

The Differential Effects of See/Say/Write Procedure Combined with DI Flashcards on Basic Multiplication Fact Fluency and Accuracy for a 10-year-old Student with an Intellectual Disability and a 10-year-old Student with Autism

Stefoni Olmstead-Thompson¹, T. F. McLaughlin², Jennifer Neyman³
^{1,2,3} Department of Special Education, Gonzaga University

Sharon Urlacher⁴
Spokane Public Schools

Abstract: *The purpose of the present study was to evaluate the effects of the See/Say/Write procedure combined with DI flashcards on the accuracy of basic multiplication facts. Two students with moderate disabilities (autism and intellectual disabilities) participated. A multiple baseline design across sets of math problems was used to evaluate the combination of the see/say/write procedure with DI flashcards. There was a clear increase in the accuracy and fluency of the basic multiplication facts after baseline. When DI flashcards were employed, improvements in student responding were found. Both participants reached mastery for their first set of math facts. The procedures were inexpensive and required little time or effort to implement. Suggestions to improve the speed to mastery were made.*

Key Words: *see/say/write, DI flashcards, math facts, elementary school students, classroom research, multiple baseline design, autism, intellectual disabilities, maintenance of treatment effects*

Introduction

In every day life there are many tasks that require math skills. These tasks range from simple tasks like, deciding how many eggs you have left in the carton to more complex tasks, like budgeting your income. Therefore, it is very evident that math proficiency is essential and necessary for almost every aspect of daily life. It is necessary to have math skills for school environments, work environments, and home life. According to Curico (1999), learning basic facts is a necessity to solve problems that are meaningful, and relevant. Without math skills it makes it very difficult for individuals to be successful in school, get good paying jobs, or even budget their money wisely. Without mastery of the basic multiplication facts, individuals are likely to have difficulty in their schooling and are more at risk to drop out before graduating. A lack of skills in math will make one incapable of functioning productively in today's global economy (Lerner & Johns, 2011). Math is extremely important in our culture. The ability to understand concepts and strategies is highly important to be considered a contributing member of society (Cipani, 1988; McClosky & Macaruso, 1995; Shapiro, 2011). It is very important to ensure that children have a good foundation in mathematics, especially children with disabilities. This is because difficulties in learning math are common amongst children with disabilities (Garnett, 1998; Shapiro, 2011).

On average, students should learn their math facts in the fourth grade and, later on in the fourth grade, multicolumn multiplication is added (Power Standards for Mathematics: K-12, 2011). Every year of school, the curriculum builds upon previously learned concepts in years before. If the students do not have the skills mastered, it makes it very difficult, almost impossible, for the students to keep up with the speed and complexity of the new concepts (Silbert, Carnine, & Stein, 1981). As concepts build on previous concepts, Heege (1985) noted, that insufficient memorization of the basic multiplication facts are the biggest cause for errors in the students' calculations and causes the biggest problem with complex arithmetic. When a student has their basic math facts memorized, it makes it easier for them to focus on the steps of the more complex arithmetic concepts. Math takes time to learn and is not a skill you can just one day pick up and master (Lerner & Johns, 2011). To be successful in understanding and maintaining mathematical skills takes a sufficient amount of drill and practice of the subject or concept. For a typical individual to successfully comprehend and apply the relationships and patterns in mathematics requires a great deal of practice and time (Cruikshank, 1992). For children with disabilities this time required is even greater. And today there are many students with cognitive deficits that keep them from making sufficient progress in math. It is more difficult for them to acquire and apply mathematical concepts. That is why DI flashcards maybe employed to help these children with cognitive deficits overcome their challenges in math (Becker, McLaughlin, Weber, & Gower, 2010; Erbey, McLaughlin, Derby, & Everson, 2011; Geary, 2004; Lund, McLaughlin, Neyman, & Everson, 2012; Treacy, McLaughlin, Derby, & Schlettert, 2012).

