ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

THE DIFFERENTIAL EFFECTS OF DIRECT INSTRUCTION MODEL-LEAD-TEST PROCEDURE WITH AND WITHOUT A REWARD ON ROTE COUNTING, NUMBER RECOGNITION AND RATIONAL COUNTING WITH A YOUNG CHILD

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Abstract: *Counting numbers can be struggle for kindergarten students. We evaluated the effects of direct instruction Model-Lead-Test (MLT) for a kindergartner's rote counting, number recognition and rational counting. The results indicated that MLT produced a gradual increase in the child's performance. However, when a highly desired reward was added, the participant's skills to count and rational count and recognize numbers increased even further. Maintenance for rote counting produced a decrease in performance that was not found for number identification or rational counting. When a reward was added and MLT was reintroduced for three sessions, performance improved. When maintenance was again employed, the child's performance for each of our three measures did not decrease. The efficacy of employing MLT and rewards in the home was discussed. Suggestions for future research as well as limitations to our outcomes were made.*

Key Words: *model, lead, and test error correction, rewards, counting, 3-year-old child key*

Introduction

Improving math literacy is a very important goal for both students and society. Having math skills has been associated with graduating from high school and later adult economic success (Lloyd, 1978). Even with the advent of modern technology, basic skills in math remain very important. The mastery of primary rote counting, number recognition and rational counting are cornerstone skills in math and a precursor for success in kindergarten as well as elementary school math (Blank, 1973; Frank, 1989). According to Stein, Kinder, Silbert, Carnine, (2006), indicated that counting skills are not only important in and of themselves, but are also important prerequisite skills for many problem-solving strategies.

The teaching of early math concepts to kindergarten children is crucial in helping them to become lifelong learners. The main distinguishing factor of direct instruction model-lead-test procedure is that, the teacher is carefully managing and evaluating the education levels of the students. The very purpose of the direct instruction or the model-lead-test procedure is to maximize the cognitive and learning abilities of students by increasing their rate of success and their achievements. In the environment of the direct instruction, the student can avail the structured and academically oriented learning environment where they actively engaged in the instructions and demonstrate the high rate of success. Several studies show that direct instruction model-lead-test procedure can increase the success rate of students by 80% or more (Joyce & Weil, 1996).

Review of Literature

One teaching procedure used to teach rote counting to children, which contain sequentially planned learner and teacher tools (Stood, & Jitendra, 2007). These programs are also designed for students who are learning mathematics for the first time. The basic programs are broken into 10 to 20 units, which have to be taught in a school year. These programs include all the skills needed for intermediate mathematics instruction (Silbert, Carnine, & Stein, 1990). When teachers teach rote counting to kindergarten students they subconsciously use rote counting with rational counting together. According to the Frank (1989) "Consider the teacher who tries to teach rote counting from one to ten simultaneously with point counting from one to ten objects. Pupils in this situation are learning not only to say number name in sequence but also simultaneously to point to objects in set" (p.14).

When employing a model-lead-test procedure, the teacher starts the class by getting the attention of the students. The teacher can use phrases like, "Look up here" and, "We are going to start". The teacher also tells the students what was covered in the last class and what they are going to learn today. For example, in the learning of rote counting, the teacher starts with, "Yesterday we learned the counting of 3 and 4." "Today we will learn how to count our fingers, flowers, stars, toys and coins." It has been found to be necessary that this phase be brief and concise; otherwise the students may lose interest and attention and forget everything (Jones, Wilson & Bhojwani, 1997). These same principles can be applied in the rational counting and number recognition. Since, these are part of basic math, it is necessary that the students be taught to be interested in the lesson and math.

In the rational counting the teacher demonstrates using pictures or objects to help the students learn something new (Jones et al., 1997). Similar to the first phase, it should be brief and should cover the basic aspects of counting. After the demonstration, the students should be allowed to practice counting themselves. If the student is encountering any problems, counting numbers or recognizing numbers, the teacher should supervise the students for a few practice examples. (Anderson et al., 1979).

