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Using *Handwriting Without Tears*® and a modified copy, cover, compare through chaining to teach name writing to a preschooler with developmental delays to write his name

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Abstract

The purpose of this study was to evaluate the effectiveness of the *Handwriting Without Tears*® curriculum in conjunction with both forward and backward chaining on a preschool student with pervasive developmental delays across all academic areas. This student was selected from an integrated Early Childhood Education Assistance Program (ECEAP) located in the inland Northwest. The classroom was a mixture of students with special needs, students coming from families with low socioeconomic statuses, as well as English language learners, all ages three to five. The *Handwriting Without Tears*® program was used in conjunction with a forward and backward chaining strategy to teach the student skills to write his name. The final results suggested a general increase in handwriting skills using forward chaining, but indicated that the backwards chaining, errorless learning method was more successful in teaching letter formation for uppercase letters. The goal of the study was to have the participant learn to write his first name, which contained six letters, beginning with teaching the formation using upper-case letters only.

Keywords: Backward chaining, *Handwriting Without Tears*®, developmental delays, name writing, handwriting

1. Introduction

Children learn to write their names at an early age as a part of an important developmental stage. Handwriting is important for self-identification, pre-academic skills as well as communication (Graham, 1999). Handwriting and good penmanship skills become increasingly important for children to master in order to achieve academically. A study published in 2003 found that students in kindergarten now spend 42 percent of their school day doing paper and pencil activities (Marr, Cermak, Cohn & Henderson, 2003). Research in recent years has begun to show that, by teaching consistent and effective handwriting skills in a child's early learning years, children are more likely to develop good habits and retain their skills into kindergarten. Ways to teach consistent handwriting skills for preschool children include starting from the top with downward strokes, using appropriate grip, and using songs, rhymes and other engaging strategies. These handwriting skills apply and contribute to later academic success.

The *Handwriting Without Tears*® curriculum is one such program that contains these strategies and has contributed to teaching important handwriting skills to early learners (Roberts, 2009). This curriculum has received more attention in the past few years, especially as more studies have brought to light its success in teaching these early skills. For instance, two preschoolers with developmental delays showed increases in their handwriting skills when using the *Handwriting Without Tears*® program for intervention (McBride, Pelto, McLaughlin, Barretto, Robison, & Mortenson, 2009).

One instructional approach which is often used for teaching the acquisition of new skills, involves forward or backward chaining (Cooper, Heron, & Heward, 2007). Forward and backward chaining are two different task analysis techniques that require breaking a goal or skill into smaller, definable and more attainable parts and slowly allowing the individual to independently complete each part.

Backwards chaining involves having the individual complete the final step independently first thus resulting in a successful product. After that final step is mastered, then the individual would be responsible to complete both the final step and the one just prior to it, in effect developing the skills of the task from completion to beginning. This strategy allows the individual to slowly attain the skills, confidence and ability to complete all required prerequisite skills before reaching the final goal. This is often referred to as errorless learning, which is an effective tool used in teaching new skills to individuals with deficits. Wilson, Baddeley, Evans and Shiel, (1994) determined errorless learning was superior in comparison with methods where the subjects were not as carefully prompted and therefore allowed to make mistakes. This study focused on teaching severely memory-impaired patients important daily living skills such as object and name recognition using backwards-chaining, or errorless learning, methods (Wilson, *et al.*, 1994).

The instructional technique used in this study is a modified cover, copy, and compare (CCC). CCC is a student managed self-tutoring strategy that has produced academic outcomes across a wide range of academic tasks (Konrad, & Joseph, 2014; Joseph, Konrad, Cates, Vajcner, Eveleigh, & Fisheye, 2012; Skinner, Turco, Beatty, & Rasavage, 1989; Smith, Dittmer, & Skinner, 2002) and student populations (McLaughlin & Skinner, 1996; Skinner, McLaughlin, & Logan, 1997; Skinner, Ford, & Yunker, 1991). CCC requires the student to copy an academic stimulus, cover this copying and produce the letter or word from memory and has been recently documented as efficacious in a meta-analysis (Joseph *et al.*, 2012). If the student makes an error, the pupil goes through three repetitions of correcting an error. Since handwriting is a writing skill, we wanted to employ CCC to determine its efficacy with handwriting. The use of CCC has not been documented with the development of handwriting skills. We have modified CCC for use with students who have moderate to severe disabilities (Membrey, McLaughlin, Derby, & Antcliff, 2011). In present research, we modified CCC to examine its effectiveness as part of an intervention package to improve the handwriting with a preschool student.