Direct instruction flashcards have been employed to improve the performance of students with a wide range of academic problems ranging from reading sight words (Bishop, McLaughlin, Derby, 2011; Erbey et al., 2012; Green, McLaughlin, Derby, & Lee, 2010; Kaufman, McLaughlin, Derby, & Waco, 2011; Ruwe, McLaughlin, Derby, & Johnson, 2011) to learning basic math facts (Erbey et al., 2011; Lund et al., 2012; Kaufman et al., 2011; Standish, McLaughlin, & Neyman, 2012; Treacy et al., 2012). DI flashcards are often paired with some type of reward for improved student performance for a wide range of skills (Bechtoldt, McLaughlin, Derby, & Blecher, 2014; Kaufman et al., 2011; Lund et al., 2012; Mangundayao, McLaughlin, Williams, & Toone, 2013; Standish et al., 2012; Treacy et al., 2012) as well as requiring the student to engage in additional practice with a racetrack like intervention (Kaufman et al., 2011; Romjue, McLaughlin, & Derby, 2011; Standish et al., 2012). Using the see/say/write procedure involves the student look at the math fact and its solution, (see) saying the math fact and its answer, and (write) writing down the problem and its answer on the sheet of paper or a white board. These math facts are randomly presented to the students. Using this procedure, a teacher can teach either an individual student or a group of students. Choral responding (Marchand-Martella et al., 2004) is usually required when teaching small or large groups to monitor and assess accuracy of student responding. When an error occurs, error correction is carried out using the model, lead, and test format (Marchand-Martella et al., 2004; Peterson, McLaughlin, Weber, Derby, & Anderson, 2009; Shouse, Weber, McLaughlin, & Riley,

2012; Silbert, Carnine, & Stein, 1981). This has also be called “I say or write,” “we say or write,” and “you say or write.” Once the student makes a correct answer independently, the card is placed two or three from the top of the stack of flashcards so it can be presented in a short time after error correction took place, it also provides additional opportunities for the student to practice his errors correctly. Once the student is correct on the error flashcard three times in a row, it is placed at the back of the stack (Becker et al., 2009; Erbey et al., 2011; Lund et al., 2012; Silbert et al., 1981).

The purpose of the study was to evaluate the effects of the see/say/write procedure (Kunzelmann, Cohen, Hutten, Martin, & Mingo, 1970) combined with DI flashcards (Lund et al., 2012; Silbert et al., 1981; Skarr, McLaughlin, Derby, Meade, & Williams, 2012; Skarr, Ruwe, Zielinski, Sharp, Williams, & McLaughlin, 2014) on the accuracy and fluency of basic multiplication facts. Since much of our previous research has involved students with learning disabilities, a second purpose was to replicate and extend our previous research using DI flashcards in math to teach students with more moderate disabilities such as autism or intellectual disabilities. A final purpose was to assess the effects of DI flashcard with a see/hear/write procedure in a low income resource room setting and to improve the confidence of the previous research (Becker et al., 2009) carried out in the same elementary school with a different resource room teacher.

Methodology

Participant and Setting

There were two participants included in this study. Participant A was a 10-year-old boy with an intellectual disability. Participant B was a 10-year-old girl with autism. Both participants attended a Title 1 school in the Pacific Northwest. They were in the 5th grade and pulled out of their general education classroom to receive special education services in the resource room twice a day. They both had goal areas of reading, writing, math, and behavior. According to the *Woodcock Johnson III: Test of Achievement*, (Woodcock, McGrew, & Mather, 2001) given in the spring of 2012 and the MAP testing (Measures of Academic Progress), both participants performed at about a 2nd grade level in all subject matter areas. These outcomes also aligned with the data the teacher took daily with classroom-based assessments.

The study took place in the special education resource room in a Title 1 elementary school located in a large urban school district in the Pacific Northwest. The resource room serviced the students who are entitled to receive special education services. The students were integrated in the general education classroom and pulled out of class for specialized instruction in their goal areas, according to their IEP (individualized education program). Students came to the resource room for either 30 minutes or 120 minutes, based on their qualifying goal areas being served in the resource room. The study took place every morning for 30. In addition to the special education teacher, who taught 3rd-6th grade) there was a part-time special education teacher (who

taught K-2nd), and two instructional assistants in the classroom. During the study there were 10 other students in the classroom. There were seven 6th graders practicing keyboarding and three kindergartners working with the part-time special education teacher. The study was partitioned off reducing the amount of sound and distractions. The environment was usually quiet during the time the study took place with little distractions. The first author was majoring in special education at a local private university and completing her student teaching for an endorsement in special education.

Materials

Materials needed for this study were pre- and post-tests for the multiplication facts 0-12. Based on each participant's pre-test performance, three sets of multiplication facts were determined. Set 1 included multiplication facts 4's and 6's, Set 2 included 7's and 8's, and Set 3 included 9's and 12's. Probe sheets (See Figure 3), pencils, and a timer were needed for data collection and were employed before the intervention took place. The data collection sheet can be seen in Figure 4. During intervention three white boards were used (one for each participant and one for the first author), three dry erase markers, and cloth erasers were required. (See Figures 1 and 2).