For the effective use of model-lead-test procedure in mathematics, it is necessary students be provided with a great deal of opportunities to practice the skills being taught (Silbert et al., 1990). Teachers and instructors can also use worksheets that contain a lot of practice material for students to achieve adequate levels of fluency and retention of the disabled students. Apart, from providing the published worksheets or practice books, the teachers can also give the customized worksheets for the number and picture recognition (Blank, 1973).

Direct Instruction (DI) has grown in importance as an effective school-wide academic intervention (Marchand-Martella, Slocum, & Martella, 2004). Moreover DI is the teaching method in which the learning objective requires the direct participation of the student or learner in what must be done, said, or written (Magliorao, Lockee, & Burton, 2005). DI has been

ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

effective in teaching basic skills to students with and without disabilities (Stein et al., 2006; Marchand-Martella, 2004). The application of MLT using the "I do it, we do it, and you do it," where the teacher demonstrates the learning, the teacher and students together follow and repeat the demonstrated task and then students do the skill or learning by themselves. The direct instruction teaching model-lead-test procedure is an explicit instruction method (Price & Nelson, 2003).

Recent research has documented the effectiveness of using MLT with DI flashcards to teach skills to students with and without disabilities. For example, Ruwe, McLaughlin, Derby, and Johnson (2011) were able to teach three middle school students with intellectual disabilities sight words. In addition, after the sight words were taught, increases in fluency were found. Using DI flashcards with MLT has also been effective in teaching math facts (Erbey, McLaughlin, Derby, & Everson, 2011; Lund, McLaughlin, Neyman, & Everson, 2012; Mangundayo, McLaughlin, Williams, Neyman, & Toone, in press; Mann, McLaughlin, Derby, Williams, & Everson, 2012; Treacy, McLaughlin, Weber, Derby, & Schlettert, 2012). In addition, both general and special education students have benefited from the use of MLT when paired with DI flashcards (Crowley, McLaughlin, & Kahn, in press; Kaufman, McLaughlin, Derby, & Waco, 2011; Standish, McLaughlin, & Neyman, 2011).

Model, lead, and test has also been implemented with visual prompts to teach a single student with autism nine locations in his classroom and school (Petersen, McLaughlin, Weber, & Anderson, 2008). Their results indicated that prompts could be gradually withdrawn and the student continued to know his location in the school. Bulkley, McLaughlin, Neyman, and Carosella (2012) were able to implement MLT without flashcards to teach three students with learning disabilities their letter sounds. When MLT was introduced across sounds, student performance improved. Shouse, McLaughlin, Weber, and Riley (2012) were able to teach a single preschool student his colors employing MLT coupled with a reward. When MLT and the reward were withdrawn, little decline in student performance was found.

The purpose of the present research was to implement model, lead, and test with a single typically developing student to teach three different skills in math. Another purpose was to determine the effects of employing a consequence that was highly favored by the participant on her academic outcomes. The final purpose was to examine the use of MLT with young typically developing child in three settings (home, daycare, and university student lounge).

Methodology

Participant and Settings

There was one participant in the study. She was a three-year-old typical developing female and was the daughter of the first author. She was attended a daycare four days each week. Prior to beginning the study the participant was able to count to ten accurately. The participant was excited and enthusiastic when asked to work with the first author. The participant was chosen for this study because she was confused between numbers and letters, and to improve her counting and to prepare her for when she begins kindergarten.

ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

The settings included the child's home, a student lounge at a private university, and the participant's daycare. In the participant‘s home, data were gathered after she came home from daycare. The session occurred in environment quiet with the participant's mother and these data were gathered in two places (living room or in the home office). The home offices consist of one table and one chair and some academic books. The participant was sitting on the floor when the data gathered. She was unusual quiet, and approximately nothing distracts her attention. The living room consisted of dining table and a TV witch still on most of the time, and a large sofa seat which the participant like seat on when the research gathered the data. The home office was quite with few distractions than the living room. The second setting session took place on her day care at the dining room, which consists of two large tables and lots of small chairs. The sessions collected at the participant's day care at noon when most of the kids went to their bed for sleeping time so the atmosphere was quite. The final setting took place at Gonzaga University in the student lounge of the education building. The participant and the first author sat on the table. The only other people present in the lounge were two students who were quietly studying at other table.