The purpose of this study was to evaluate the effectiveness of the prewriting and handwriting skills using the *Handwriting Without Tears*® curriculum in conjunction with both forward and backward chaining for a preschool student with pervasive developmental delays across all academic areas. The goal of the study was to have the participant learn to print his first name in capital letters (6 letters).

2. Method

2.1 Participant and Setting

The participant in this study was a 5-year-old boy in preschool with developmental delays. The participant was in the beginning stages of screening for a severe behavior disorder. The participant lived with one older brother, who was a year older as well as his mother and his mother's boyfriend. His biological father was an inconsistent part of his life and lived at a different location. His first language was English, and he had a very slight speech impediment, as was developmentally appropriate for his age, which affected his pronunciation of certain letter sounds and identification. At the beginning of the study, he was unable to identify or print any letter from the alphabet, and was recommended to

participate in the study because of his deficits in pre-academic writing and reading skills by the speech and language pathologist and a school psychologist. .

The study took place in an ECEAP (Early Childhood Education and Assistance Program) preschool room located in a Title I public elementary school in the Inland Northwest. The elementary school contained classrooms ranging from preschool to sixth grade. The participant attended preschool for 2.5 hours each day in the afternoon, Monday through Thursday. The ECEAP classroom was a federally-funded, Head Start program designed to prepare the students for kindergarten. The class integrated 3-5 year old students with special needs, students of very low income, English Language Developers, and typically developing children. Of the eighteen available spots for students in the ECEAP program, 6 spots are designated for students with special needs. The participant filled one of these six slots because of a diagnosis of developmental delay. There were approximately 16-18 students present in the preschool each day. There was also a lead teacher, two instructional assistants, and a student teacher. The study was conducted Mondays thru Thursdays, during free play or closing circle activities over a 12-week period. The research was conducted by the first author, who was completing her endorsement in Special Education from a local private university and to meet the ed TPA requirements.

3. Materials

The materials used in this study included the *Handwriting Without Tears*® materials (Olsen, 1998, 2005). This included a white board and white board pen, magnetic *Handwriting Without Tears*® board with a smiley face prompt in the upper left corner, pencils and pens. Edible rewards of M & M's® and jelly beans, were used. In addition, daily use of a student practice worksheet and data collecting worksheets was required of the participant. Other forms used by the researcher included a session log and inter-observer agreement data forms. The *Handwriting Without Tears*® program was used in conjunction with a modified copy, cover, compare (CCC). This modified CCC was known as Trace, Imitate, Copy, Memory (TICM). Initially TICM was combined with forward chaining then due to participant progress, the forward chaining was switched to backwards chaining for the last 4 sessions (Cooper, Heward, & Heron, 2007). The student practice worksheet provided practice using the TICM format to practice his letters and also provided permanent product records of the participant's comprehension of letter formation. The data collection sheets included a list of the study's target letters and were used to measure the aspects (size, slant, formation) of letter formation that the subject correctly displayed in each session throughout the course of intervention, which included sessions 1-23 by the end of the study.

4. Dependent Variable and Measurement

The dependent variable was the participant's ability to accurately print each of the 6 upper-case letters of his name, according to the characteristics defined by *Handwriting Without Tears*®. During this study the first author used a permanent product recording system. Permanent product recording was taken in the form of a worksheet containing nothing but the prompt "Name: ____". The participant was expected to print his name in upper-case letters on the line to

the best of his ability, after being given the directions of “write your name the best you can!” (See Figure 3). This worksheet was given to the participant at the end of each intervention session in order to track the progress of his understanding and ability to accurately print the upper-case letter of his name. After the participant completed the worksheet by writing his name to the best of his ability, the level of comprehension was assessed by determining the number of points to give for each letter the participant had drawn, as determined by the size, slant, and formation of the letter.

