the same manner as the letter cup. Once the cups were refilled drawing resumed. The question the experimenter asked in this phase was, “What number is the hour hand pointing to?” or, “What number is the minute hand pointing to?” Response card procedures followed: Participants were given 10 s according to a digital watch to respond. If at the end of the 10 s a participant was still writing, an additional 5 s was given followed by the, “Cards up” cue. As in Narayn et al. (1990), feedback was delivered after each opportunity to respond. The experimenter praised the group if everyone had the correct answer (e.g., “Awesome class, the hour hand is pointed at the 2”). If only some of the participants’ responses were correct, the experimenter said, “I see some of you have the correct answer,” followed by saying the correct
answer. If none of the participants responded correctly, the experimenter said, “I see no one has the correct answer.” The correct answer, as defined by the phase, was given with the following error correction procedure. If the trial required hour hand discrimination, the experimenter said, “Remember, the hour hand only reaches to the numbers. So tell me class, what number does the hour hand point to?” If the trial required minute hand discrimination, the experimenter said, “Remember, the minute hand reaches to the edge of the clock. So tell me class, what number does the minute hand point to?” Participant responses were emitted vocally during error correction procedures. Response card and feedback procedures that followed the experimenter’s question in all training phases were identical. Error correction procedures varied by phase.

Phase II

Phase II required the participants to indicate the hour. Trials were generated by placing the numbers 1-12 in a cup. A second cup had the numbers 1-5. The number drawn from the first cup indicated the hour, and the number drawn from the second cup indicated the minute mark of that hour. For example, if the number drawn from the first cup was 9 and the number drawn from the second cup was 3, the hour hand was placed on the third minute mark of the ninth hour (the hour hand pointed at the 47 minute mark). When all numbers were drawn from a cup, the numbers were put in the cup and drawn again. The minute hand was arbitrarily moved to a different location on each trial. The
question the experimenter asked was, “What is the hour?” Response card and feedback procedures were identical to the previous phase. If an error was made the correct answer was given and the experimenter said, “the hour hand is past the n, but not all the way to the n. For example, if the hour hand pointed between the 4 and the 5 hour mark, the experimenter said, “the hour hand is past the 4 but not all the way to the 5.” Participants were not required to repeat the correct answer.

Phase III

This phase was a combination of Phases I and II. Participants were required to indicate the hour or the number at which the minute hand pointed. Trials were generated in an identical manner to Phase II for the hour and Phase I for the number where the minute hand was pointed. The experimenter asked, “What is the hour?” or “What number does the minute hand point to?” Error correction procedures were identical to Phases I and II. The error correction procedure used was indicated by whether the trial targeted identifying the hour or minute hand discrimination.

Phase IV

In this phase, participants were required to indicate time to the exact hour. Trials were generated by placing the numbers 1-12 in a cup. The number drawn from the cup indicated the trial time. For example, if the number drawn was 11, the trial time was 11:00, and the hands of the clock were placed
accordingly. The experimenter asked the question, “What time is it?” If a response was incorrect, the hour was found using the error correction procedure in Phase II followed by saying, “the minute hand is pointing to the 00 mark which means o’clock. That means the time is n o’clock.” Participants were not required to repeat the correct answer.

Phase V

The fifth phase required the participants to indicate time to the hour and exact 5-min interval. The hour and position placement was generated by following the procedures in Phase II. The minute was generated by placing the numbers 1-12 in a cup. The number drawn from the cup was multiplied by 5 to indicate the minute. For example, if the number drawn from the first cup was 6, and the number drawn from the second cup was 8, the trial was 6:40 and the clock hands were placed accordingly. The experimenter asked, “What time is it?” If a response was incorrect, the hour was indicated saying, “The minute hand points directly at a dark line, which means we can skip count by 5s. Count with me.” Once the minute was found, the experimenter said, “That makes the time n:nn.”

Phase VI

Participants were required to indicate the time to the exact hour and minute for the final phase. The trial time was generated in the same manner as Phase V. A third cup, however, had the numbers 1-4 placed in it. The number
drawn from the third cup was added to time generated from the Phase V procedures. For example, if the number drawn from the first cup was 1, the number drawn from the second cup was 6, and the number drawn from the third cup was 3, the trial time was 1:33. The clock hands were moved to reflect the trial. As in the previous 2 phases, the experimenter asked the question, “What time is it?” If a response was incorrect, the error correction procedure from Phase V was followed by saying, “That is as far as we can count by 5s. Now let’s count by 1s to where the minute hand points. Count with me.” Once the exact minute was found, the experimenter said, “That makes the time n:nn.”

