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The effects of direct instruction flashcards to increase number recognition for a five-year-old general education ell student

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Abstract
The purpose of this study was to determine the effectiveness of DI flashcards on the number identification for an English Language Learner (ELL) in a general education kindergarten classroom. A single subject multiple baseline across different sets of numbers was used for this study. By the end of this study, our participant showed mastery of correctly identifying all numbers zero through 31 in random order. Additionally, the student's self confidence in math grew as a result of his increased skills in number recognition. Our procedure was cost effective and required little time for both the first author and the participant.

Keywords: General Education Student, DI Flashcards, Number Recognition, Kindergarten, Very Effective Effect Sizes Multiple Baseline Design, Non-Overlapping Data Points (NDP)

Introduction

In everyday life, there are many important tasks that require the use of math, especially in the primary grades. Therefore, it is apparent that math proficiency is necessary, especially in school. According to Curico (1999), learning basic facts is not a prerequisite for solving problems, but learning facts becomes a necessity to solve problems that are meaningful, and relevant. Number identification is a prerequisite for all areas of math, and is a skill set that our society expects pre-kindergarteners to have already mastered (Shapiro, 2014). Without basic numeral identification, later math skills that the children will encounter will become much more difficult. Math underachievement also poses major problems for typically developing children in general education classrooms (Shapiro, 2014), because these children cannot grasp more complex concepts as they are introduced causing them to fall farther behind from the rest of their peers.

The Direct Instruction (DI) flashcard system is a successful academic intervention strategy that can be adapted and used in many academic areas (Silbert, Carnine, & Stein, 1981). There are many advantages of using the DI flashcard system. One advantage is the ease at which it can be implemented in almost any academic subject area or classroom setting, to teach specific skills quickly and easily (Skarr, Zielinski, Ruwe, Sharp, Williams, & McLaughlin, 2014; Van Houten & Rolider, 1989). The DI flashcard procedure uses a mixture of mastered and unmastered facts (Seines, McLaughlin, Derby, Weber, & Gortsema, 2015; Skarr et al., 2014). When a child is shown a flashcard of a fact and he or she answers correctly, the flashcard is moved to the back of the deck. If the child answers the math fact incorrectly, the instructor would model the correct response to the child. Then, the child would repeat the answer and the card would be moved two or three cards back (Silbert et al., 1981; Harris et al., 2015). Once the child has answered the math fact correctly three times, the flashcard is moved to the back of the deck. The same model, lead, test procedure is repeated with every error the child makes (Skarr et al., 2014). It has been shown that students that are taught using this teaching method have performed higher on post-tests compared with students who are taught using traditional methods (Sindelar & Wilson, 1991).

In addition, a wide range of research has documented DI flashcards in teaching math facts (Glover, McLaughlin, Derby, & Gower, 2010; LeBrun, Jones, Neyman, McLaughlin, & Schuler, 2014; Skarr et al. 2014), sight words (Erbey, McLaughlin, Derby, & Everson, 2011; Hopewell, McLaughlin, & Derby, 2010; Kaufman, McLaughlin, Derby, & Waco, 2011;

Shahtout, McLaughlin, Derby, & Arenez, 2012), and colors and numeracy (Delong, McLaughlin, Neyman, & Wolf, 2013; Mangundayo, McLaughlin, Williams, & Toone, 2013). DI flashcards have been successfully employed in special education preschools (Mangundayo, McLaughlin, Williams, & Toone, 2013), elementary schools (Cravalho, McLaughlin, Derby & Waco, 2014; Crowley, McLaughlin, & Kahn, 2013; Lund, McLaughlin, Neyman, & Everson, 2012), middle schools (Bjordahl, Talboy, Neyman, McLaughlin, & Hoenike, 2014; Ruwe, McLaughlin, Derby, & Johnson, 2011), and high school (Hayter, Scott, McLaughlin, & Weber, 2007; LeBrun et al., 2014). Unfortunately, very little research with DI flashcards has taken place in general education (Thomas, McLaughlin, & Derby, in press).