Name _____

4 <u>X 4</u>	7 <u>X 7</u>	8 <u>X 12</u>	4 <u>X 9</u>	9 <u>X 6</u>
8 <u>X 8</u>	9 <u>X 4</u>	6 <u>X 12</u>	4 <u>X 8</u>	7 <u>X 4</u>
12 <u>X 12</u>	7 <u>X 9</u>	4 <u>X 12</u>	12 <u>X 2</u>	9 <u>X 7</u>
6 <u>X 6</u>	7 <u>X 3</u>	8 <u>X 5</u>	12 <u>X 9</u>	8 <u>X 6</u>
6 <u>X 9</u>	7 <u>X 12</u>	9 <u>X 11</u>	6 <u>X 7</u>	9 <u>X 12</u>
12 <u>X 8</u>	8 <u>X 7</u>	6 <u>X 8</u>	12 <u>X 6</u>	4 <u>X 6</u>

Figure 1. A sample probe sheet used for data collection.

Figure 2 The data sheet used to track the number of corrects and errors.

Session	Date	IOA	Conditions	Set 1 Corrects	Set 1 Errors	Set 2 Corrects	Set 2 Errors	Set 3 Corrects	Set 3 Errors
1		Y/N							
2		Y/N							
3		Y/N							
4		Y/N							
5		Y/N							
6		Y/N							
7		Y/N							
8		Y/N							
9		Y/N							
10		Y/N							
11		Y/N							
12		Y/N							
13		Y/N							
14		Y/N							
15		Y/N							
16		Y/N							
17		Y/N							
18		Y/N							
19		Y/N							
20		Y/N							
21		Y/N							
22		Y/N							
23		Y/N							
24		Y/N							
25		Y/N							

Definitions

Correct Multiplication Math Fact: Given a 2-minute timing and a probe sheet with 30 facts, 10 facts from each set, the student will complete as many as they can. The problems will be counted as correct if there is an answer given and the answer is correct for the math fact.

Error Multiplication Math Fact: Given a 2-minute timing and a probe sheet with 30 facts, 10 facts from each set, the student will complete as many as they can. They problems will be counted as an error if there is an answer given but it is then incorrect answer for the math fact. (If the problem is left blank, it will not be counted as an error.)

Participant:

Primary:

Dependent Variables and Measurement

One dependent variable was measured in the study. It was the number of correct multiplication facts. It was counted as correct if, during the 2-minute timing on the probe sheet the product was written correctly for that given multiplication fact. These data were gathered through out the school day. A data collection sheet can be seen in Figure 4. Permanent product data collection was conducted at the beginning of each session. Prior to meeting with the participant each session, the first author would create a probe sheet including 10 multiplication facts from each set. The problems were chosen at random and presented randomly to the participants. The first author would give the participants the probe sheet and a pencil, set the timer for two minutes and instruct them to answer as quickly as possible, but to be as accurate as possible. The first author collected the probe sheets that were graded later in the school day. After the data were collected, the first author would transfer the scores to the data collection sheet indicating how many correct responses were given for each set and how many errors there were for each set. The data collection sheet can be seen in Table.1.

Experimental Design and Conditions

A multiple baseline design (Kazdin, 2011) across three sets of multiplication facts, as determined by the pre-test) was used to evaluate the combination of model-lead-test and See/Say/Write procedures on multiplication fact accuracy and fluency. Participant 1 and 2 received two days of baseline before beginning intervention. Each participant was introduced to Set 1 (4's and 6's) facts. Introduction of a new set of numbers was dependent on each participant's success.

Baseline. Prior to starting instruction, the first author presented the students with a probe sheet consisting of 30 basic multiplication facts. There were three sets of facts and ten facts were randomly picked from each set to be included on the probe sheet. The first author created the probe sheets prior to the data collection session and would randomly pick the facts to ensure unpredictability. The student was given two minutes to complete the probe sheet and was instructed to do as many as they could in the two minutes, to work carefully to get them right, and skip the ones they did not know and come back to them at the end. During baseline no praise was given and no instruction was used to improve the students' accuracy or fluency in basic multiplication facts. The number of sessions for baseline ranged from 2 to 21 sessions.

See/say/write procedure combined with DI flashcards. Each intervention session began after the data collection session was complete. For intervention, white boards were used. The first author gave students their own white board, white board marker, and cloth eraser. The first author would write a randomly chosen math fact, from the current set on the white board. The first author would write the whole statement including the answer and present it to the students. The participants would look at the statement, and then chorally, they would say the statement and its answer. The first author would flip the white board around and erase the answer and would present it to the participants again and prompt them to say the complete statement, including the answer. Again, the students would chorally respond to the prompt, saying the complete statement and answer. The first author would then flip her white board over and have the students write the math fact and its product from memory. The first author presented the math fact to them and they compared what each had written. If an error was made, the model/lead/test correction procedure (Marchand-Martella, Slocum, & Martella, 2004; Shouse, Weber, & McLaughlin, 2012) was employed. The first author would model the correct response, the participants and the first author would say the correct response together, and then the first author would have the participants say the correct response independently.

