A Comparison of Discrete Trial Training and Embedded Instruction on the Promotion of Response Maintenance of Coin Counting Skills for Middle School Students with Intellectual Disabilities

Thesis

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Abstract

This study compared the effects of two different instructional strategies. The first is a systematic, classroom-based, teacher-directed instructional strategy called discrete trial training (DTT). The second is a more naturalistic instructional strategy performed outside of the classroom called embedded instruction. The study was conducted to determine which strategy would best help middle-school-age children with intellectual disabilities maintain acquired math skills over time. The math skill for the students involved was counting quarters and nickels (in like groups), up to $1.50. Either DTT or embedded instruction was provided to the students until they could count quarters and nickels with 100% accuracy across three consecutive trials. After mastery was reached, the students were moved to a maintenance phase where data was collected two times per week, but not on the same day. The data were compared to see which strategy helped students maintain mastery levels of the skill. The strategies were alternated and data from each strategy were compared. The study demonstrated that both instructional methods were able to help students with intellectual disabilities reach mastery levels of performance and maintain these levels over time. However, one student acquired the skill slightly more slowly with DTT, requiring one additional teaching session. In addition, all students were able to apply the embedded instruction skill in various settings and all three students stated that they preferred embedded instruction.
Dedication

I dedicate this to my students who inspire and teach me new things each day. Thank you for coming along with me on our journey to learning, and laughing with me along the way. I love each day with you!
Acknowledgements

I would like to thank Dr. Helen Malone for her time, support, guidance, and patience. I have learned so much from you throughout my program and you have become one of my biggest inspirations in working with people with disabilities. Thank you for sharing your passion with all of your students. I would also like to thank Dr. Sheila Morgan for being my second reader. I learned so much from your classes. Also, a huge thank you to Chris Tullis for hours of time spent collecting IOA and procedural fidelity data, answering emails, and editing my many drafts. I appreciate all of your time and know that I couldn’t have finished without your constant support. I would also like to thank my wonderful classroom staff—Krysten Cotone, Deborah Hoffman, and Gina Pagani. Your love, support, kindness, hard work, and willingness to try and do anything means the world to the students, and to me, too. Thank you so much for everything you do everyday. Lastly, I would like to thank my family for your love and support. You have supported me through each step of my education and I would not be who I am without you. And to my husband, Eric, I could never find the words to really thank you. You helped me survive with your positive attitude, ability to make me laugh, encouragement, love, and willingness to jump in and do all the things I didn’t have time to do at home. Thank you for everything you do for me everyday. I love you!
Vita

Education

2006----------------------B.S. in Education, Miami University

2002----------------------Carlisle High School

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2006—present.........Intervention Specialist at Middle School West

2007----------------------Tutor for student with cognitive disability

2003—2006.............Respite care provider

Honors and Awards

2006----------------------Magna cum Laude for B.S. in Education, Miami University

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2005----------------------ETS Recognition of Excellence, Praxis II: Principles of Learning and Teaching

2003—2005.............President’s List, Miami University

2002----------------------Dean’s List, Miami University

Fields of Study

Major Field: Education
(Special Education: Mild/Moderate and Moderate/Intensive)
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Chapter 1: Introduction

Individuals with intellectual disabilities have deficits in the area of memory (Heward, 2003; Leven, Lyxell, Andersson, Danielsson, & Ronnberg, 2008; Van der Molen, Van Luit, Jongmans, & Van der Molen, 2007). Teachers who work with students with intellectual disabilities must plan to help students remember learned skills as evidenced through response maintenance. Cooper, Heron, and Heward (2007) define response maintenance as the extent to which a learner continues to perform the target behavior after a portion or all of the intervention responsible for the behavior’s initial appearance in the learner’s repertoire has been terminated. Response maintenance is essentially the continued performance of a behavior over time at levels that approximate mastery.

Students with intellectual disabilities may require well-planned instruction to ensure that their behavior is maintained over time. Past research has supported the efficacy of highly structured teaching programs (Engelmann & Osborn, 1970; Lovaas, 2003), as well as less structured programming (McGee, Krantz, Mason, & McClannahan, 1983; McGee, Krantz, & McClannahan, 1985; McGee, Morrier, & Daly, 1999). Two specific instructional methods that have been demonstrated to be effective are embedded instruction (McGee et al. 1983; McGee, Morrier, & Daly, 1999; Sigafoos, O’Reilly, Ma, Edrisinha, Cannella, & Lancioni, 2006) and discrete trial
Embedded instruction, also called incidental teaching or natural environment teaching (NET), occurs when the natural environment is arranged to gain the student’s interest and allow for instruction during the existing routines and activities in the student’s day (McGee et al., 1983). Embedded instruction provides for instruction in the context of natural stimulus conditions and natural contingencies of reinforcement (McGee, Morrier, & Daly, 1999). Although occurring as part of a natural routine with already existing stimuli, instruction and reinforcement are planned and then provided by the instructor (McGee et al., 1983; McGee, Krantz, & McClannahan, 1985; McGee, Morrier, & Daly, 1999). When using this method, instructors use routines that are already present in the students’ day as the context for instruction. The teacher provides instruction in these settings and routines, for a more natural instructional methodology. Using this strategy, opportunities to teach differing skills are a part of the typical day and typical routines (Sigafoos et al., 2006). For example, in a study done by McGee et al. (1983), incidental teaching was used to teach receptive object labels to two middle-school-aged children with autism. This was done in the context of making lunch, throughout which the instructor requested needed objects with a prompt of “Give me____.” The child’s response was to select the item specified by the instructor. Tokens and behavior-specific praise were given contingent on correct responding. Students were given gestural prompts if they were unable to select the correct object. The reinforcer for correct responding was the ability to complete making their lunch. Instruction was provided in the kitchen and the completed lunches were taken to school.
on the following day. The data indicated that both participants showed an increase in their percentage of correct receptive object labeling with the intervention, but no data was collected on response maintenance of these skills.

Embedded instruction has been demonstrated to be effective with toddlers with autism (e.g., McGee, Morrier, & Daly, 1999) and elementary aged children with autism or developmental disabilities (e.g., Johnson, McDonnell, Holzwarth, & Hunter, 2004; McGee et al., 1985; McGee et al., 1983; Sigafoos et al., 2006). Embedded instruction has been used to teach many skills, including communication (e.g., Johnson et al., 2004; McGee et al., 1999), social skills (McGee et al., 1999), and language skills (McGee et al., 1985; McGee et al., 1983). It has also been demonstrated to be effective when teaching content material in general education settings (Johnson et al., 2004) and for decreasing self-injurious behavior. Additionally, embedded instruction can help promote response maintenance. A study by Johnson et al. (2004) demonstrated response maintenance for two to five weeks with embedded instruction. In this study, embedded instruction was used to teach content-area skills in a general education setting for three elementary-aged students with developmental disabilities. Instruction was provided in an inclusive, general education classroom and target skills included modified standards from the science class or IEP goals that were appropriate and necessary in the classroom (i.e., requesting help). Trials were done during existing classroom routines. All three students were able to maintain their learned skills through the entire study with the use of embedded instruction. McGee et al. (1985) also demonstrated response maintenance in a study of the effects of incidental teaching on preposition use by three elementary-aged children with autism. Instruction was
provided in a classroom setting and generalization probes were given in a different classroom. Stimulus items were toys and other desired items. These items were placed on a shelf with a shoebox to represent the targeted prepositions (e.g., under, inside, etc.). Students had to use the correct preposition when requesting the desired item, based on its location. Reinforcement consisted of descriptive praise and access to the desired item for 5 sec. Errors were followed by prompts during which the teacher told the student the correct way to describe the location of the item (e.g., “Say, ‘The clown is under the box’”). All three participants achieved mastery levels and maintained them throughout 10 maintenance trials, with two of the three students clearly maintaining higher levels in this phase when incidental teaching was used. The specific length of time in the maintenance phase was not given in the study and is a limitation of this research.