Probes

After two sessions in a given training phase, the participants were tested on 10 probe trials. To advance to the next phase, participants were required to meet the criterion of 9 out of 10 correct trials. Probe trials were generated in the same manner as trials within a given training phase. Response card use as a group continued as normal; however, participants received no feedback on their answers. Correct responses were not praised, and incorrect responses were not corrected. In order to maintain responding, participants were thanked intermittently for their hard work and told how many questions remained before returning them to their class.

If a participant did not achieve 9 out of 10 correct trials, training continued for that phase for all participants. Rather than singling out a
participant for continued training for not having reached the probe criteria, all participants resumed training for that phase. After an additional two training sessions, all participants were tested on new probe trials. New probe trials were generated to prevent the participants from testing on the same set of probes. When all participants scored 9 out of 10 correct probe trials, training advanced to the next phase.

Design

To assess the effect of response card use on the acquisition of telling time, an assessment was given before and after completing the training. The pre- and post-assessments included the same trials presented in random order. During the probe phases, if all participants responded at or above the probe criterion, they proceeded to the next phase of the procedure. However, if any one participant failed to respond at or above the probe criterion, all participants received further training in the last training phase conducted for 2 sessions. After the additional training sessions, a probe session was conducted again.
RESULTS

The pre-assessment, training phases, and post-assessment results for Participants 1-3 are shown in Figure 1. Results are shown as a percentage of correct responses. Figures 3, 4, and 5 show the same data but are depicted individually by participant.

The pre-assessment data indicate that all participants scored low with a range of 2-5 correct responses. Participant 1 scored 11.43% correct, Participant 2 scored 5.71% correct, and Participant 3 scored 14.29% correct. An analysis of each participant’s responses revealed that the participants frequently, not always, responded to the experimenter’s questions with an answer of, “no o’clock.”

Figure 2 depicts the participants’ percentage of correct answer by training phase. Pre-assessment and post-assessment results are also depicted. For training phases, Participant 1 scored a range of 83.02-100.00% correct responses. Participant 3 scored similar results with a range of 92.45-100% correct responses. Participant 2 had the greatest difference in range with a range of 69.86-97.96% correct responses.

Table 1 summarizes the results of each response card training phase. The table depicts 1) the number of opportunities to respond, 2) the number of correct and incorrect responses, 3) the percentage of correct responses, 4) the
number of necessary trials required before reaching probe criterion, and 5) the number of training hours required before reaching probe criterion.

All participants were able to meet probe criterion. Participant 3 was able to meet probe criterion on the first attempt on all probes. Participant 2 required continued training following the initial 2 training sessions in Phases V and VI. Participant 1 also required continued training following the first Phase VI probe. All participants met or exceeded probe criterion in 6-8 hours of group training.

When the post-assessment was given, the number of correct responses increased for all participants. Participant 1, Participant 2, and Participant 3 scored 97.14%, 85.71%, and 100% correct, respectively on the post-assessment. Participant 1 increased from 4 correct responses to 34 resulting in an 85.71% correct response increase from pre- to post-assessment. During the post-assessment, Participant 1 emitted only 1 incorrect response. The incorrect response was likely a counting error, as the response was 1 min less than the exact time. Participant 2 increased correct responding from 2 responses to 30 correct responses for an 80% increase from the pre-assessment. Participant 3 was the only participant who responded correctly on all post-assessment trials for an 85.71% correct increase.
DISCUSSION

Results of the present study indicate that a teaching program that includes sequential lesson presentation, active student participation with response cards, reinforcement of correct responses, and error correction procedures following incorrect response can be an effective method to teach students diagnosed with intellectual disability to tell time. The relevance of the present study is in its contribution to the limited telling time literature for persons with intellectual disability (e.g., Partington et al., 1979; Smeets et al., 1986). Also, content of response card literature was extended by including mathematical subject matter, specifically time management (e.g., Narayan et al., 1990; Davis & O’Neil, 2000; Marmolejo et al., 2004). These results support using a programmed sequence of instruction with response card methodology to aid in the acquisition and fluency building of telling time behavior.

Results of the present study are encouraging; however, aspects of the findings warrant attention. It should be noted that if student’s share a similar academic goal, such as learning to tell time, consideration should be given to each student’s repertoire. Students with comparable academic skill should be placed into the same groups to maximize the effectiveness of group instruction. By circumstance, the participants of the current study entered with similar behavioral repertoires. The common abilities of the student should influence how
the content of instructional material is presented in order to capitalize on the previously established student repertoires.