When the first author noted that our participants were making sufficient progress toward mastery on the first set of fact, she added the DI flashcards for additional practice with the math facts. This change occurred after the 13th data collection session for Set 1. After the participants finished the See/Say/Write procedure the first author began instruction with the DI flashcards. The first author would alternate back and forth between the participants and have them say the complete fact on the flashcard. If they were correct, the flashcard was placed in a pile on the

table (Brasch, Williams, & McLaughlin, 2007). If they made an error, the model/lead/test correct procedure was again implemented. Error cards was placed three cards back in the pile. This was done to allow additional practice on facts that the students had not mastered. For correct responses the first author gave the participants specific and general praise statements (e.g. "Great job," "Nice self-correction," "You said that math fact perfectly," "You're right"). Each session took between 30-45 minutes to complete.

Maintenance

Once the participants showed mastery (100% accuracy) with the set they were working for two consecutive data days, then the first author began instruction in the next set and the previous set was placed in maintenance. Maintenance took place after session 13 for both Participant's 1 and 2 with Set 1 facts.

Reliability of Measurement for the Dependent and Independent Variables

Inter-observer agreement was taken a total of 17 times. The research would make a copy of the probe sheets from each session and would meet with another teacher candidate from Gonzaga University every Sunday. When they would meet, the teacher candidate would take the copies of the probe sheets and grade them. The research would then take the copies of the probe sheets and compare them to the data from the original probe sheets. The first authors used event ratio to compute mean agreement scores and the mean agreement was 99.99% agreement for corrects.

Reliability as to the implementation of DI flashcards with the see/say/write format were gathered by observing the first author work with each participant. This was done three times over the duration of the study. The third or fourth authors gathered this information and made the determination as to whether it was baseline, the DI flashcard condition, or maintenance. Reliability of measurement for the independent variables was 100% each time it was gathered. Student work was also assessed and it indicated that each participant was in the various conditions for the correct number of sessions for the various sets.

Results

Participant A

The results for participant A are shown in Figure 3. There were a total of 10 facts tested in each session for all sets. During baseline, the mean correct for set one was 2.5 out of ten total with a range from 2 to 3 correct. Baseline lasted two days for set one. During intervention for set one the mean correct was 5.27 with a range from 1 to 10 correct. Set one was in intervention for 13 days. Maintenance for set one lasted six days and the mean correct was 9.17 correct with a range from 8 to 10 correct. During baseline for set two, the mean correct was 2.2 with a range from 0 to 6. Set two was in baseline for 15 days. During intervention of set two the mean correct

was 5.17 with a range from 2 to 8. Intervention of set two lasted for six days. During baseline for set three the mean correct was 2.76 with a range from 0 to 7 correct. Baseline remained in effect for Set 3 for the duration of data collection.

Participant B

The results for participant B are shown in Figure 4. There were a total of 10 facts tested in each session for all sets. During baseline, the mean correct for set one was 1.5 correct with a range from 1 to 2. Set one was in baseline for 2 days. During intervention, the mean correct for set one was 5.33 correct with a range from 2 to 10 correct. Intervention on set one lasted 13 days. Maintenance was taken for six days and the mean correct was 10, 100% accuracy. During baseline for set two the mean correct was 5.33 with a range from 2 to 7. Baseline for set two lasted 15 days. The mean correct for intervention of set two was 6.83 correct with a range from 5 to 10. Intervention for set two lasted 6 days. During baseline for set three, the mean correct was 1.9 with a range from 0 to 4 correct. Baseline lasted 21 days and never entered treatment.

Figure 3. The number of correct math facts across sets for Participant A who had ID.