The purpose of this particular study was to increase the accuracy and fluency of basic number identification with a five-year-old male, who was learning English, to catch him up with the rest of his typically developing kindergarten classmates. A second purpose was to replicate and extend the recent work of Rivera, Heric, Williams, McLaughlin, and Johnson (2015) who were able to document the effectiveness of DI flashcards in math with an elementary student enrolled in a private catholic school. Based on the urging of Jasny et al., (2011) and Nosek et a;/. (2015), final purpose was to replicate again the use of DI flashcards in the schools which would continue to increase the confidence an educator to employ such procedures.

Method

Participant and Setting

Our participant was a male and a 5-year-old kindergarten student at the time the study began. He did not have an IEP or 504 plan. He was considered an English Language Learner (ELL) and received English Language services. His first language was Russian and he was learning English. Since he had no preschool or any type of academic preparation at home, he was behind in number recognition, mainly with numbers in the twenties. The participant was very motivated to work one-on-one with the first author so no extra reinforcers were needed.

The study took place in the participants' classroom at a table away from the rest of the students. The study was conducted during independent literacy or math stations when the first author could pull the student over to a table to work one-on-one with him while the rest of the students worked independently on their station work. The participant's classmates, 16 kindergartners, were present during the study as well as the first author. Each session lasted roughly 5 minutes to get through all of the flashcards.

Materials

The first author used flashcards, in which a single number was printed on each card. The first author used blank notecards and a black sharpie marker to make the flashcards. The flashcards contained numbers 0 through 31.

Dependent Variables and Measurement

There were two dependent variables measured in this study. The first dependent variable was the number of correctly identified numerals by the participant. A correct response was defined as the participant saying the number within five seconds of the flashcard being presented. The second dependent variable was the number of errors made during each session by the participant. A response was scored as an error if the participant said an incorrect number or if a response was not made within the allotted five seconds. If a participant incorrectly labeled a number and then self-corrected within five seconds, an error was not recorded and the response was considered a correctly identified number.

Data Collection and Interobserver Agreement

Data were collected by the first author. These data were gathered each session by recording the accuracy of number recognition by the participant. She did this as part of her teaching routines in the classroom. The first author went through the flashcards with the participant without providing assistance or feedback to the responses given. The first author marked correct or incorrect on the data sheet for each number.

Interobserver agreement was collected 20 of the 20 (100%) sessions during intervention with the participant. Interobserver agreement data were collected from a videotape of these sessions taken with an iPad. This footage was shown to a masters student from the same university as the first author, and an independent tally, on a separate data-recording sheet for corrects and errors, was made. This data-recording sheet was identical to the one used by the first author (see Appendix A). The number of correct and incorrect responses, recorded by both the primary and reliability data collector on their individual recording sheet was compared. The smaller number of corrects and errors were divided by the larger and multiplied by 100 for each session. Mean agreement was 100% for all sessions.

Appendix A

Intervention

Set 1

5													
17													
24													
3													
29													
0													
2													
7													
26													
1													
10													

Set 2

28												
13												
23												
4												
18												
22												
6												
11												
25												
12												

Set 3

8													
31													
9													
14													
20													
15													
19													
21													
16													
27													
30													

Experimental Design and Conditions

A single subject, multiple baseline design (Kazdin, 2011; McLaughlin, 1983) across different sets of numbers was used to evaluate the effectiveness of direct instruction flashcards. The participant received three different collections of baseline data before beginning intervention of set 1. The sets were determined by dividing up the numbers that the participant did not know into three different sets. Each set contained on average three to four unknown numbers with an average of seven known numbers. The introduction of a new set of numbers was dependent on the participant's success with the previous set of numbers. A new set was introduced after the participant correctly identified all numbers in a set for a minimum of three consecutive sessions.

Baseline

Baseline data were collected in the participant's folder that was used as a data collection sheet for many topic areas in the classroom. The folder included data on the participant's ability to recognize capital and lowercase numbers, identify letter sounds, how well the participant could rhyme, how the participant wrote his name, and number recognition Baseline data were collected three different times throughout the year; once in September, once in November, and once in February of the academic year. For the number identification section of the folder, numbers zero through 31 were written in random order in a table. When the first author collected data, the first author asked, "What number?" to the participant while pointing to a particular number in the table, and correct responses were recorded by highlighting numbers that the participant correctly stated. The participant was not given any feedback regarding the accuracy of his response during this time. However, he was encouraged to try his best and verbal praise was given for participation.