There are several limitations of the embedded instruction research. First, the maintenance periods are not always clearly defined and are relatively short. In addition, there are few studies that compare the effectiveness of embedded instruction with other instructional methods. The behaviors selected do not include behavior chains and show little data collection on the students’ performance of the skills in novel settings or beyond short maintenance periods.

An alternate method that has been demonstrated to be effective when providing instruction to students with disabilities is discrete trial training (Downs et al., 2008; Smith, 2001). Discrete trial training (DTT) has been used to teach skills to students with autism and developmental delays (Lovaas, 1987, 2003; McEachin, Smith, & Lovaas, 1993; Smith, 1999, 2001). DTT is a simplified, one-on-one, teacher-directed
instructional method with goals focusing on each individual student (Smith, 2001). In discrete trial training, instruction is provided in multiple, quickly presented learning trials (Sigafoos et al., 2006). Smith (2001) describes DTT as having five parts: (a) cue, (b) prompt, (c) response, (d) consequence, and (e) intertrial interval. The cue is a discriminative stimulus, in the form of a brief, clear directive or question (e.g., touch your head). The prompt is used to guide the student to the correct response and may be given with the cue or immediately after. For example, the teacher may model the correct response. These prompts are faded as the student shows mastery of the skill. The response is the emission of the target skill by the student (e.g., touching head). The consequence following the response consists of reinforcement for an accurate response and a removal of attention, signal of inaccuracy (e.g., teacher stating no), or removal of teaching materials for an inaccurate response. The final part of DTT is an intertrial interval, which is a brief pause of one to five seconds between the consequence from one trial and the cue for the next.

DTT is most often used for children with autism to teach new forms of behavior, new discriminations between stimuli using receptive language, expressive language, conversation, or sentences, grammar and syntax (Smith, 2001). It can also be used to expand their existing skills (Cooper et al., 2007; Smith, 2001), teach the use of alternative communication systems (Cooper et al., 2007; Smith, 2001), or manage challenging behavior (Smith, 2001). Some benefits of DTT include short instructional units, individualized instruction, multiple opportunities to respond, and flexibility in the times that it can be provided (Downs, 2008).
A study by Taubman, Brierley, Wishner, Baker, McEachin, & Leaf (2001) studied the use of DTT with preschoolers with developmental disabilities. Eight students were taught movement, pre-math, and language skills in a whole-group format in a classroom. Instruction occurred in their “special day class: preschool” classroom, where a combination of choral responding and 1:1 trials were used. With 1:1 instruction, the teacher moved sequentially to each student on a random, rotating basis. The least intrusive prompts were used and no aversive or punishing contingencies or techniques were used. Differential reinforcement was used. Although the instructional method proved to be effective for skill acquisition, there was no data collection on the response maintenance of the skills.

DTT is most often used to teach language skills and is often used with children who have autism. In addition, much of the research on this type of instruction has been conducted with younger children. A study conducted by Downs et al. (2008), provided three preschool students with significant language and cognitive delays discrete trial training at least two times per week for two years to learn language skills, pre-academics, imitation, daily living skills, and find motor skills. They found DTT, even in relatively small amounts, to be effective for teaching preschool students with developmental disabilities various receptive and expressive language skills. However, no data was presented in relation to maintenance of those skills over time.

One limitation of the body of research for DTT is the focus on a limited population, most often autism. In addition, there is little research on extended response maintenance periods and generalization.
Few studies have examined the difference between embedded instruction and discrete trial training (e.g., Sigafoos et al., 2006). In the study by Sigafoos et al., (2006), embedded instruction and DTT were compared when teaching correct responding, reducing self-injury, and improving mood, to a 12-year-old boy with autism and severe intellectual disability, using an ABABA design. Embedded instruction was incorporated into swinging, walking, and music activities. Discrete trial training occurred in the classroom. Correct responses were reinforced with social praise, pats on the back, smiles, and continuation of the activity. A system of least prompts was used to prompt correct responses. During DTT, the student had higher rates of self-injury, lower mood ratings (more negative) and fewer correct responses than in embedded instruction. However, the difference in performance of correct responding could be due to the difference in tasks. In DTT, imitative and receptive labeling tasks were targeted and may have been more difficult. In embedded instruction, the target behaviors were producing a manual sign or pressing a button, which may have been easier.

Even fewer studies have examined and compared response maintenance with these two methods. Downs et al., (2008), suggested that future studies should examine the long-term outcomes of students with developmental disabilities who are exposed to DTT. Because the maintenance of a skill over time is so important, it is critical for researchers and practitioners to know which methods may promote response maintenance most effectively. Mirenda-Linne and Melin (1992) compared the effectiveness of discrete trial training and embedded instruction to improve expressive social language for two boys with autism. The findings in this study indicated that these two methods of instruction may differ in their effectiveness based on the person’s stage
of learning (e.g., acquisition versus maintenance). DTT produced faster acquisition of
skills, while skills learned with embedded instruction were maintained and generalized
more during probes a week later. Long-term maintenance data was not collected in this
study.

Generalization and maintenance are vital to learning and evidence that
meaningful learning has happened (Stokes & Baer, 1977). Both in research and
practice, ensuring that learned skills maintain over time is essential to proving that a
true and lasting behavior change has occurred (Stokes & Baer, 1977). Different
instructional strategies may lead to different levels of response maintenance with
behaviors. Because of the limited information on response maintenance,
implementation of embedded instruction or DTT may only be a part of what is
necessary to program for learned responses to persist over time.

The present study was designed to determine which instructional method is most
effective for helping middle-school aged children with intellectual disabilities maintain
acquired skills over time by answering the following questions:

1. What effect does embedded instruction have on maintenance of coin counting
   skills for students with intellectual disabilities?

2. What effect does DTT have on maintenance of coin counting skills for students
   with intellectual disabilities?

3. Which instructional strategy, DTT or embedded instruction, best promotes
   response maintenance of coin counting skills for students with intellectual
disabilities?
Chapter 2: Method

Participants

The participants were three middle-school-aged students with intellectual disabilities who attended a public middle school. Data from each child’s educational records, specifically their Individual Education Plan (IEP) was accessed. Information taken from the IEP included student diagnoses (e.g., learning disability, cognitive disability, etc.) and student academic goals to ensure that the skills targeted were in line with the student's educational programs.