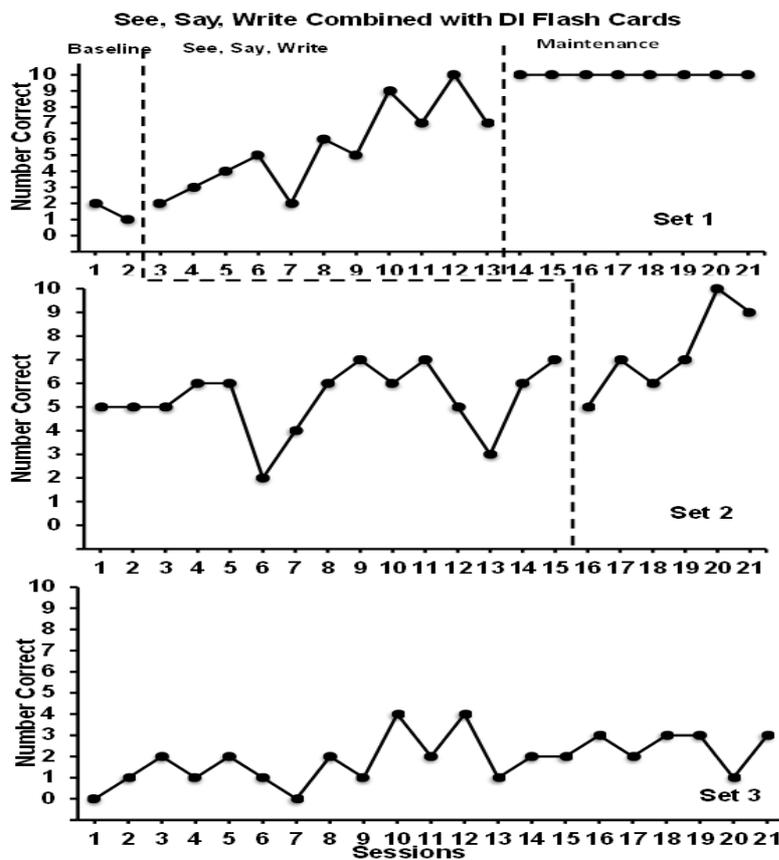
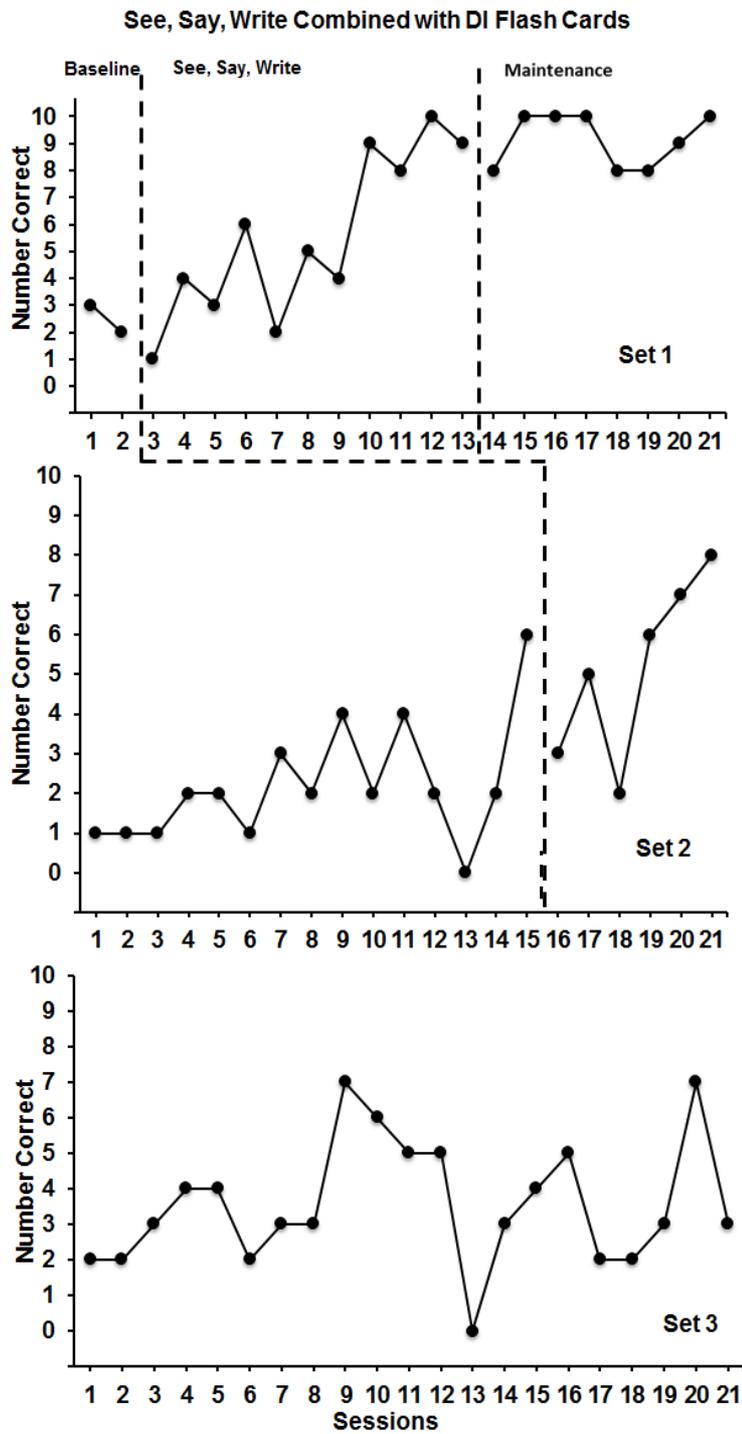


Figure 4. The number of correct math facts across sets for Participant B with ASD.