DI flashcards

Three sets of numbers were created for the participant. The order of numbers consisted of a mix of some numbers the participant had mastered recognizing with some numbers that the participant had not mastered. Each set consisted of an average of three unknown numbers mixed with an average of seven known numbers. Set 1 consisted of four unknown numerals and seven known numerals. Numerals that were in Set 1 included: five, seventeen, twenty-four,

three, twenty-nine, zero, two, seven, twenty-six, one, and ten. Set 2 consisted of four unknown numerals and 6 known numerals. Numerals that were in Set 2 included: twenty-eight, thirteen, twenty-three, four, eighteen, twenty-two, six, eleven, twenty-five, and twelve. Set 3 consisted of four unknown numerals and seven known numerals. Numerals that were in Set 3 included: eight, thirty-one, nine, fourteen, twenty, fifteen, nineteen, twenty-one, sixteen, twenty-seven, and thirty.

At the beginning of each session, the first author went through the flashcards of the current instructional set of flashcards with the participant. The set was gone through three times before taking data on the responses of the participants. During "practice rounds," the participant was given verbal praise and high-fives for correct responses. When incorrect responses were given a model, lead test correct format was employed and the missed flashcard was moved, at least three places, back in the stack. Data was taken during the fourth time through the flashcards. A pile or stack of correct flashcards and a separate pile for incorrect flashcards was created by the first author. These stacks were employed based on the participant's answers. The same model, lead, test correction procedure was used by the first author with the flashcards in the incorrect pile to review the unknown numerals. The first author recorded the number of correct responses and the number of incorrect responses by the participant on the data recording sheets. This recorded data for both unknown numbers and known numbers that had been previously mastered.

Results

Baseline

The baseline performance of our participant can be seen in Figure 1. Out of the three different baseline days, the participant correctly identified 20 out of 32 numbers for all three sets. The 12 numbers that the participant missed were consistently missed during all three days of baseline. In baseline, his performance averaged 7.0 for Set 1, 6.0 for Set 2, and 7.0 (range 6 to 8) for Set 3.