The characteristics of size, slant, and formation were each measured by a score of 0 or 1. For the letter to be correct, the letter would have to fulfill all three characteristics accurately thus receiving three points. Correct size was defined as being consistent in size and width with other letters, without filling up the entire page and not so small as to not being recognizable. Correct slant was defined as the letter having no slant. Correct formation was defined as being recognizable as the letter is was intended to represent, with consistent line thickness, with no unnecessary breaks in the strokes, no added lines, and no obvious lack of knowledge as to what the letter is supposed to look like. In order for formation to be counted as correct, the participant also had to draw the separate lines and curves of each letter in the correct sequence and orientation. Therefore, the researcher had to observe the sequence of strokes in order to accurately score this characteristic. For the *Handwriting Without Tears*® program, each letter begins at the top for correct formation. For example, for the letter “D”, one must start at the top and go *down* to make a big line, hop back up to the top of the line, and then go *around* making a big curve to meet at the bottom of the big line in order for the formation to be counted as correct.

If any component of a letter was incorrect, the first author marked a (-) mark on the data sheet to designate that component of the letter as incorrect. If any or all components of the letter were correct, a (+) mark was used to designate that characteristic as correct. After the different criteria for each letter was marked as correct or incorrect on each the data sheet, the total number of correct and incorrect letter characteristics for that session was noted on the session log, which was then used to determine inter-observer agreement. The participant needed to successfully write one letter scoring three points for two days consecutively to reach mastery of that letter. In order to reach the next level of mastery, the participant needed to score three points for the mastered letter and the next letter.

5. Experimental Design and Conditions

A criterion changing design (Kazdin, 2011; McLaughlin, 1983) was used in this study. A baseline was gathered, initial intervention was implemented, then a second intervention was implemented to determine if it would be more effective than the initial intervention.

Baseline: During baseline, the participant attempted to print the letters of his first name on a blank sheet of paper without any sort of model or aid. When the participant was unsuccessful printing the letters of his name or any other letter of the alphabet, he was assessed once again with a model. The participant had his nametag in view and was asked to copy the letters of his first name. The participant

was unable to form any of the letters in his name. The participant was assured that it was okay to make mistakes, and there was no assistance given by the first author during any part of the task, besides the visual model of his nametag. The participant was encouraged to stay on task during the administration of the test.

5.1. Initial intervention – forward chaining

The *Handwriting Without Tears*® program was used in conjunction with the forward-chaining TICM worksheets (Figure 4) to teach the participant how to correctly print the letters of his name as described. Each lesson worked to teach

the participant one letter of his name starting from the beginning of his name. Lessons would begin with teaching the participant the formation of the letter on a *Handwriting Without Tears*® magnetic board, which provided a large space for the participant to practice the precise fine motor strokes. The magnetic board procedure was followed by having the participant practice these strokes on a white board using a white board marker. Finally, the TICM worksheet (Figure 3) was used in order to promote independent formation of the letters in the participant’s name. This worksheet utilized size-controlling boxes, which aimed to carry-over the already implemented size control features of the magnetic board yet in paper form. The worksheet also carried over the *Handwriting Without Tears*® orientation cue of the smiley face in the upper left hand corner. These size-controlling box and smiley face prompts were slowly faded with each letter as the participant learned to print them independently.

During the forward-chaining method, the learner was led through the trace, imitate, copy and memory sequence beginning with the first letter of his name until mastery was reached. After minimal progress over 16 sessions with the forward-chaining method, the research decided to switch the intervention approach to a backward-chaining method.

5.2 Second intervention – backward chaining

The second intervention occurred during session 20-23 and involved having the learner use a laminated worksheet with size-controlling boxes and smiley-face start point prompts to tracing the first five letters of his name for practice. This process occurred before completing the trace, imitate, copy and memory process beginning at the *last* letter of his name and working backwards after mastery was reached on each letter. Throughout intervention, if the participant made any errors, the first author would use prompts and language from the independent variable *Handwriting Without Tears*® program in order to explain misunderstood concepts, such as slant. The first author also implemented a model-lead-test strategy in order to assess whether or not the participant understood the correction. The participant was given verbal praise throughout the intervention session. This was usually when he was implementing previously taught strategies to correctly form difficult components of letters. If the first author determined that the participant was focused and responsive to instruction, the participant was given edible reinforcement in the form of M&M’s® and jelly beans. The participant’s preferred rewards were also given after the participant completed the permanent product worksheet, but only if it was obvious that the participant took his time to carefully form the letters.