Discussion

When the first author began to employ the use of DI flashcards combined with the see/say/write procedure, student performance increased. When the participants finished the see/say/write procedure, the first author would bring instruction with the DI flash cards to give the students additional practice with the multiplication facts. The first author hoped that this additional practice would produce an increase in the progress the participants were making toward mastery. The change in the intervention proved to be effective and both participants began to make progress toward mastery in Set 1.

The present outcomes extend our previous work employing DI flashcards with see/say/write channel from precision teaching (Kunzelmann et al., 1970; Lindsley, 1991). The outcomes also extend the efficacy of DI flashcards with an elementary student with autism. Much of our previous research has employed students with learning disabilities (Becker et al., 2009; Erbey et al., 2011; Kaufman et al., 2011; Lund et al., 2012) or behavior disorders (Shahtout et al., 2012; Treacy et al., 2012). In the present case the math performance of students with more moderate disabilities was improved. Also, maintenance of treatment gains for Set 1 was found for both our participants.

Both participants received an equal amount of specific and general praise for correct responses. As the study progressed, the students showed excitement to be pulled from class and spend time with the first author. When the first author asked the participants what they learned from doing this activity, Participant A's performance indicated he was learning his math facts quickly. He also mentioned that he wanted to race the first author, because he is really fast now. Participant B said she could answer math questions better, and that would help her in her future when she needs to know how to do her work in math. She mentioned going to the store and having to use multiplication while she was shopping. The first author asked the participants what was their favorite part of the intervention. Both participants agreed that it was being able to leave their general education classroom and work with the first author. As you can infer from the comments the participants made, they both enjoyed the intervention and improved their confidence in their math abilities. Participant A started off the intervention being very hesitant to try. He doesn't like being wrong and didn't want to try. By the end of the study, he was so confident in his multiplication facts, he wanted to race the first author on filling out his probe sheet. He then wanted to show the first author he was faster than her. Both students made great gains by the end of the data collection. These subjective outcomes may add some social validity (Carter, 2010; Wolf, 1978) to the outcomes. In future research a more systematic measurement of social validity will have to be carried out to truly make such a determination (Carter, 2010).

There were limitations in the present research. Since both participants' skills were well below their regular developing peers in math, they were not receiving instruction and review from just the first author. Participant B expressed that she had a set of flashcards at home. She

told the first author that her mom helps her practice and had taught her a song to remember her facts for 7's. Also, the general education classroom teacher expressed that she gave the students entry tasks every morning. On certain mornings, she focused her entry tasks on mathematic review. Also, multiplication problems are part of that review multiple times per week. This extra exposure and practice the participants received in the instruction area may have affected our results. These extraneous factors may well have assisted our participants in math. There is no way in which these factors can be controlled in a typical elementary school, so our outcomes need to be viewed with some caution. The differential results for Participant's A and B by disability designations of our participants remains a limitation. It may well be that these outcomes may be a function of the severity of each participant's academic deficits. We have found this with preschool students when we have employed DI flashcards (Chandler, McLaughlin, Neyman, & Rinaldi, 2012; Ehlers, McLaughlin, Derby, & Rinaldi, 2012; Higgins, McLaughlin, Derby, & Long, 2012). However, we have also found very impressive outcomes when employing DI flashcard with young students (Herberg, McLaughlin, Derby, & Gilbert, 2011; Mangundayo et al., 2013).

Summary and Conclusions

The procedures were straightforward and easy to implement. However, the first author made an extra effort to ensure that the participants remained on task and did not get distracted. This procedure was inexpensive and all instructional materials utilized were found within the classroom. Additionally, the first author created the flash cards and probe sheets that were needed. The special education teacher and instructional assistant were very satisfied with the intervention and its outcomes. They both noticed an improvement in the students' abilities and confidence levels in the classroom. The classroom special education teacher was also very pleased with the participants' progress during the study due to the fact that this skill is such an important skill for the student to have. The skill is related to both students' IEP goals and it is also a prerequisite skill needed to complete more complex mathematical problems. Basic multiplication fact accuracy and fluency will be used later on in their academic careers and also in their future as adults.