Throughout the study, the participants received daily math instruction in a resource classroom and spent more than half of their day in this setting for instruction in various areas. All three students had intellectual disabilities, as determined through testing done by the educational psychologist. When in a general education setting, these students were supported either by an intervention specialist or an educational aide, in order to provide accommodations and modifications to the curriculum. The students were selected for this intervention because of their struggle with response maintenance of coin counting.

Joan was a 15-year-old girl in the eighth grade. She had an intellectual disability and had been receiving services under that category since the age of five. At the time that this intervention began, her academic skills (i.e., reading, writing, and math) were at an average level of mid- to late- kindergarten, as determined using curriculum based
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<td>12</td>
<td>Intellectual Disability</td>
<td>Early- to Mid-Kindergarten</td>
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Table 1. Participant information.

assessments and the Fountas and Pinnel Benchmark Assessment Kit for reading. Joan also had significant delays in fine motor, gross motor, and speech and language skills for which she received occupational therapy, adapted physical education, and speech and language therapy. Shane was a 14-year-old boy in the eighth grade. He had an intellectual disability and had been receiving services under this category since kindergarten. Shane had academic skills (i.e., reading, writing, and math) averaging at the early- to mid- first grade level as determined by curriculum-based assessments and the Fountas and Pinnel Benchmark Assessment Kit for reading. He also had delays in fine motor, gross motor, and speech and language skills for which he received occupational therapy, physical therapy, adapted physical education, and speech and
language therapy. Dexter was a 12-year-old boy in the seventh grade. He had an intellectual disability and had been receiving services under this category since elementary school. Dexter’s file with educational history is incomplete due to several moves in his early years of school. His current academic performance averages from early- to mid-kindergarten as determined by curriculum-based assessments and the Fountas and Pinnel Benchmark Assessment Kit for reading. All three students attend general education classes during science and social studies. While in the general education setting, all three students’ work is greatly modified to their academic level and an educational aide is present for the entire period to assist and provide modifications and accommodations.

Materials

The materials used in this study included the following: (a) nickels, (b) quarters, (c) Flash cards with money amounts in five-cent denominations written on them, (d) various reinforcers from vending machines, the cafeteria, and the school store.

Setting

All students attended a public middle school and received instruction for math in a special education classroom. Two to four other students with similar disabilities were typically present at the time of instruction. Sessions involving discrete-trial training were conducted at various tables in the students’ classroom. The table was selected before each session based on the staff present and where the other students were working. If another teacher or aide was present, a table that was separated from the rest of the class was used. If no other staff members were present, a table off to the side of the room was selected so that the other students could still be visually
monitored. Sessions with embedded instruction were conducted in three settings: (a) the cafeteria lunch line; (b) the school store; and (c) the vending machine in a school hallway.

**Experimenter**

The experimenter for this study was a graduate student who was also the intervention specialist of the participants. The experimenter provided instruction and collected data.

**Dependent Variable**

The behavior targeted with the participants was counting quarters with total values of $0.25 to $1.50 or nickels with total values of $0.05 to $1.00. The dependent variable for this study was selected based on the following principles described by Baer, Wolf, and Risley (1968). This skill was age appropriate and was used by children, teens, and adults. It could provide access to future positive reinforcement, in the form of purchasing desired items, and allowing the participants to have more independent access to shopping at stores, restaurants, vending machines, etc. This skill would also allow them to function more independently in the same environments as their peers.

During discrete trial training, a correct response was defined as the student counting out the correct amount of change, in nickels only, with values from $0.05 up to $1.00.

During embedded instruction, a correct response was defined as the student counting out the correct amount of change, in quarters only, with amounts ranging from $0.25 to $1.50 before inserting that amount into the vending machine or handing it to the cashier in the cafeteria or school store.
**Data Collection**

Data were collected using direct observation and event recording of correct responses. The percentage of correct responses was calculated by dividing the number of correct responses by the total number of opportunities to respond. During the acquisition phase, sessions lasted 3 to 6 min and were conducted 4 to 5 times per week. During the maintenance phase, instruction no longer occurred and sessions were conducted at a lower frequency than in the acquisition phase. Each maintenance session lasted for approximately 5 min and sessions were conducted 2 times per week, but not on the same day. Feedback and error correction were not provided during maintenance sessions.

**Interobserver Agreement and Procedural Fidelity**

Data on IOA were collected during each phase for each participant using a total count of frequency within intervals by dividing the higher total number of observed correct responses by the lower total number of observed correct responses, and then multiplying by 100 (Cooper et al., 2007). For example, if observer one counted three occurrences and observer two counted five occurrences, the percentage would be calculated by doing 3/5 x 100 to get 60% agreement. The experimenter collected data during instruction and a second independent observer collected reliability and procedural fidelity data. This second observer was familiar with the behavior being measured and was provided training by reviewing the definitions of the behavior. Data recorded during these sessions was compared for the entire session.

Across phases and participants, IOA was calculated to be 100%. For Joan, IOA was collected during 14% of baseline sessions, 19% of instruction sessions, and 22% of
maintenance sessions. For Shane, IOA was collected during 14% of baseline sessions, 21% of instruction sessions, and 27% of maintenance sessions. For Dexter, IOA was collected during 14% of baseline sessions, 29% of instruction sessions, and 36% of maintenance sessions.

This observer collected data on the accuracy of the experimenter’s assessment of each of the target skills, as well as on the accuracy of the experimenter’s implementation of instructional methods. To ensure procedural fidelity, a graduate assistant familiar with discrete trial training, embedded instruction, and this study observed sessions and gave feedback to the instructor orally and using a checklist based on the research procedures.

The percentage of procedural fidelity was determined by dividing the number of steps completed correctly by the total number of steps completed and multiplying by 100. For Joan, procedural fidelity data was collected during 14% of baseline sessions, 19% of instruction sessions, and 22% of maintenance sessions. For Shane, procedural fidelity data were collected during 14% of baseline sessions, 21% of instruction sessions, and 27% of maintenance sessions. During baseline, instruction, and maintenance, procedural fidelity was 100% across all participants. For Dexter, data on procedural fidelity were collected during 14% of baseline sessions, 29% of instruction sessions, and 36% of maintenance sessions. Across all phases and sessions with all participants, procedural fidelity was 100%.

**Social Validity**

Social validity for this study was collected through oral question and answer, due to the participants’ limited reading and writing skills. Each of the 3 participants
was individually asked the following questions: 1. Did you like counting coins with Mrs. Turner? 2. Do you think you learned a lot from counting coins with Mrs. Turner? 3. Which did you like better—counting nickels at the table or counting quarters at different places in our school and community?