6. Reliability of Measurement and Inter-observer Agreement

Because each worksheet was collected using permanent product, inter-observer agreement was conducted on 100% of the sessions. For assessing the formation of the letters, videos were taken by the primary data collector in order for the secondary data collector to score accurately. The primary and secondary data collectors separately scored the permanent product sheets and then compared their results and scores on the size, slant, and formation of each letter. The total number of points that were counted as correct and incorrect for each letter by each first author were measured to see if there were disagreements on any ratings. The method used for computing inter-agreement scores was by finding the total number of correctly identified characteristics at the end of each session by each scorer. The lower number of total correct words divided by the higher number of total correct words and multiplied by 100 was used to find the inter-observer agreement percentage. The mean inter-observer agreement score found was 95.8% (range 50% to 100%).

7. Results

The results of the implementation of the *Handwriting Without Tears*® strategies on letter formation with correct size, slant and formation are displayed in Figure 1. In order to best visually illustrate the data, Figure 1 shows not only the total points out of 18 that were available from each permanent product assessment by session but also depicts how many points per letter were scored. Mastery of a letter was achieved when points were scored for the same letter over two consecutive sessions. Baseline data shows that the participant scored a 0 on each of his attempts for each of the 6 letters in his name. The participant’s knowledge increased at a steady rate after intervention began. The participant met the first goal by demonstrating mastery of the first letter at session 17 when he correctly printed the first letter of his name two sessions in a row. The second goal was set at mastery of 2 letters, which the participant was able to reach after the backward-chaining intervention was implemented in the final session 23.

Figure 2 represents the mastery of letters as it illustrates the number of letters earning all three points in a given session. Therefore, Figures 1 and 2 show the same set of data.

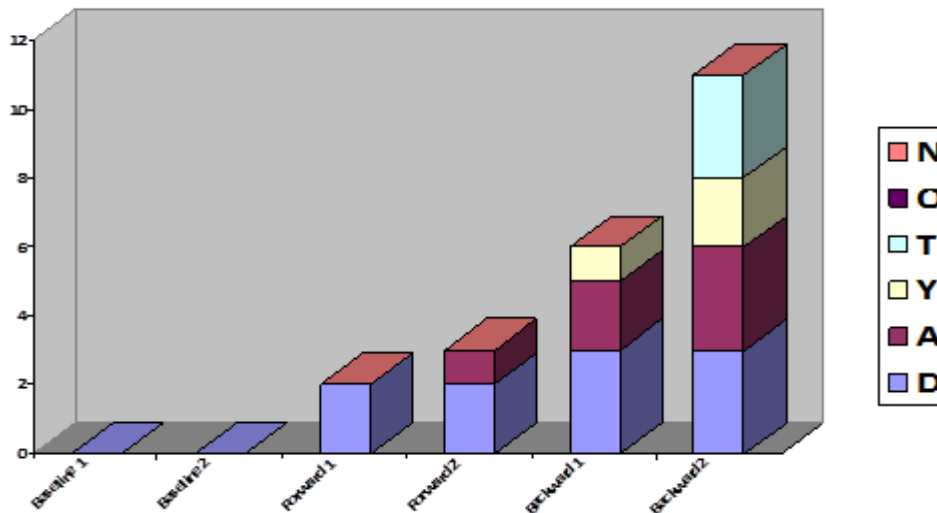


Fig 1:

The outcomes regarding implementation of the *Handwriting Without Tears*® strategies on letter formation with correct size, slant and formation