References

- Becker, A., McLaughlin, T. F., Weber, K. P., & Gower, J. (2009). The effects of copy, cover, and compare with and without error drill on multiplication fact fluency and accuracy. *Electronic Journal of Research in Educational Psychology, 18*, 747-760. Retrieved from <http://www.investigacion-psicopedagogica.org/revista/new/english/antiores.php>
- Bechtoldt, S., McLaughlin, T. F., Derby, K. M., & Blecher, J. (2014). The effects of direct instruction flashcards and a model, lead, and test procedure on letter recognition for three preschool students with developmental disabilities. *Journal on Developmental Disabilities, 20*(1), 5-15.
- Bishop, L., McLaughlin, T. F., & Derby, K. M. (2011). A comparison of direct instruction flashcards and reading racetracks on the acquisition and generalization of core words in context for a seven-year-

- old elementary student with health impairments, learning delays, and behavioral concerns. *International Journal of Social Science and Education*, 1(4), 525-539. Retrieved from: <http://advasol.net/?q=node/19>
- Brasch, T. L., Williams, R. L., & McLaughlin, T. F. (2008). The effects of a direct instruction flashcard system on multiplication fact mastery by two high school students with ADHD and ODD. *Child & Family Behavior Therapy*, 30(1), 51-59.
- Carter, S. (2010). *The social validity manual: A guide to subjective evaluation of behavior interventions*. Waltham, MA: Academic Press.
- Chandler, A., McLaughlin, T. F., Neyman, J., & Rinaldi, L. (2012). The differential effects of direct instruction flashcards with and without a shorter math racetrack to teach numeral identification to preschoolers: A failure to replicate. *Academic Research International*, 2, 308-313. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.htm/>
- Cipani, E. (1988). *Transitioning exception children and youth in the community: Research and practice*. New York, NY: Haworth Press.
- Cruikshank, D. E. (1992). *Teaching and learning elementary and middle school mathematics* (2nd ed.). New York, NY: Macmillan Publishing Company.
- Curico, F. R. (1999). Dispelling myths about reform in mathematics. *Mathematics: Teaching In the Middle School*, 4, 282-284.
- Ehlers, E., McLaughlin, T. F., Derby, K. M., & Rinaldi, L. (2012). The differential effects of direct instruction flashcards and math racetrack on number identification for three preschool students with disabilities. *Academic Research International*, 2, 285-295. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.htm/>
- Erbey, R., McLaughlin, T. F., Derby, K. M., & Everson, M. (2011). The effects of using flashcards with reading racetrack to teach letter sounds, sight words, and math facts to elementary students with learning disabilities. *International Electronic Journal of Elementary Education*, 3(3), 213-226. Retrieved from: <http://www.iejee.com/index.html>
- Garnett, K. (1998). *Math learning disabilities*. Reprinted by Learning Disabilities OnLine: LD In-Depth. Retrieved May 18, 2012, http://www.ldonline.org/ld_indepth/math_skills/garnett.html. to providing assistance in mathematics curriculum.
- Geary, D. C. (2004). Mathematics and learning disabilities. *Journal of Learning Disabilities*, 37, 2-4.
- Green, C., McLaughlin, T. F., Derby, K. M., & Lee, K. (2010). Using reading racetracks and flashcards to teach sight words to students with disabilities: Effects for acquisition and response maintenance. *Journal of Educational Research: JER*, 13(2), 84-98. Retrieved from: http://www.iub.edu.pk/jer/previous_issue.html
- Heege, H.T. (1985). The acquisition of basic multiplication skills. *Educational Studies in Mathematics*, 16, 375-388.
- Herberg, K., McLaughlin, T. F., Derby, K. M., & Gilbert, V. (2011). The effects of direct instruction flashcards on shape recognition and recall for two preschool students with disabilities. *Academic Research International*, 1(3), 55-59. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>
- Higgins, M., McLaughlin, T. F., Derby, K. P., & Long, J. (2012). The differential effects of direct instruction flashcards on sight-word identification for two preschool students with autism spectrum disorders. *Academic Research International*, 2(3), 394-402. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html/>
- Kazdin, A. E. (2011). *Single case research designs: Methods for clinical and applied settings* (2nd. Ed.). New York, NY: Oxford University Press.