**Experimental Design and Independent Variable**

Instruction was presented in two different conditions (i.e., embedded instruction or discrete trial training). The effects of the two conditions on the dependent variables were compared in an alternating treatments design (Kazdin, 1982). Regular classroom instruction was continued throughout the study using identical methods and strategies across students. The target skills in regular classroom instruction excluded the specific skills targeted for the research (i.e., counting quarters and nickels).

**Procedures**

**Baseline.** During baseline, the teacher collected data in two different ways. For baseline on DTT, the teacher showed the student an amount of money on an index card and asked the student to count out the amount of money on the card and give it to her, using nickels only. For baseline data with embedded instruction, the teacher took the student to the vending machine in the hall and asked the student to count out quarters to purchase an item of their choice. Baseline data for embedded instruction was only collected at a vending machine due to a behavior issue with another student in the classroom. This issue reduced the available staff during the lunch periods, when the cafeteria and school store could be accessed. Due to the staff and time restrictions, data was collected at the vending machines during the morning because of the flexibility in being able to access this setting. During baseline, the students did not insert the money
into the vending machine, so they did not receive any feedback. The teacher did not tell
the student whether or not they were correct and did not give any consequences.
Students did not receive any feedback or error correction. During one probe session, the
student was asked to count out five different amounts. Students participated
individually in one session each day for a week.

Embedded instruction. During embedded instruction, opportunities to respond
were incorporated into three settings and activities (i.e., buying lunch, shopping at the
school store, and purchasing items from the vending machine) using quarters only.
Instruction was conducted in one setting/activity per session, with settings/activities
being presented in alternating order to balance the number of opportunities for
instruction in each setting/activity. During embedded instruction sessions, students
completed one full sequence, as described below. Students were given variable
numbers of quarters, ranging from seven to ten quarters to begin each session. Variable
numbers were provided to help ensure that students were actually counting the correct
amount, versus eliminating a certain number each time. The number of coins given was
quasi-random, varied during sessions, and was always more than the student needed.
During embedded instruction, if the student emitted the correct response (either
prompted or independent), they were given the item they chose prior to session
beginning (e.g., soda, snack, or item from school store). In addition, the teacher praised
the student when they exhibited the correct response. Specific procedures for each
setting are described below. If the student exhibited an incorrect response during
embedded instruction, the teacher verbally signaled the incorrect response by asking the
student to check their counting and modeling the correct response if needed.
**Lunch line.** When providing instruction for purchasing food in the lunch line, the students were given an initial prompt to *buy a snack*. The students could then go through the line to the cashier to request an item and pay (snacks are kept behind the cashier). Snack items cost $0.50, $0.75, or $1.00, and could all be paid for with quarters only. The cashier was briefed prior to the trials and was familiar with what the student would be doing in the line. When the student reached the cashier, she stated the total cost and the student was given only one coin type to count out to the cashier. If the student counted out the correct amount, the cashier responded with positive reinforcement by giving the desired item and praise or other positive language (e.g., *Have a great day!* and the teacher/researcher also provided simple verbal praise (e.g., *Great counting!*). If the student did not count out the correct amount, the teacher provided prompts in a least-to-most format, beginning with a simple verbal prompt, until the student correctly counted out the correct amount of money. For example, if the student counted out the incorrect amount, the teacher first encouraged the student to check their counting (e.g., *Are you sure?* or *Check your counting*). If the student was still unable to correctly count the money, the teacher would remind the student of the skip counting sequence and begin counting for them (e.g., *We count quarters by 25. 25...*). If the student was still unable to count, the teacher modeled the entire procedure and then asked the student to try it again. If they were still unable to count the amount, the teacher helped prompt the student through each step, until they correctly counted the coins.

**School Store.** When providing instruction for making a purchase at the school store, the students were able to approach the store window and look at the items for
sale. Items available for purchase had prices of $0.25, $0.50, $0.75, $1.00, $1.25, or $1.50, so they could all be paid for using quarters only. Once they made their selection, they told the employee what item they would like to buy and the employee orally stated the total cost. The student was given only one type of coin for their purchase and had to count out the total to the employee. Just as in the lunch line, the cashier was aware of the procedures in place for teaching sessions and their role in each session. If the student counted out the correct amount, the employee responded with positive praise by giving the desired item and praise or other positive language. If the student did not count out the correct amount, the same error correction procedure was followed as in the lunch line.

**Vending machine.** When instruction was provided at the vending machine, the student was given the opportunity to choose a beverage from the machine and the student had to state the cost aloud. Cost for the drinks was $0.75, $1.00, $1.25, or $1.50, and all could be paid for using only quarters, and they were given only one type of coin to count out to pay for their drink. They had to count out the correct amount and then put it into the machine. The students were prompted to count out the money first and then check their counting on the machine’s small screen before pushing the button to get their drink. The consequences in this setting were more natural. If they put in the exact amount, the correct amount came up on the screen, and the drink came out of the machine. If they did not put in the correct amount, they either identified that the amount on the screen was not correct or waited for teacher prompting. The teacher told the students that they did not put in the correct amount, prompted them to hit the coin return button, retrieve their money and start again. Least-to-most prompting was used
to ensure that they correctly count the coins and was used exactly like in the lunch line and school store.

**Discrete-trial training.** During DTT, the teacher presented discrete-training trials based on the procedure below for a total of five trials. Due to the varying amount of time needed for prompting, reinforcement, and error correction, the actual length of learning trials varied from 2 to 5 min, but no formal timing data was collected. The basic format, as described by Smith (2001) and presented below was used.

**Cue.** The teacher showed the desired amount on a 3.5 by 5 inch index card and stated the amount (e.g., *fifty cents*). The teacher then stated, *Count and give me the amount on the card.* Only amounts in five-cent increments were given, so that students could count the amounts using nickels.

**Prompt.** If the student did not initiate counting the coins within 2 s, the teacher began slowly counting the coins to model the desired behavior. The prompts were faded as students began to exhibit the desired behavior. If students began immediately counting the coins, no prompts were given. If the student began counting while the teacher was modeling, the modeling ended so that the student could finish counting.

**Response.** The response was defined above as the dependent variable. The desired behavior was the student counting the given amount, using only nickels, with a total ranging from $0.05 to $1.00.

**Consequence.** During discrete trial training sessions, if the student emitted the desired response, the teacher immediately gave positive reinforcement in the form of verbal praise and confirmation (e.g., *Yes! That’s right, $0.50*). If the student exhibited an incorrect response, the teacher verbally signaled the incorrect response (e.g., *No.*
That’s not correct.), then modeled the correct response and provided an additional opportunity for the student to respond. If the student produced the correct response after the model, it was still counted as incorrect, due to the first response given being incorrect, but the student was given verbal praise as described previously.