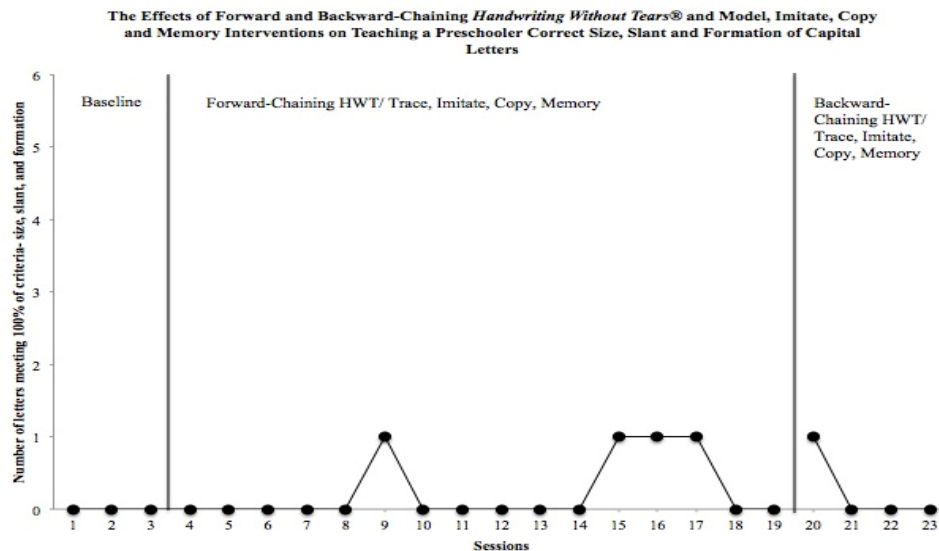


Fig 2: Number of letters scoring three points by session

The figure shows three identical blank assessment sheets stacked vertically. Each sheet has a horizontal line at the top with the label "Name:" to its left. The rest of the sheet is empty, intended for recording data.

Fig 3: Permanent Product Assessment Sheet

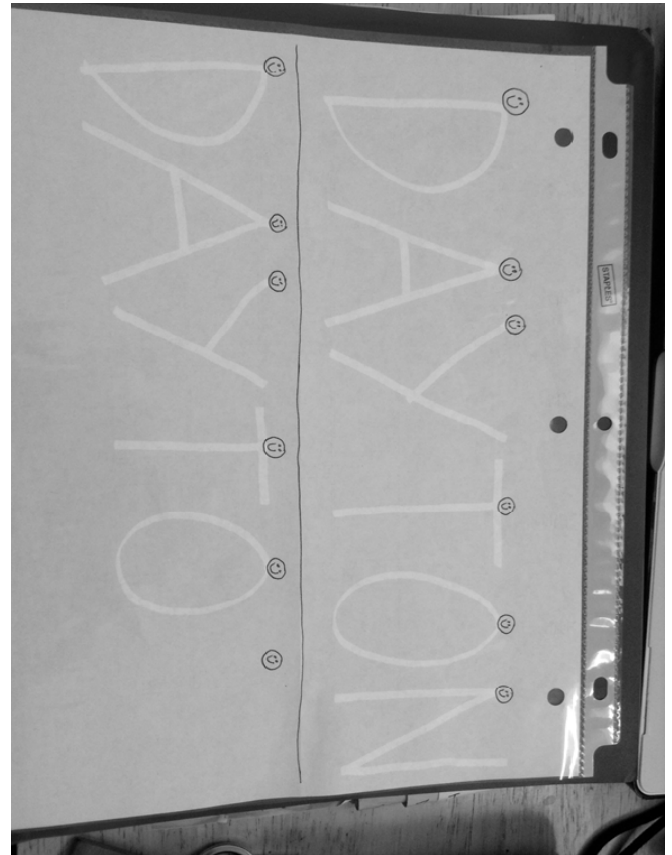


Fig 5: Backward-Chaining/Trace, Imitate, Copy, Memory Worksheet

The image shows a handwriting assessment grid for the name "DAYTON". The grid is organized into five rows, each corresponding to a letter in the name. Each row has a header with "Date:", "B/I:", "# Correct:", and "T I C M". Below the header are six boxes for data entry. The first row is filled with the name "DAYTON" in large letters, and the subsequent rows are empty for practice or assessment.

Fig 4: Forward-Chaining/Trace, Imitate, Copy, Memory Worksheet

8. Discussion

The steady yet uneven improvement in size, slant, and letter formation from baseline to intervention using the forward-chaining *Handwriting Without Tears*® strategies in conjunction with the TCIM strategy (McLaughlin & Skinner, 1996) indicated that the forward-chaining method improved student handwriting, yet not consistently enough to be considered successful. The second intervention employed demonstrated improvement, maintenance, and generalization (Stokes & Baer, 1977, 2003) of letter formation skills for the participant. Prior to the intervention, the participant was unable to print any letter in his name, even when given a model to copy. When asked to write his name, the participant produced scribbles. Once intervention began, the participant’s ability to identify and form letters increased in general, but not at a consistent enough rate. Each lesson required about fifteen to twenty minutes of instruction. After each lesson, there was allotted time for the participant to complete the permanent product assessment to determine what skills had been maintained.