- Kaufman, L., McLaughlin, T. F., Derby, K. M., & Waco, T. (2011). Employing reading racetracks and DI flashcards with and without cover, copy, and compare and rewards to teach of sight words to three students with learning disabilities in reading. *Educational Research Quarterly*, 34, 24-44.
- Kunzelmann, H., Cohen, M., Hutten, W. J., Martin, G., & Mingo, A. (Eds.) (1970). *Precision teaching: An initial training sequence*. Seattle, WA: Special Child Publications.
- Lerner, J., & Johns, B. (2011). *Learning disabilities and related mild disabilities: Characteristics, teaching strategies, and new directions* (11th ed.). Boston, MA: Houghton Mifflin Co.
- Lindsley, O. R. (1991). Precision teaching's unique legacy from B. F. Skinner. *Journal of Behavioral Education*, 1, 253-266.
- Lund, K., McLaughlin, T. F., Neyman, J., & Everson, M. (2012). The effects of DI flashcards and math racetrack on multiplication facts for two elementary students with learning disabilities. *Journal of Special Education Apprenticeship*, 1(1). Retrieved from: <http://josea.info/index.php?page=archives>.
- Mangundayao, J., McLaughlin, T. F., Williams, R. L., & Toone, E. (2013). An evaluation of a direct instructions flashcard system on the acquisition and generalization of numerals, shapes, and colors for preschool-aged students with developmental delays. *Journal of Developmental and Physical Disabilities*, 26, 461-473.
- Marchand-Martella, N., Slocum, T., & Martella, R. (Eds.), (2004). *An introduction to direct instruction*. Boston, MA: Allyn & Bacon.
- McClosky, M., & Macaruso, P. (1995). Representing and using numerical information. *American Psychologist*, 50, 351-363.
- Peterson, L., McLaughlin, T. F., Weber, K. P., Derby, K. M., & Anderson, H. (2008). The effects of a model, lead, and test technique paired with visual prompts with fading procedure to teach "where" to a 13-year-old echolalic boy with autism. *Journal of Developmental and Physical Disabilities*, 20, 31-39.
- Power Standards for Mathematics: K-12. (2011). *Blackboard*. Retrieved December 1, 2011, from http://bb.spokaneschools.org/bbcswebdav/pid-511551-dc-content-rid-413536_4/instruction/Elementary%20Curriculum%202010/Power%20Standards/comcined%20documents/K-12%20Math%20Power%20Standards.pdf
- Romjue, H., McLaughlin, T. F., & Derby, K. M. (2011). The effects of reading racetracks for teaching sight words. *Academic Research International*, 1(2), 134-146. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>
- Ruwe, K., McLaughlin, T. F., Derby, K. M., & Johnson, K. (2011). The multiple effects of direct instruction flashcards on sight word acquisition, passage reading, and errors for three middle school students with intellectual disabilities. *Journal of Developmental and Physical Disabilities*, 23, 241-255.
- Shahtout, L., McLaughlin, T. F., Derby, K. M., & Arenez, T. (2012). The effects of direct instruction flashcards and reading racetrack on sight words with two elementary students with behavior disorders: A brief report. *Academic Research International*, 2, 303-308. Retrieved from <http://174.36.46.112/~savaporg/journals/issue.html>
- Shapiro, E. S. (2011). *Academic skills problems: Direct assessment and intervention* (4th ed.). New York, NY: Guilford Press.
- Shouse, H., Weber, K. P., McLaughlin, T. F., & Riley, S. (2012). The effects of model, lead, and test and a reward to teach a preschool student with a disability to identify colors. *Academic Research International*, 2, 477-483. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>
- Silbert, J., Carnine, D. W., & Stein, M. (1981). *Direct instruction mathematics*. Columbus, OH: Charles E. Merrill.
- Skarr, A., McLaughlin, T. F., Derby, K. M., Meade, K., & Williams, R. L. (2012). A comparison of direct instruction flashcards and cover, copy, compare to teach spelling to elementary school students. *Academic Research International*, 2(2), 247-263. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>

- Skarr, A., Zielinski, K., Ruwe, K., Sharp, H., Williams, R. L., & McLaughlin, T. F. (2014). The effects of direct instruction flashcard and math racetrack procedures on mastery of basic multiplication facts by three elementary school students. *Education and Treatment of Children*, 37, 77-93.
- Standish, K., McLaughlin, T. F., & Neyman, J. (2012). The effects of direct instruction flashcards and math racetrack on math facts with one elementary student. *Academic Research International*, 2, 241-246. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>
- Treacy, R., McLaughlin, T. F., Derby, K. M. & Schletter, E. (2012). The effects of flashcards and student selected reinforcers with goals and additional practice with multiplication facts for two intermediate elementary students with behavior disorders. *Academic Research International*, 2, 469-476. Retrieved from: <http://174.36.46.112/~savaporg/journals/issue.html>
- Wolf M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, 11, 203-214.
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock Johnson Test of Achievement, III*. Reading Meadows, IL: Riverside Publishing.

Acknowledgements

This research was completed in partial fulfillment for an Endorsement in Special Education from Gonzaga University and the State of Washington. The author would like to thank the participants and the classroom teacher for their cooperation. The first three authors are in the Department of Special Education at Gonzaga University in Spokane, WA. Mrs. Urlacher has now retired from teaching special education in the Spokane Public Schools

Requests for reprints should be sent Stefoni Olmstead, Department of Special Education, Gonzaga University, Spokane, WA 99258-0025 or via email at solmstead@zagmail.gonzaga.edu. Ms. Olmstead-Thompson is a special education teacher in the Medical Lake School District #326, Medical Lake, WA. She teaches at Hallett Elementary School.