**Intertrial Interval.** Five-second intervals were used between the consequence and next cue.

**Maintenance.** Students moved into the maintenance phase once they exhibited 100% accuracy in a given condition for three consecutive trials. During the maintenance phase, students were provided opportunities to perform the skill either during class time, in real purchases at school (i.e., in the cafeteria, at the vending machine, in the school store), or in real purchases in the community, as appropriate. Students received reinforcement, as in the acquisition phase, but did not receive any feedback or error correction. Students worked on these skills for 6 to 15 min each week during the maintenance phase. If any student’s accuracy dropped below 80% for 3 consecutive trials, the plan was to provide a booster session. A booster session would consist of instruction exactly as done in the acquisition phase, with feedback and error correction. These sessions would be provided until their accuracy again reached 100%, but only for one trial. Once they reached 100% accuracy with booster sessions, they would again return to the maintenance phase. Due to the levels of student performance, no students needed a booster session.
Chapter 3: Results

Results for each participant are detailed in this chapter, as well as social validity findings of the research study.

Joan

Results for Joan are presented in Figure 1. Joan’s baseline data for embedded instruction consisted of three data points, at 0% correct. The data points were stable with no variation, and a mean and range of 0. Joan’s data for embedded instruction in the intervention phase consisted of 3 data points at 0% accuracy followed by an increasing trend to 100%. Once that level of accuracy was reached, it remained at 100% for the remainder of the study. The data had a mean of 67% and a range of 0–100%. Joan first reached 100% accuracy after 3 sessions of instruction, and maintained that level of accuracy for the remaining 7 sessions in the instruction phase. She was not immediately moved into the maintenance phase after 5 trials of 100% accuracy, due to her not reaching this level of accuracy with DTT. The initial goal was to move both types of instruction into the maintenance phase at the same time. However, due to slow acquisition of the skill in DTT, she was moved to maintenance after 7 consecutive sessions at 100% accuracy in embedded instruction. In the maintenance phase, Joan had 5 sessions with embedded instruction and her performance maintained at 100%.
Joan’s baseline data for DTT consisted of 4 data points, with little variability or trend. The levels of accuracy ranged from 0 to 20% with a mean of 10%. Joan’s data in the intervention phase for DTT consisted of 11 data points that showed an immediately increasing trend and level with minimal variability. Her levels of accuracy ranged from 20 to 100% with a mean of 73%. Joan did not reach the previously set criteria for moving into the maintenance phase early enough in the school year for adequate data collection in this phase.
Figure 2. The percentage of accuracy of responding for Shane in baseline, intervention, and maintenance phases for discrete trial training (DTT) and embedded instruction (EI).

Due to time constraints and overall high levels of accuracy ranging from 80 to 100% for 5 consecutive trials, she was moved into the maintenance phase. In this phase, 4 data points were collected, with accuracy ranging from 80 to 100% and a mean of 92%.

Shane

Shane’s data are presented in Figure 2. Shane’s baseline data for embedded instruction consisted of 3 data points all at 0%. Shane’s data during the instructional
phase consisted of 8 sessions, with a range of 0 to 100% and a mean of 63%. Shane first reached 100% accuracy after 3 sessions of instruction and maintained that level of performance for the remainder of the study. Shane’s maintenance data for embedded instruction consisted of 5 data points, all at 100%.

Shane’s baseline data for DTT consisted of 4 data points that were fairly stable at a low level of performance and little variability. The mean for baseline performance was 35% with a range of 20 to 40%. Data for DTT in the instruction phase consisted of 10 data points with a range of 40 to 100% and a mean of 82%. During this phase, Shane’s level of performance increased immediately with some variability. After reaching 100% accuracy after five sessions, his performance was stable for the remaining sessions. In the maintenance phase, there are 5 data points, all at 100%.

Dexter

Dexter’s data are presented in Figure 3. Dexter’s baseline data for embedded instruction consisted of 3 data points at 0% accuracy. In the instructional phase, Dexter’s performance was measured over 9 data points, with a range of 0 to 100% and a mean of 55.6%. During the instructional phase, Dexter’s performance was initially stable at 0% for 3 trials and then increased to 100% with some variability, but an overall increase in the level of performance. He was moved to the maintenance phase with 3 non-consecutive data points at 100% to ensure enough time for maintenance collection, before the school year ended. His maintenance data consisted of 5 data points at 100% accuracy with no trend or variability.
Dexter’s baseline data for DTT consisted of 4 data points with a decreasing trend, little variability, and low levels. The data ranged from 20 to 40% with a mean of 30%. In the instructional phase, Dexter’s performance was measured across 9 data sessions, with a range of 20 to 100% and a mean of 62.2%. During the instructional phase, the level was immediately higher and showed an increasing trend with some
variability. Data in the maintenance phase consisted of 5 data points, all at 100% accuracy.

Social Validity Results

In response to question 1 (i.e., Did you like counting coins with Mrs. Turner?), all three students answered, “yes.” In response to question 2 (i.e., Do you think you learned a lot from counting coins with Mrs. Turner?), all three students answered, “yes.” They also all stated that they preferred counting quarters in our school and community.

In addition to the social validity questions, the experimenter observed Shane generalizing the skill to a new setting. On the last day of school, Shane attended a trip to the pool with his eighth grade class. The experimenter observed him accurately counting quarters for another student to use for a purchase at the concession stand.
Chapter 4: Discussion

Effects of DTT on coin counting skills (nickels)

Upon introduction of DTT, all three students showed an immediate increase in their level of correct coin counting. Their performance improved steadily with no more than two consecutive trials at the same level of accuracy, and this occurred only once for each participant. Joan had difficulty acquiring the skill with DTT as quickly as the other participants, and her transition to maintenance had to be done before she had 3 consecutive trials at 100% accuracy. Once in the maintenance phase, Joan did not maintain 100% accuracy, but her performance continued at a much higher level in relation to baseline. However, both Dexter and Shane maintained the skill at 100% for all sessions in the maintenance phase. For two of the three students, DTT was effective at both developing and maintaining the skill. Joan had difficulty acquiring and maintaining the skill with this type of instruction, but was able to show significant improvement and maintenance at or above 80% accuracy.

Effects of embedded instruction on coin counting skills (quarters)

Upon introduction of embedded instruction, Shane and Joan exhibited an initial increase, then brief decrease (i.e., 2 trials), followed by an increase to 100% by the fourth trial. Once Joan and Shane reached 100%, their performance never dropped below this level. Upon the introduction of embedded instruction for Dexter, his performance dropped to 0% for 3 consecutive trials, but then increased to 100% and
remained at that level, except for one trial. All three students reached mastery levels after 3 sessions and maintained at 100%, with the exception of one of Dexter’s trials. One reason for his wide range in performance at either 0% or 100% was due to the nature of the task. One trial of embedded instruction was taken per session and could only be counted as 0% for an incorrect trial or 100% for a correct trial. Overall, embedded instruction was effective in teaching the participants to mastery. These skills also were as durable as those taught using DTT methods.