The purpose of the present study focused on the behavior of telling time; the study was restricted to teaching the interpretation of an analog clock. Learning to tell time is the first step. In order to achieve a comprehensive understanding of telling time, “time-using” skills must also be taught (Moyer, 1983). Such skills build on the ability to tell time. These skills include determining the amount of time between two given times and predicting the clock time after a specific amount of time passes. It is in this way the ability to tell time serves a functional role in an individual’s life. Training phases could also include generalization to a variety of clock faces. For examples, students could train using clock faces with Roman numerals or pictures in place of Arabic numbers. Furthermore, students could learn to read clock faces without minute marks.

Future research could include typically developing individuals. Should such research be successful with diverse levels of academic skills, instruction of telling time could begin at earlier educational stages.

A further limitation was an issue of timing. Because the study was conducted at the end of the school year, no follow-up maintenance data were collected. The experiment concluded the last week of the participants’ school year. Once the school started after summer break, attempts were made to obtain permission to collect follow-up data. The participants’ guardians did not
respond when contacted by telephone and mail regarding informed consent to collect maintenance data.

Two areas of the design of the study also warrant attention. In its current form, the design of the study does not control for learner history and repeated testing. One possible solution is to use a multiple baseline design to control for learner history and conduct multiple probes. A limitation of this study is that the participants were not allowed to move through the training phases at their own pace. If one student did not meet the criterion on the probe trials, all students continued to receive training in that phase prior to the probe. With a group contingency, if one student repeatedly failed to meet criterion on the probe, students who do meet criterion may find repetitive practice of the same skill aversive.

Greenwood et al. (1984) and Heward (1994) identified active student responding (ASR) as an important component of effective instruction and a benefit to using response cards is it is a low-cost method for increasing active student responding that allows an instructor to assess the understanding of a group or individual and immediately provide feedback accordingly (Heward, 1994). However, a high number of student responses does not guarantee that instruction will be effective. Increased practice of a skill does not always result in increased performance, quality as well as the quantity of practice is important (Moyer & Moyer, 1985). In the three-term learning contingency, increasing the
frequency of ASR focuses on but one part of the equation. The use of response cards is simply a tool to facilitate and increase active student responding. However, if instructional material is poorly designed, and without systematic feedback, high rates of ASR can be pointless.

The participants of the current study entered with the ability to rote count by 1 and 5 to 60. Furthermore, the participants were trained to discriminate the hour and minute hands unlike participants in the Smeets et al. (1986) study in which this skill was established in their repertoire. The participants in the current study were also trained to tell time to the exact hour and minute. The goal of Smeets et al. (1985) and Smeets et al. (1986) was to train the participants to tell time at the nearest 5-min interval. Moreover, no prompts for correct responding were required in the current study. In Sowers et al. (1989) and Martin et al. (1987), the ability to respond to the placement of hands on a clock was accomplished using prompts. An additional strength of the current study is that training was conducted in a small group (3 individuals) whereas all previous studies conducted individual training.

To assess a measure of social validity, the participants and the secondary observer (the participants’ regular teacher) were interviewed at the end of the study. All participants reported they enjoyed using the response cards and would use them again for other classes. Two of the participants reported that using the cards “felt like a game.” The participants’ teacher reported she “liked that the
students received a lot of practice within the lesson.” She also praised the fact that “the teaching steps were concise and built on previous lessons,” and would use response cards in her classroom.
Conclusion

In conclusion, results of the current study indicate that a programmed teaching sequence and response card use with systematic feedback after lesson presentation may be an effective method for small group instruction of students with intellectual disability to tell time. The ability to tell time can contribute to an individual’s independent functioning. If an individual can tell time, he/she could learn to follow a schedule or daily routine. The amount of direct supervision and caregiver assistance, whether in institutional settings, schools, or in homes, could be reduced.
Table 1