Materials

The material which used was the 1 to 20 was counting song "Numbers help me count 1-20", "1-20 Chant! by ELF Learning" and "Learn Basic English Numbers - pumkin.com fun kids English vocabulary cartoon." The materials used to teach number recognition were flashcards. There were two sets of handmade cards with the numbers 1 to 9 on 3 x 5 inch colored ends. The first set was pink and the second set was green. For rational counting materials that used were a variety of pens, ball, and small boxes that the participant could count.

Dependent Variable

The dependent variable was the number correct for rote counting, number identification, and rational counting. For rote counting, a correct response was defined as the participant orally saying numbers in sequence with no more than a two second pause between numbers. For number recognition, a correct response was defined as the participant orally saying the number on the card within 2s. For rational counting, a correct was scored when the participant counted sequentially as she touched each object within 2s. Any other responses were scored as errors.

With rote counting, the participant was asked by the first author, "Count as high as you can." The participant started counting after the first author said, "go." When the participant made an error in sequence number or delayed more than two seconds. The first author said "stop" for example in session 6 the participant said "11, 12, 14." Immediately the first author said stop. Then, the first author recorded the last number correctly correct. Than the model lead and test procedure (Erbey et al., 2011; Kaufman et al. 2011; Silbert et al., 1981; Shouse et al., 1012) was implemented. The error card was placed back two from the top of the stack participant to say the correct number by going back two numbers and was required to say, 11, 12 and 13 with stress on number 13. The participant then shown a set of nine shuffled cards with numbers 1 through 9, and the participant had to say the number presented correctly within 2s. When our participant made an error, MLT was employed. After the participant could say the correct answer independently of any adult assistance, those error cards put back two or three cards from the top of the stack. This was done to provide additional practice on errors (Erbey et al., 2011; Glover,

ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

McLaughlin, Derby, & Gower, 2012; Green, McLaughlin, Derby, & Lee, 2010; Ruwe et al., 2011). If the participant counted sequentially as she touched the object within two second each number was scored. Failure to count sequentially or not touching the object to be counted was scored as an error.

Experimental Design and Conditions

The design that we employed was a combination multiple baseline as well as an ABCDCD and ABCD design across skills (Kazdin, 2011). A description of the various phases follows.

Baseline. All baseline data collection occurred in the participant's home except for Session 3, which occurred at the participant's daycare at noon. The participant was asked to count as high as she could. For number identification, the participant was shown a set of nine shuffled cards with numbers one to nine written on them. The participant had to orally say the number shown. For rational counting, the first author asked the participant how many pens were present. "Can you count it?" The participant was required to count the objects in order. The number of sessions in baseline ranged from 2 to 3. For number identification and rational counting, these baseline sessions took place on sessions 8 and 9.

Model-lead-test. The direct instruction MLT strategy was used to help the participant with all three tasks. This condition was in effect for 5 to 12 sessions for rote, number identification and rational counting.

MLT + Rewards. On session 16 the researcher provided a token to the participant. This token was awarded for every correct answer**.** These tokens were used on the weekend at a children's Chuck E. Cheese establishment. In addition, the participant had to count her tokens prior to each visit to Chuck E. cheese.

Maintenance. This condition was employed after the first author felt that the participant had mastered her numbers. During maintenance the material was simply presented to the participant as in baseline. No MLT or rewards were in employed. This condition was in effect twice for rote counting and once for both numeral identification and rational counting. The number of sessions also ranged from 1 to 8 sessions.

Reliability of Measurement

An inter-observer agreement was collected during 4 of the 29 sessions, which constituted 17.24% of all sessions. The secondary observer watched and independently scored the participant's responses. Both observers marked whether or not the participant's response was correct or an error. Any deviation in scoring was scored as a disagreement. The percentage of agreement was calculated by dividing the number of agreements plus disagreement. This number was multiplied by 100 to find the percent. The mean percent of interobserver agreement was 100%.

ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

Findings

Baseline

The number correct for all three types of counting is presented in Figure 1. The overall mean for baseline was (*M* = 4.166; range 2 to 6 numbers correct) rote counting (top panel). Baseline for numeral identification begun on sessions 9 and 10. The mean number correct for both sessions was 5.0. Baseline also began for rational counting on sessions 9 and 10. The participant was able to count three numbers correctly using rational counting.