There were some issues that occurred during the implementation of the intervention, including some external, uncontrollable factors, which may have affected the performance of the participant immensely. While the participant was able to make progress using the initial intervention chosen by the first author, (the forward-chaining method of teaching the participant his name from beginning to end), his progress was not consistent. The forward-chaining method also made it difficult for the participant to learn the correct order of the letters in his name, and he

began to write the letters of his name in the incorrect order. In addition to this confusion, the participant also experienced some major life changes during the time period of the initial intervention, which greatly affected his ability to perform to his highest potential during intervention sessions 11-19. It became difficult to keep the students attention, as he was consistently upset, tired and aggressive with his classmates, as well as the first author.

After attempting to work with the participant during the week in which sessions 12-19 were completed, the first author decided that the data were inconsistent thus enough to warranting a change in the intervention strategy. The backward-chaining method allowed for a shorter intervention period of ten to fifteen minutes per session, and also showed a greater amount of generalization of knowledge from the participant. The participant immediately showed mastery of a wider array of characteristics for letters throughout his name, and not only the final letter, which was being taught using the TCIM and backward-chaining method.

Although mastery was not reached on the final letter of the participants name by the end of sessions, the backward-chaining method was more effective in terms of allowing the participant to generalize his knowledge. Once the first author concentrated on the backward-chaining method, the intervention became much simpler and focused.

The final issue that arose during intervention was the participant's lack of motivation. After the week in which he experienced the upsetting life change, the participant began to struggle with the assessments given after each lesson due to this lack of motivation, and would put minimal effort into completing each test. This was an issue for the first author, as it affected the accuracy of the data due to the fact that the participant was uninterested in whether or not he was accurately forming the letters of his name. To counter this motivational issue, a rewards system was put in place after session 19, along with the new intervention strategy, using edibles that were known reinforcers for the participant. If the participant exhibited proper motivation and effort while working on the intervention and completing the assessment, the participant was given 2-3 M&M's® and/or jelly beans. Once the rewards system was initiated, the participant exhibited much more effort when completing the test.

The *Handwriting Without Tears Program*® program is fairly expensive, costing around \$300 for the kindergarten hands-on classroom kit but this does include materials that are non-consumable. The consumable materials are only about \$7 per student. The first author was provided with the materials used during intervention, including the wooden pieces, magnetic drawing board, and teacher guide and student workbook for reference for free by the classroom teacher. Because the materials were supplied to the first author, the intervention was extremely low cost. Implementing the intervention required effort on the part of the first author because the participant's performance varied so much and because the *Handwriting Without Tears*® material was being combined with a modified version of the copy, cover, and compare strategy (TCIM). TCIM was developed by the first author through consulting various sources and professionals available to the first author, such as the classroom occupational therapist. The *Handwriting Without Tears*® program was already written and validated. The first author was also required to create a worksheet to be used during each lesson as intervention, but was able to use strategies from the *Handwriting Without Tears*® Program. See Figure

4 for an example of the forward-chaining intervention sheet created by the first author. See Figure 5 for an example of the backward-chaining worksheet.

The master teacher plans to continue implementing the *Handwriting Without Tears*® program with the participant in order to maintain the information learned during intervention. This program is also used consistent in kindergarten classrooms throughout the district in which the participant is scheduled to continue his education. If the first author was to continue the study, she would continue to administer the daily backward-chaining intervention in order to maintain the participant's knowledge. This intervention could also be used in coordination with other academic areas, in order to improve reading and comprehension skills. It would be beneficial to assess the effects on the participant's generalized letter formation skills, such as during free play and craft activities.

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The first four authors are members of the Department of Special Education at Gonzaga University in Spokane, WA. Denis Donica, DHSc, OTR/L, BCP. Associate Professor, Graduate Program Director. Director of Admissions at East Carolina University. Georgia Kalb is a special education preschool teacher in Spokane Public Schools, Spokane, WA. Requests for reprints should be sent to Isabelle Klee, Department of Special Education, Gonzaga University, Spokane, WA 99258-0025 or via email at iklee@zagmail.gonzaga.edu or isabelle.ck@gmail.com

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