**Comparison of discrete trial training versus embedded instruction**

Embedded instruction allowed the students to reach mastery level with the skill one trial sooner for Shane and Dexter, and six trials sooner for Joan, than with DTT. Once in the maintenance phase, the skills taught with embedded instruction remained at 100% for all three students. In both types of instruction, one student (i.e., Joan in DTT and Dexter in embedded instruction) dropped below mastery level for at least one trial. Dexter dropped below mastery for one session, while Joan dropped below for two sessions. In addition, Joan acquired the skill more slowly with DTT and the criteria for her transition to the maintenance phase had to be modified. Shane acquired mastery levels quickly with both types of instruction and maintained at 100% for the remainder of the study. Joan acquired mastery levels more quickly and had stronger maintenance with embedded instruction. This may have been because the reinforcers (i.e., food, drink, school supplies) were readily available and highly preferred. Joan’s mean levels of performance in the maintenance phase were 100% for DTT and 92% for embedded instruction. Dexter was also moved into the maintenance phase earlier than the originally set criteria, due to time constraints. Aside from one incorrect trial, Dexter had
10 consecutive trials at 100%, with the incorrect trial in session 18. Once in the maintenance phase, Dexter maintained 100% with both DTT and embedded instruction.

Overall, embedded instruction was slightly more effective than DTT. It is possible that the students preferred and performed better with embedded instruction due to the reinforcers used. Had the same reinforcers been used for both methods, the results may have been slightly different.

**Limitations**

One limitation of this study was the amount of time in the maintenance phase. Due to the school year ending and families declining summer programming, the maintenance phase for each participant lasted for approximately one and a half months, with 9 to 10 data points being collected. Ideally, the longer the maintenance phase, the better. However, it is difficult to ensure extended access to students over time. Even being able to collect maintenance data for 6 months would provide stronger data.

Another limitation was due to the nature of the setting and person conducting the research. Typical math instruction continued to be provided throughout the intervention and maintenance phases, due to the study being conducted in a classroom and with the classroom teacher as the experimenter. Instruction did not cover the specific skills for this study (i.e., counting nickels and quarters), but did review coin values and skip counting skills. All three participants were provided with the same target skills and instructional methods each day, throughout all phases of the study, to minimize confound effects.

Another limitation was that students were able to demonstrate generalization of the skill learned in embedded instruction in the community (e.g., a vending machine in
the community). However, no opportunities were given for demonstrating generalization of counting nickels, as learned in DTT.

The final limitation was in social validity. Due to the participants’ cognitive levels, asking simple questions about preferences was the most extensive form of data collection for social validity from the participants. Staff members were not asked to participate in any data collection for social validity, because of their unfamiliarity with these instructional types, their lack of knowledge and background in working with students with moderate/intense disabilities, and the time constraints of the experimenter, study, and staff. Parents were not surveyed due to previous difficulties with contacting and communicating with parents.

**Future Research**

Future research should focus on an extended maintenance phase to gather more long-term data about the effectiveness and differences in performance with skills taught using DTT and embedded instruction. Because much of the existing research focuses on participants with autism and severe disabilities, future research should continue to explore the effects of these instructional strategies with students who have moderate cognitive disabilities or with new populations, such as students with learning disabilities.

Future research could also focus on isolating the skill and instruction. In the current study, students continued to receive typical math instruction during their math period. Although they did not receive any additional instruction on the target skills, they continued to work on similar skills. Depending on the situation, cessation of other math instruction may be unethical, as it would prevent the participant from gaining
other skills. However, if appropriate and ethical, isolating these instructional methods in future research would strengthen the data.

In the current study, one difference in the participants’ performance was the difference in the amount of time for skill acquisition. Future research should also compare the effects of DTT versus embedded instruction on skill acquisition. Researchers with long-term access to participants could examine and compare data on both skills acquisition and response maintenance.

Future research should also work to provide equal opportunities for generalization of the target skills. In the current study, students were only given the opportunity to emit the behavior learned in embedded instruction in a novel setting.

Another area for future research would be to collect more comprehensive social validity data. Teachers and parents could be surveyed and more concrete data could be collected from the teachers, parents, and staff.

A final area for future research would be to collect data on participants’ performance of skills in novel situations. (i.e., setting/situation generalization). Demonstration of a skill in a novel situation not only shows that the student has a solid grasp on the skill, but also proves that their learning has been meaningful, as they are able to effectively apply it in various settings. Data on the best instructional method for helping students to correctly generalize and perform the skill over a period of time (i.e., response maintenance) will help identify the most effective instructional methods.

Implications for Practice

The results of this study indicate that both DTT and embedded instruction are effective for helping students acquire and maintain skills over time. However, each
student reached mastery levels at different times and thus entered the maintenance phase at different times. Once in the maintenance phase, the skills taught with embedded instruction remained at 100% for all three students. Two of the three students remained at 100% in the maintenance phase with DTT also. Because both types of instruction were generally effective, both instructional methods would be an asset to instruction and in helping to promote response maintenance. When surveyed, all three students stated that they preferred embedded instruction, but this may have been due to the immediate presence of preferred reinforcers. However, this is the natural result of behaviors in the environment, unlike in DTT where praise is given. In the real world, as in the context of shopping or performing tasks for a job, praise is not a common, natural reinforcer. Practitioners should provide both systematic instruction, as in DTT, and naturalistic instruction, as in embedded instruction, to ensure that students are receiving the most complete education possible. Providing both types of instruction ensures that students are receiving the direct, one-on-one instruction needed for explicit skills, while embedded instruction provides them opportunities to receive immediate and natural reinforcers, while performing the skills in their natural setting. In addition, practitioners could offer preferred items, like those available during embedded instruction in this study, during DTT. This may increase student interest in this instructional method.

If implementing these strategies, it would be necessary for the practitioner to have the time and staff available to work one-on-one with a student during DTT. The practitioner would also need the time, staff, and schedule flexibility, to provide NET in real settings.
When working with students with mild to moderate needs, the student to staff ratio is often higher and may make these forms of instruction more difficult to do on a regular basis. However, working with students in rotations, relying on short periods of independent work, assistance from support staff or related service staff, parent or student volunteers, etc., may help make these instructional strategies more accessible for instructors with a higher student to staff ratio.

In addition, due to the very systematic nature of DTT and the ability to create systematic methods of delivery for embedded instruction (e.g., task analyses), other staff members could also provide instruction, those providing the instruction should be trained on the methods and provided with a task analysis to ensure procedural fidelity.

As with any instruction, systematic data collection is essential to tracking student progress and the effectiveness of the methods provided. This information should also be used to help guide the selection of the best instructional method for each individual student. While all of the students in this study preferred embedded instruction, they also benefitted from DTT and thus both instructional methods will continue to be used with the students, even after the study ends.
References


APPENDIX A

PARENTAL PERMISSION FORM FOR STUDENT PARTICIPATION
The Ohio State University Parental Permission
For Child’s Participation in Research

Study Title: A comparison study of discrete trial training and embedded instruction to promote response maintenance of coin counting skills for middle school students with cognitive disabilities

Researcher: Helen I. Malone & Heather Turner

Sponsor:

This is a parental permission form for research participation. It contains important information about this study and what to expect if you permit your child to participate.

Your child’s participation is voluntary.

Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose:

The goal of this study is to determine which method of teaching is best to help your child (and the other participants) maintain coin counting skills over time.