Model-Lead-Test (MLT)

The MLT was implemented for 12 sessions for rote counting. As seen in Figure 1, the number of correct oral numbers increased over time (*M* = 4.166; range 2 to 6 correct). When MLT was implemented for five sessions for both numeral identification and rational counting, child performance increased only slightly (*M* = 5.8; range 5 to 6 correct) numeral identification and rational counting (*M* = 3.8; range 3 to 4 correct).

Model-Lead-Test + Reward

After the reward was introduced with MLT on session 16, the participant's performance increased after the second session for this condition. As seen in Figure1, the number of correct gradually increased (*M* = 7.16; range 5 to 9 correct) for rote counting. When this was added to number identification, the participant's performance improved (*M* = 7.83; range 6 to 9 numbers correct). For rational counting, MLT with rewards, a large increase in student performance was found.

Maintenance

With note counting, after participant's spring vacation, accuracy decreased (*M*= 6; range 6). However, for number identification and rational counting, no such decrease in performance was found (*M*'s = 9).

MLT + Reward for Rote Counting

The reward was reintroduced for rote counting for three sessions. The participant mastered each number using rote courting (*M* = 9).

Maintenance Rote Counting

The second maintenance was implemented for four sessions with rote counting; the child mastered her whole numbers with rote courting (*M* = 9).