*Participant Training Results*

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<td>71 2  97.26 25 1.00</td>
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*Note 1.* The table indicates each participant’s results per phase. The table shows the number of opportunities to respond (OTR), the number of correct responses (C), the number of incorrect responses (I), the percentage of correct responses (%C), the number of trials necessary before probe criterion was met (T), and the number of necessary training hours before probe criterion was met (H).
Figure 1. The figure depicts the percentage of correct answers by participant per training session. Pre-assessment (P) and post-assessment (PT) results are also shown.
Figure 2. The figure depicts the percentage of correct answers by participant per training phase. Pre-assessment (P) and post-assessment (PT) results are also shown.
Figure 3. The figure depicts the percentage of correct responses emitted by Participant 1 through pre-assessment (P), training sessions, and post-assessment (PT).
Figure 4. The figure depicts the percentage of correct responses emitted by Participant 2 through pre-assessment (P), training sessions, and post-assessment (PT).
Figure 5. The figure depicts the percentage of correct responses emitted by Participant 3 through pre-assessment (P), training sessions, and post-assessment (PT).
APPENDIX A

OVERHEAD CLOCK DIAL
APPENDIX B

LESSON SCRIPTS
Lesson I

Let’s get started. Look up at the board, (analog clock projected on the board) that is a clock. A clock helps us to tell time. A clock has numbers and hands. Today we are going to talk about the hands.

There are two hands of a clock that help us to tell time – the hour hand and the minute hand. This is the hour hand (pointing to hour hand). It tells us the hour. See how it is short. It only reaches to the numbers on the clock. This is the minute hand (pointing to minute hand). It is longer than the hour hand. It reaches all the way to the edge of the clock.

Let’s do some examples together. I am going to move the hour hand, and I want you to tell me what number it is pointing to. (Move hour hand to point to the number 10). What number is the hour hand pointing to? (Wait for students to respond). Nice work class, the hour hand is pointing at the 10. You are too smart!

Now I am going to move the minute hand, and I want you to tell me what number it is pointing to. (Move minute hand to point to the number 3). What number is the minute hand pointing to? (Wait for students to respond). Way to go, the minute hand is pointing at the 3.

Remember, the hour hand is short. It only reaches to the numbers on the clock. The minute hand is long. It reaches all the way to the edge of the clock. Do you have any questions about the hands of the clock?
(Answer student questions as needed). Let’s practice. (Begin response card procedures).

Lesson II

(Analog clock projected on the board). A clock helps us to tell time. It tells us the hour and the minute. Remember that the hour hand is short, and the minute hand is long? Today we are going to learn to tell the hour. To tell the hour, you need to find the hour hand.

The numbers on the clock will help you to tell the hour. Let’s read the numbers on the clock together. (Point to each number as it is read said aloud). One, two, three...ten, eleven, twelve. Good job, so the hour can only be one of those numbers. If the hour hand is pointed directly at the number and the dark line that is the hour. (Point to the dark mark next to the number). (Move hour hand to point directly on the 12). See how the hour hand is in perfect line with the 12? That means that the hour is 12. Now, the hour stays the same until the hour hand reaches the next number. (Move hour hand to point between the 12 and 1). Even though the hour hand points in the middle, the hour is still 12 because the hour hand has passed the 12 but not all the way to the 1. (Move hour head to point between the 7 and 8). Now the hour hand points between the 7 and 8. The hour is still 7 because the hour hand has passed the 7 but not all the way to the 8.
Lets do an example together. (Move hour hand to point directly at the 6.) What is the hour? (Wait for students to respond). Very good, the hour is 6 because the hour hand is pointed directly at the 6. What if the hour hand was here? (Move hour hand between the 6 and 7). What time would it be? (Wait for students to respond). The hour is still 6 because it has passed the 6 but has not gotten to the 7. Do you have any questions about finding the hour? (Answer student questions as needed). Let’s practice. (Begin response card procedures).

**Lesson III**

Let’s review what we have worked on so far. We have learned the hour hand and minute hand. The hour hand is short and points to the numbers, and the minute hand is long and reaches all the way to the edge of the clock. To tell the hour, you have to look at the hour hand. The hour can only be a number 1-12. If the hour hand points between two numbers, you have to look back to see what number the hour hand is has completely passed.

Okay, let’s practice everything we have learned so far! I will be asking you to tell me the hour or what number the minute hand points to. (Begin response card procedures).
Lesson IV

(Analog clock projected on board). There are 60 minutes in one hour. Rather than writing all those numbers on the clock, there are little marks near the edge of the clock to help us count. We start counting directly on the 12. The dark line there is 00 (point to mark). The next is 01, 02, 03, 04, and 05. I want us to count together each minute mark as I point to them. Remember, start at 00. (Point to each line as counting). Let’s start, 00, 01, 02...58, 59, 60 or 00. Very nice.