Procedures/Tasks:

Your child will continue receiving research-based instruction during math class. For the skill of counting coins, their instruction will be in the form of embedded instruction (a more natural form of instruction in the context of real activities) and discrete trial training (a more direct form of instruction done in the classroom).

As part of the study, we are also asking your permission to access your child’s educational records, specifically their IEP. Information taken from the IEP will include student diagnoses (e.g., learning disability, mental retardation, etc.) and student academic goals to ensure that the skills targeted in this research are in line with the student’s educational programs. This information will be used in the write-up of this thesis (and any subsequent research articles) so that readers will have a clear description of who the participants were and what their educational needs included.
Duration:

Your child may leave the study at any time. If you or your child decides to stop participation in the study, there will be no penalty and neither you nor your child will lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.

Risks and Benefits:

Your child may benefit from receiving systematic, research-based instruction during their school day. He/She may also benefit from having planned, programmed instruction designed to promote generalization, which will help him/her maintain the learned skills over time.

There are no physical, legal, social, or economic risks to the student. The only risk is a minor psychological risk if a participant struggles, regresses, and/or makes no progress during the training and begins to have negative feelings.

Confidentiality:

Efforts will be made to keep your child’s study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your child’s participation in this study may be disclosed if required by state law. Also, your child’s records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies;
- The Ohio State University Institutional Review Board or Office of Responsible Research Practices;
- The sponsor, if any, or agency (including the Food and Drug Administration for FDA-regulated research) supporting the study.

Incentives:

There are no incentives for this study.

Participant Rights:

You or your child may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you or your child do not agree to take part in the research or choose to end your participation at any time, it will have no effect on your current or future relationship with the teacher, school, or the evaluation of your child’s performance. If you or your child is a student or employee at Ohio State, your decision will not affect your grades or employment status.
If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions:
For questions, concerns, or complaints about the study you may contact **Heather Turner**.

For questions about your child’s rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

If your child is harmed as a result of participating in this study or for questions about a study-related harm, you may contact **Heather Turner**.
Signing the parental permission form

I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name of subject

Printed name of person authorized to provide permission for subject

Signature of person authorized to provide permission for subject

Relationship to the subject

Date and time

Investigator/Research Staff

I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

Printed name of person obtaining consent

Signature of person obtaining consent

Date and time
APPENDIX B

STUDENT ASSENT FORM
The Ohio State University Assent to Participate in Research

Study Title: A comparison study of discrete trial training and embedded instruction to promote response maintenance of coin counting skills for middle school students with cognitive disabilities

Researcher: Heather Turner

Sponsor:

This will all be read aloud to students. If they would like to participate, they can sign at the bottom.

- You are being asked to be in a research study. Studies are done to find better ways to treat people or to understand things better.
- This form will tell you about the study to help you decide whether or not you want to participate.
- You should ask any questions you have before making up your mind. You can think about it and discuss it with your family or friends before you decide.
- It is okay to say "No" if you don't want to be in the study. If you say "Yes" you can change your mind and quit being in the study at any time without getting in trouble.
- If you decide you want to be in the study, an adult (usually a parent) will also need to give permission for you to be in the study.

1. What is this study about?
   This study will help us find out which way of learning helps you remember a skill better for a long time.

2. What will I need to do if I am in this study?
   If you do this study, you will need to keep participating in math class. You will work with Mrs. Turner at the table for math sometimes. Other times, you will practice in the cafeteria, hallway or at the school store.

3. How long will I be in the study?
   For the rest of the school year.
4. Can I stop being in the study?
   You may stop being in the study at any time.

5. What bad things might happen to me if I am in the study?
   If you have trouble with the lesson one day, you might feel a little sad.

6. What good things might happen to me if I am in the study?
   You will learn how to count coins and get to practice it for the rest of the year.

7. Will I be given anything for being in this study?
   No.

8. Who can I talk to about the study?
   For questions about the study you may contact _______________.
   To discuss other study-related questions with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.
Signing the assent form

I have read (or someone has read to me) this form. I have had a chance to ask questions before making up my mind. I want to be in this research study.

Signature or printed name of subject ____________________________ Date and time ______________ AM/PM

Investigator/Research Staff

I have explained the research to the participant before requesting the signature above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

Printed name of person obtaining assent ____________________________ Signature of person obtaining assent ____________________________ Date and time ______________ AM/PM

This form must be accompanied by an IRB approved parental permission form signed by a parent/guardian.
APPENDIX C

IRB APPROVAL LETTER
February 4, 2011

Protocol Number: 2010B0425
Protocol Title: A COMPARISON STUDY OF DISCRETE TRIAL TRAINING AND EMBEDDED INSTRUCTION TO PROMOTE RESPONSE MAINTENANCE OF COIN COUNTING SKILLS FOR MIDDLE SCHOOL STUDENTS WITH COGNITIVE DISABILITIES, Helen Malone, Heather Turner, Special Education

Type of Review: Initial Review
IRB Staff Contact: Jacob R. Stoddard
Phone: 614-292-0526
Email: stoddard.13@osu.edu

Dear Dr. Malone,

The Behavioral and Social Sciences IRB APPROVED the above referenced research.

Date of IRB Approval: February 3, 2011
Date of IRB Approval Expiration: January 7, 2012

In addition: In addition; the protocol has been approved for the inclusion of children (permission of one parent sufficient).

If applicable, informed consent (and HIPAA research authorization) must be obtained from subjects or their legally authorized representatives and documented prior to research involvement. The IRB-approved consent form and process must be used. Changes in the research (e.g., recruitment procedures, advertisements, enrollment numbers, etc.) or informed consent process must be approved by the IRB before they are implemented (except where necessary to eliminate apparent immediate hazards to subjects).

This approval is valid for one year from the date of IRB review when approval is granted or modifications are required. The approval will no longer be in effect on the date listed above as the IRB expiration date. A Continuing Review application must be approved within this interval to avoid expiration of IRB approval and cessation of all research activities. A final report must be provided to the IRB and all records relating to the research (including signed consent forms) must be retained and available for audit for at least 3 years after the research has ended.

It is the responsibility of all investigators and research staff to promptly report to the IRB any serious, unexpected and related adverse events and potential unanticipated problems involving risks to subjects or others.

This approval is issued under The Ohio State University’s OHRP Federalwide Assurance #00006378.

All forms and procedures can be found on the ORRP website - www.orrp.osu.edu. Please feel free to contact the IRB staff contact listed above with any questions or concerns.