Figure: 1

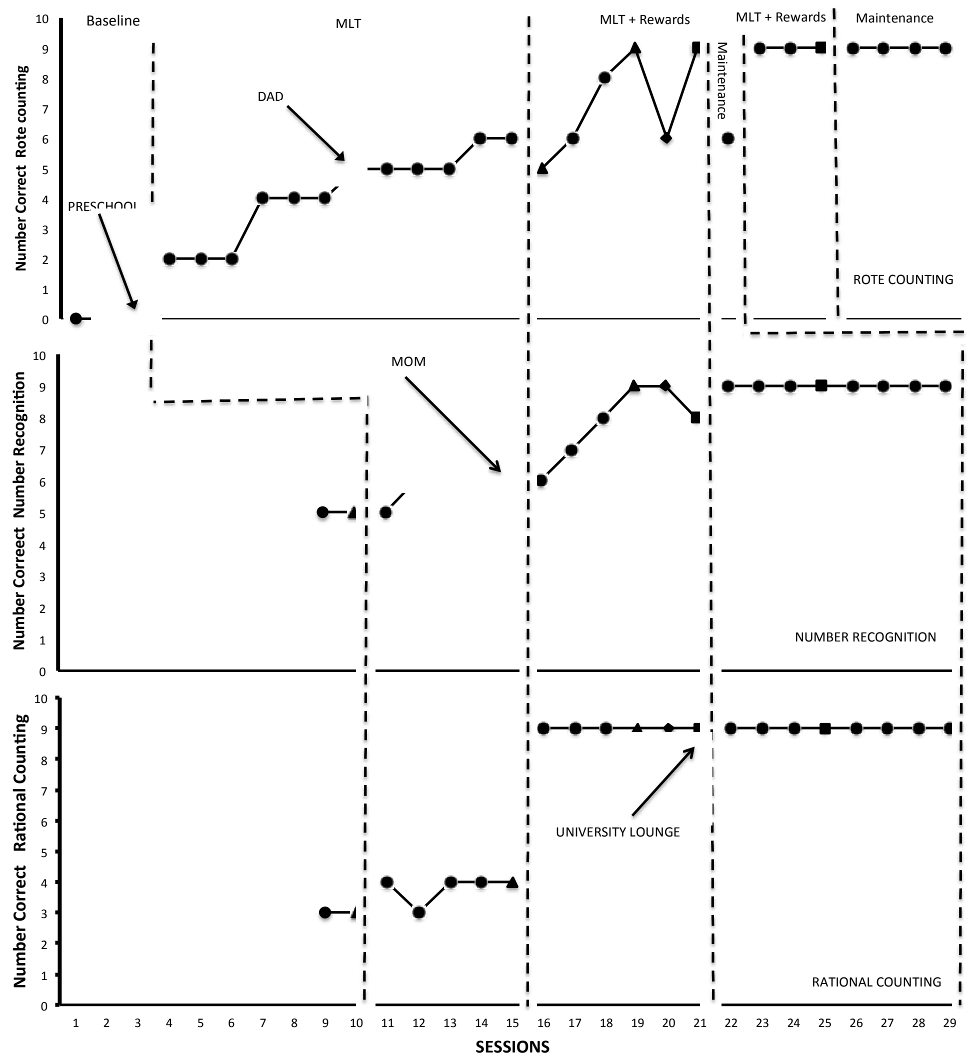

Figure 1. The number of correct for rote counting, number recognition, and rational counting during baseline, MLT, MLT + Reward, and Maintenance. When data were gathered in the home by the father, these outcomes were plotted with a closed circle. If the participant's mother took data, a closed diamond was employed. When data were gathered in the participant's daycare by the father, a closed triangle was used.

Conclusion

The model-lead-test procedure was effective method in teaching basic mathematics to children such as rote counting, number recognition and rational counting. By using this method, the first author taught a math county strategy to our participant. Prior to data collection, our participant

ISSN: 2278-4012, Volume:2, Issue:3, JULY 2013

was never able to rote count any numbers. The first MLT condition with rote counting generated a graduate increase for rote counting. After that, the participant's performance began to gradually improve. However, when the reward was implemented in sessions 16 to 21, the participant's performance quickly improved for all three skills. The first author, after a week break, tested the participant. He found her performance decreased for session 22 with rote counting. So, the first author implemented MLT with rewards again. Moreover, the participant in number recognition greatly improved. For rational counting, large increases were found.

Suggestions and Recommendations

There were several limitations in the present case report. The first was the lack of a continuous baseline for two skills (letter identification and rational counting). A strong case could be made for the changes in child performance when MLT was being implemented with rote counting and no improvements were observed for numeral identification or rational counting. The first author was the parent for the participant and that may well have made the present outcomes more impressive since the child's parent was the major person carrying out the various procedures. It may very well be than a different adult would have found different outcomes. However, when either the mother or father carried out data collection, little or no difference between parents was found. The data also found that the person doing the instruction did not make any difference. Additional research could also determine which setting was better, home, university lounge, or daycare facility.

The use of a young child with flashcards has received some attention in the peer reviewed literature (Chandler, McLaughlin, Derby, Ehlers, McLaughlin, Derby, & Rinaldi, 2012; Travis, McLaughlin, Derby, Dolliver, & Carosella, 2012; Herberg, McLaughlin, Derby, & Gilbert, 2011). We have noted that the effectiveness of MLT with DI flashcards is less when the participants are preschoolers with disabilities. In the present case we found robust effects with a typically developing preschooler.

The use of MLT with cards similar to that of DI flashcards provides a replication of much of our previous work employing DI flashcards (Ehlers et al., 2012; Erbey et al., 2011; Kaufman et al., 2011; Mann et al., 2012; Treacy et al., 2012). Additional research could examine the effects of MLT with and without flashcards. Also, MLT could be implement, withdrawn, and employed again to assess the effectiveness of MLT. Even with our present design, the effectiveness of MLT was difficult to clearly document.

The use of 'Chuck E Cheese' coins as a reward to each correct number was effective. On certain days, she insisted on working additional sessions to earn more such coins. She would even play a teacher role to the first author. Moreover even reward him with giggling. Her enthusiasm was also observed when she watched cartoons that taught counting. It appears that employing some form of a reward would be key to teach rote counting, number recognition and rational counting (Campbell, Kyriakides, Muijs, & Robinson, 2004; Charlesworth, 2011). Several other authors (Alberto & Troutman, 2012; Cooper, Heron, & Heward, 2017) have indicated the need to employ rewards to improve student outcomes in either academic or social skills.

Acknowledgement

This study was competed in partial fulfillment for the requirements for a Master of Education in Special Education Department of Special Education at Gonzaga University. The author would like to give particular thanks to the participants family for allowing him to complete this study. Portions of these data were presented at the Spokane Intercollegiate Research Conference, April, 2013. Requests for reprints should be addressed to Mustafa Al dahri, Department of Special Education, Gonzaga University, Spokane, WA 99258-0025 or via email weberk@gonzaga.edu

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