When the minute hand points at the 00 mark, we say it as o’clock. So to tell the time, you find the hour first and the minute second. (Present the time 2:00). Let’s do an example together. First, let’s find the hour, what is the hour? (Wait for students to respond). Great, the hour is on the 2. Now let’s find the minute. The minute hand is pointed at the 00 mark. Remember; when the minute points to the 00 mark, do we say it is 00 or o’clock? (Allow students to respond). You remembered, we say o’clock. Now we just have to put the hour and minute together. So what time is it? (Allow students to respond). Fantastic, it is 2 o’clock. Wow, you just read a clock. You are too smart. You found the hour first and then the minute. And the minute had was on the 00 mark and you remember that we say o’clock.

Let’s do some practice. (Begin response card procedures).
Lesson V

Last time you learned to tell the o’clock times. Let’s keep working. Remember that the clock shows 60 minutes. I’ll point to the minute mark, and you all count. (Count 00 to 60). Wow, that takes a while right. Well, there is a faster way! The dark lines can help you by counting by 5s.

Instead of counting each minute mark, you can skip count. Let’s practice skip counting to 60 together. Start with 00, ready go. (Count to 60 by 5s while pointing to the corresponding minute mark). Very nice. The dark line at the 12 starts with 00 (point to 00 mark). Then move to the dark line at 1. If we skip count that would be minute five. Let’s check our work by counting each minute mark. (Count 00-05 while pointing to each minute mark). Great job! See, skip counting is much faster. If the minute hand points directly to a dark line, you can skip count to it by 5. To find the time now, just find the hour and then skip count to the mark where the minute hand points. Let’s do an example together. (Analog shows the time 3:35). What time is it? Find the hour first. (Allow students to respond). Excellent, the hour is 3. Now let’s find the minute. Look, does the minute hand point exactly to a dark line? It does, so we can count to it by 5s. Let’s do it together: 00, 05,…30, 35. What is the minute? Perfect, the minute is 35. What time is it then? (Allow students to respond). Look at you all telling time, the time is 3:35!
Do you have any questions? (Answer student questions are needed.) Let’s start practicing. (Begin response card procedures).

*Lesson VI*

So far we have talked about finding the hour and the minute if the minute hand points directly to a dark line. If the minute hand points directly to the dark line, we can count to it faster by counting by 5s. Well what if the minute hand doesn’t point exactly to a dark line? Try to get as close to it as possible by counting by 5s and then start counting by 1 to the exact minute. For example (display the time 7:06), what time is it? First let’s find the hour first. (Allow the students to respond). Good, the hour is 7. Now let’s find the minute. Before we start counting all the minutes, let’s see if we can skip count to get close to the number first. Can we count by 5s to get close to the minute hand? Yes, we can. So let’s start counting together, remember start at 00 on the dark line of the 12:00, 05. Now, is that exactly where the minute hand points? No, so now we just start counting by ones. We ended at 05, so that makes one more mark 06. Let’s check our work by counting by 1s to see if we are correct. 00, 01, ... 05., 06. Nice work, that makes the time 7:06.

What if the minute hand pointed between the 12 and the 1. Would we be able to count by 5s to get to the minute hand? No, we wouldn’t be able to get pass 00, so we would just count by 1s. Let’s look at another
example (display the time 11:04), what time is it? Find the hour and then the minute. What is the hour? (Allow students time to respond). Great work, the hour is 11. Now let’s find the minute, are you able to skip count to get close to the minute hand? No, we’re not able, so let’s count by 1s. Ready, (point to each minute mark) 00, 01, 02, 03, 04. What is the minute? (Allow students time to respond). Very nice, the minute is 04. What is the time then? (Allow students time to respond). Look at that, you can all tell time, the time is 11:04!

Let’s practice telling time. (Begin response card procedures).
APPENDIX C

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APPENDIX D
RESPONSE CARD
APPENDIX E

PROCEDURAL FIDELITY CHECKLIST
Procedural Checklist

Observer: ___________________    Date: ____________

Procedural Checklist: Place a check in the box if:

Participant has the following materials

- Response Card
- Marker
- Eraser
- Work Cover

Experimenter

- Tells students to put up their covers
- Turns on overhead projector
- Asks, "Can everyone see the board clearly?"
- Starts 30 m timer

In Session

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Feedback:

- Praise statement for correct answers
- Error correction procedure if incorrect
APPENDIX F

PRE- AND POST-ASSESSMENT DATA SHEET
Pre- and Post-Assessment Data Sheet

Participant: __________                      Date: __________
Observer: __________

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REFERENCES