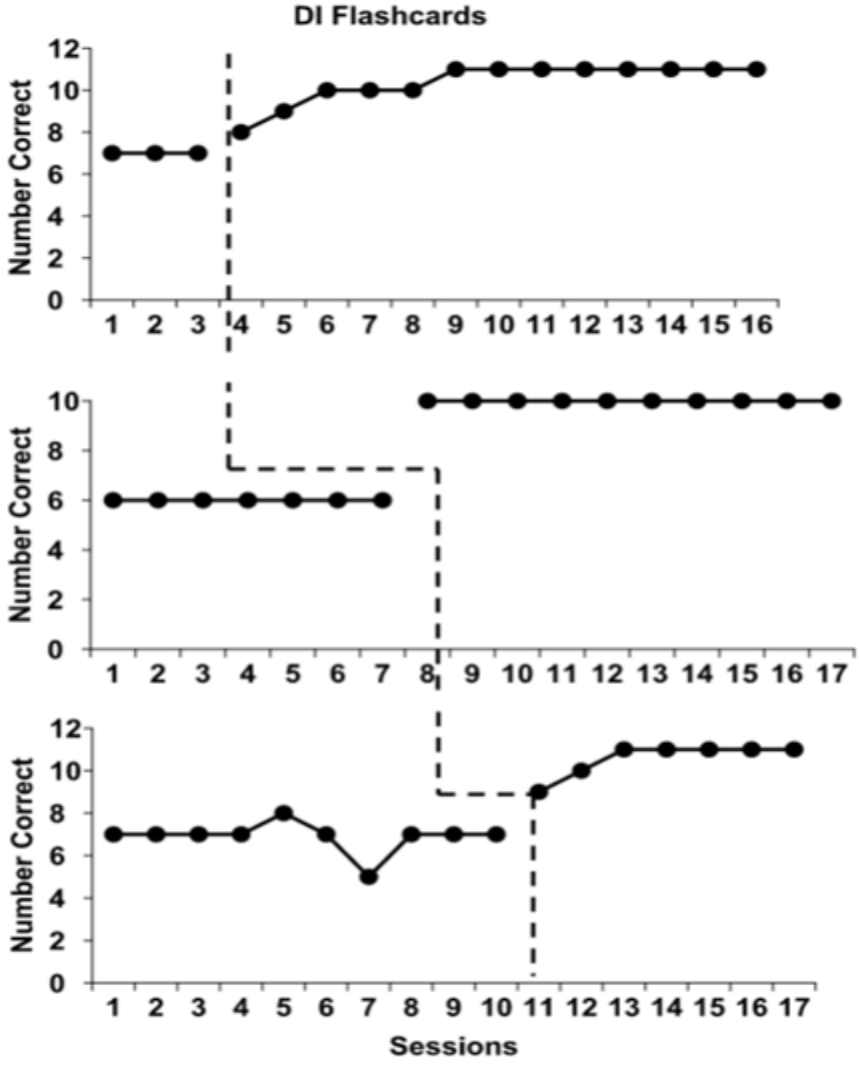

Fig 1: Number of numerals correct for Baseline and DI flashcards for Sets 1-3.

DI flashcards

The results of the DI flashcard procedure are also presented in Figure 1. When the DI flashcard procedure was implemented, the student began to show rapid progress. The results for Set 1 are shown in Figure 1. After eight sessions, the participant could correctly identify all 11 numerals in Set 1 so the first author moved on to intervention of Set 2. The results for Set 2 are also shown in Figure 1. Our participant could correctly identify all 10 numerals in Set 2, so the first author moved on to intervention of Set 3. After two sessions of intervention of DI flashcards with Set 3, the participant could correctly

identify all 11 numbers. The mean for Set 1 during DI flashcards was 10.38 with a range of 8 to 11). A comparison between baseline and DI flashcards revealed indicated there were no overlapping data points (NDP) for all three sets when DI flashcards were employed (Scruggs, & Mastropieri, 2001). This adds additional confidence in the present outcomes.

Discussion

The results show that the participant made quick progress when DI flashcards were employed. This was replicated for all three sets. This outcome replicates previous research using DI flashcards with math (Kaufman et al., 2011; Skarr et al., 2014). The outcomes also replicate the work of Rivera et al. (2014) with a general education student enrolled a parochial school setting. Finally the research also supports previous research showing the effectiveness of this intervention when teaching students who are preforming lower than the rest of their peers.

The intervention was successful because the participant did increase his number recognition by correctly identifying all numbers, zero through 31. This was done requiring our participant to respond within a minimum of five seconds. The participant really enjoyed the time spent working with the first author during each session. Due to the participant's willingness and excitement to work with the first author could have led to his quick ability to master number recognition.

The results hold a significant amount of importance for the participant. Increasing his number recognition allowed the participant to reach grade level standards and it caught him up to being at the same level of number recognition as his classmates. Because of his increased number recognition, the participant's self-confidence also increased and the first author found that the participant was willing to raise his hand more to answer questions in daily work because he knew the answers to more math related topics.

There were several strengths in the present case report. First, it did not take a significant amount of time out of the school day to complete. The maximum amount of time used every day was approximately five minutes per session. At most, three sessions a day could be completed. Another strength was the funds needed to implement this study were minimal. The only items that were needed were flashcards the first author made using notecards that the school provided as well as the recording sheet that was printed. The effort by the first author or anyone implementing this study was minimal as well.

One weakness of this study is that it only included one child. This made the outcomes somewhat limited. Since the participant was very motivated to work with the first author as well as being very motivated to learn, that could have been why he did so well. Another weakness was that every day, the child continued to work with numbers while he was in school, which could have been another reason as to why he was so successful. By learning number recognition throughout the day, the participant may well have generalized (Stokes & Baer, 1977) that information to the study.

One way this study could have been improved is by extending the sequence of numbers that the sets included. By extending the numerals in each set, the participant could have worked on recognizing numerals higher than 31. Finally, additional general education students could have been included.

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