Shari R. Speer, PhD, Chair
Behavioral and Social Sciences Institutional Review Board
APPENDIX D

DATA COLLECTION SHEET (EXPERIMENTER AND INTEROBSERVER)
## Instructional Method

**Circle method used**

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<thead>
<tr>
<th>Discrete Trial Training</th>
<th>Embedded Instruction: Vending Machine</th>
<th>Embedded Instruction: Cafeteria Snack</th>
<th>Embedded Instruction: School Store</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Trial</th>
<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
</tr>
</thead>
</table>

Correct responses marked C
Incorrect responses marked I
Unused trials crossed out with an X

**Condition:**
- Baseline
- Instruction
- Maintenance

Correct = % Accuracy

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## Instructional Method

**Circle method used**

<table>
<thead>
<tr>
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<th>Embedded Instruction: Cafeteria Snack</th>
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<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
<th>C or I</th>
</tr>
</thead>
</table>

Correct responses marked C
Incorrect responses marked I
Unused trials crossed out with an X

**Condition:**
- Baseline
- Instruction
- Maintenance

Correct = % Accuracy
APPENDIX E

PROCEDURAL FIDELITY CHECKLISTS
### Task: Counting Coins (nickels)

**Student:**

**Data Collector:**

**Condition:** Baseline

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<tr>
<th>Teacher Procedure</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show desired amount on index card.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>State amount (e.g., &quot;thirty five cents&quot;)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Say, &quot;Count and give me the amount on this card.&quot;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Wait silently while student counts out amount using coins.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wait 5 seconds between student completion of task before next cue.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Date**

**% Reliability**

---
Task: Counting Coins (nickels)  
Student:  
Data Collector:  
Condition (circle one): Discrete Trial Training

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show desired amount on index card.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>State amount (e.g., “thirty five cents”)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Say, “Count and give me the amount on this card.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wait while student counts amount.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>If correct, give positive reinforcement through verbal praise, confirmation, and a pat on the shoulder.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If incorrect, verbally signal the incorrect response (e.g., “No. That’s not correct.”)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wait five seconds between consequence and next cue.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
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</tr>
</tbody>
</table>

Date

Reliability %
Task: Counting Coins (nickels)  
Data Collector: ____________________________

Condition (circle one): Maintenance (Discrete Trial Training)

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Show desired amount on index card.</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>State amount (e.g., “thirty five cents”)</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Say, “Count and give me the amount on this card.”</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Wait while student counts amount.</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Wait five seconds between consequence and next cue.</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
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</tr>
</tbody>
</table>

Date

Reliability %
### Task: Counting Coins (quarters)

**Student:**

**Data Collector:**

**Condition:** Instruction (NET: Vending Machine)

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say, “Choose a drink.”</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Wait for student to choose drink.</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Say, “How much does that cost?”</td>
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<td></td>
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</tr>
<tr>
<td>Wait while student says cost. If they do not say it, give cue again and then use least to most prompting (e.g., point to the price, give verbal cues).</td>
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</tr>
<tr>
<td>Say, “Count out the correct amount for your _______.”</td>
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<td></td>
</tr>
<tr>
<td>Wait while student counts out amount.</td>
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</tr>
<tr>
<td>If the student counts the correct amount, say “Put your money in and get your _______.”</td>
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</tr>
<tr>
<td>Assist the student if they need help pushing the correct buttons to choose their drink.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>If the student does not count out the correct amount, say, “Check your counting again.”</td>
<td></td>
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</tr>
<tr>
<td>If they still do not count out the correct amount, model it for the student.</td>
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</tr>
<tr>
<td>If modeling was needed, have the student count the amount again and insert it.</td>
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</tr>
<tr>
<td>Prompt student to check screen (if appropriate) to see if they inserted the correct amount.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>If the student did not insert the correct amount, prompt them to push the coin return button and try counting again.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>If the student needed to push the coin return and count again, use least to most prompting to ensure they count the correct amount.</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Say “Put your money in and get your _______.”</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assist the student if they need help pushing the correct buttons to choose their drink.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Date**

**Reliability %**

54
Task: Counting Coins (quarters)  

Student: ____________________________

Data Collector: ________________________________

Condition: Instruction (NET: Cafeteria Snack)

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say, “Buy a snack.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>Wait while the student selects a snack.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say, “How much does that cost?”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If the student is unable to read the price, use least-to-most prompting to help them identify and state the price.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If the student does not begin counting out the amount, say “Count out that amount and give it to the cashier.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wait while the student counts out the amount.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If they count the correct amount, let them give it to the cashier and get their snack.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If they do not count the correct amount, model how to count it for them.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>If modeling was needed, have students try counting the amount again.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>If they are not able to correctly count it after modeling, provide least-to-most prompting to help them count the correct amount.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say, “Okay, now you can pay.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wait while they give their money to the cashier and get their snack.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>1</td>
</tr>
</tbody>
</table>

Date: ________________________________

Reliability %: ____________________________
### Task: Counting Coins (quarters)

**Student:** ____________________________

**Data Collector:** ____________________________

**Condition: Instruction (NET: School Store)**

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say, “Choose what you would like to get.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wait while the student looks and checks all items.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Say, “How much does that cost?”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If the student is unable to locate the price, use least to most prompting to help them.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>If there is not a price on the item, say, “You can ask _____ how much it costs.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say, “Count out that amount and give it to _____.”</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wait while the student counts out the amount.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>If they count the correct amount, let them give it to the cashier and get their item.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>If they do not count the correct amount, model how to count it for them.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>If modeling was needed, have students try counting the amount again.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>If they are not able to correctly count it after modeling, provide least-to-most prompting to help them count the correct amount.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say, “Okay, now you can pay.”</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wait while they give their money to the cashier and get their item.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Date:** ____________________________

**Reliability %:** ____________________________
### Task: Counting Coins (quarters)

<table>
<thead>
<tr>
<th>Teacher Procedure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say, “Choose a drink.”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>Wait for student to choose drink.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Say, “How much does that cost?”</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say, “Count out the correct amount for your drink.”</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wait while student counts out amount.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Say “Put your money in and get your drink.”</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Assist the student if they need help pushing the correct buttons to choose their drink.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Date**

**Reliability %**
APPENDIX F

SCHOOL APPROVAL FORM
November 2, 2010

The Ohio State University
Office of Responsible Research Practices
300 Research Foundation Building
1960 Kenny Road
Columbus, OH 43210

Dear Review Board:

On behalf of the administration at Gahanna-Jefferson School District, I would like to confirm my support for the research study of Heather Turner for a thesis entitled: A comparison study of discrete trial training and embedded instruction to promote response maintenance of coin counting skills for middle school students with cognitive disabilities. It is our understanding that this will involve three Gahanna Middle School West students during their math class and/or when students are purchasing lunch items as participants in the research study. The teacher understands the expectations, risks, and benefits of their participation in the study. The researcher has gained the support of other educators with whom they will be working.

We understand that the protocol for human subject research will be adhered to through information letters, and have been assured that this will not disrupt the educational atmosphere of the classroom and will not be overly burdensome for teachers or students. Having been fully notified of the expectations of the study, we give approval for this study to take place at Gahanna Middle School West with the assurance from the investigator that the results will be shared with the administrative team and participating teachers once the study has been completed.

We welcome the opportunity to assist the research of Ms. Heather Turner in meeting the goals of this study and anticipate that the study will hold significance to the field.

If you have any questions or comments on my letter of support, please, you may contact me at (614) 471-7065 or via e-mail at WhiteR@gips.org

Sincerely,

[Signature]

Rae Harriott-White, Ph.D.
Human Resource Coordinator

---Quality Inspired By Vision: A Student’s Pathway To The Future---