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An Evaluation of the Effectiveness of Implementing DI Flashcard Procedure to Teach Basic Multiplication Facts with an Elementary Private School Student with Learning Disabilities

Hadeel Altharwa, Jennifer Neyman, T. F. McLaughlin, Gary Johnson

***Abstract* – The purpose of the present study was to assess the effectiveness of Direct Instruction (DI) flashcards on improving the mastery of basic multiplication facts. Our participant was a fifth grade student attending a parochial school. Our participant was falling farther behind in his math and that is why he was selected to participate by his classroom teacher. The number of correct math facts was the dependent variable. Based on pre-testing three sets of math facts were devised. A multiple baseline design across sets was employed. The overall outcomes indicated large improvements in student performance when DI flashcards were used to teach our participant his math facts. The practicality and efficacy of employing DI flashcards was discussed. Our findings replicate several of our own studies employing DI flashcards to teach basic skills in math or reading.**

***Keywords* – DI Flashcards, Math, Multiplication, Parochial School, Elementary School Student, Multiple Baseline Design, Learning Disabilities.**

I. INTRODUCTION

Students who have difficulty in math often drop out of school (Lloyd, 1978). In fact third grade math performance is highly correlated to dropping our of school [1] Also, dropping our of school leads to high under or unemployment [2, 3, 4]. Generally youth who drop out of school experience serious negative outcomes such as unemployment, underemployment, and incarceration [3, 6]. Unfortunately, the dropout rate for students with disabilities is approximately twice that of general education students [6]

Many children with learning disabilities (LD) face continue to have difficulty in the area of math [7, 8] Mastery in multiplication is an important component for completing different mathematical subjects such as algebra, geometry, and physics. Without the memorization of multiplication facts at an early age, a student will struggle with other math topics that could discourage the child and prevent them from succeeding. Knowing multiplication facts is also a necessary skill to complete everyday activities [9] . Individuals who have mastered multiplication facts will benefit from this important skill and will be more self-sufficient. [9] Since money plays a major part in our everyday life, it is crucial that an individual can multiply numerals to successfully deal with financial matters, such as purchasing items, and estimating cost of products.

The first purpose of this study to teach our participant 20 multiplication facts using a DI flashcard system. A second purpose was to replicate some of our previous research [10-12] and to teach math facts with DI flashcards to a new individual and educational setting). The final purpose was to replicate our recent work [13] in the same parochial school with a different student.

II. METHODOLOGY

A. Participant and Setting

Our participant in this study was a 9-year-old female with a learning disability. She was attending a Catholic elementary school in the Pacific Northwest. The participant was a student in a 5th grade classroom. According to the her teachers, she was a hard worker and was very cooperative. While the participant knew the correct process to solve story problems, she frequently would get the answer wrong due to errors in long division. Her errors came from the fact that she had not mastered 0-12 multiplication facts. The participant was chosen for this study because she struggled with multiplication facts and that affected her academically.

The study was conducted every school day, for one hour on the floor, in the hall outside of the participant's 5th grade classroom, during the session; the first author would sit facing the participant. There were few distractions during the transition periods; the hallways became loud for a brief time, e. g., 2 minutes.

B. Materials

The materials needed for this study was a pre-test developed by the first author, in addition, flashcards were purchased that included multiplication facts from each of the three sets used for every session. Each contained six or seven multiplication facts that the participant did not know in the pretest and seven of thee multiplication acts that the student showed mastery of on the pretest already knew. The known to unknown ratios varied from 43 to 50%. Set 1 included 3x9, 9x3, 6x4, 4x7, 7x4, 4x8, 8x4; Set 2 included 4x9, 9x4, 6x7, 6x8, 8x6; and Set 3 included 7x7, 7x8, 8x7, 7x9, 9x7, 8x8.

C. Dependent Variables and Measurement

The behavior measured was the number of correct multiplication facts. A correct response was defined as the answer to the equation presented on the flashcard that was said correctly within two seconds. An incorrect response was defined as a number different from the correct answer said, the participant did not respond, or respond after two seconds. Two seconds was chosen to teach our participant to respond quickly.

Data were recorded on the 15 multiplication missed during the pretest. For each correct or incorrect response given by the participant the first author would write a "+" for correct answer and "-" for an incorrect answer next to the equation written on the data collection sheet. This process was repeated for all three sets of flashcards over the six sessions.

D. Experimental Design

A multiple baseline design [14, 15] across three multiplication fact sets was used. The study began with baseline for all three sets once a stable trend was observed in baseline.

The first author showed the participant the card, and the participant said the entire statement e.g., 3x9= 27. When the participant responded correctly and within two to three seconds, the first author put the card in the back of the pile. When the participant responded correctly but took longer than two seconds the first author placed the card back two to three cards from the front of the pile. However when the participant responded incorrectly, the first author informed the participant the correct answer and placed the card two to three cards back in the pile. The first author continued placing the card two to three cards back in the pile until the participant responded acceptably within two seconds, four times in a row. When the participant responded acceptably to every fact, the first author took out two cards from the deck.

1. Baseline: The participant was presented one card at a time; the first author used a prompt for the participant to begin. The participant was asked to state the answer for the fact presented on the card, errors were not corrected during baseline. If the participant answered a problem incorrectly, there was no response given by the first author. The first author then recorded the participant's response and then presented the next card.

2. DI flashcards: A Direct Instruction flashcard system was used to teach multiplication facts. The first author presented one card at a time (prompt?), when the participant verbally stated the correct answer to a multiplication fact; the first author placed the card at the back of the deck. When the participant stated an incorrect answer or did not respond, the first author said the entire equation and the answer and then placed the card three to four cards back in the deck. This placement in the deck was repeated until the card had been correctly identified for four times in a row, after which the card was placed at the back of the deck. Specific praise was provided during the intervention when the participant answered correctly.

E. Reliability of Measurement

Inter observer agreement was collected every session for Set 1 and 2 (100%). For Set 3, interobserver agreement was only taken during baseline on five occasions. Interobserver agreement was taken simultaneously using independent data sheets. For each equation the participant answered both the observer and inter-observer marked the equation on their separate data collection sheet wither with a "+" or "-". The observers were separated so that they could not see each other's data collection sheet. The interobserver agreement was calculated for correct responses by dividing the number of agreements by the number of agreements plus disagreements, which was then multiplied by 100 to get the percentage. Interobserver agreement for each of our three sets was 100%.

III. Results

A. Baseline

During baseline for Set 1, the participant scored zero out of seven multiplication problems in both sessions. In Set 2, the participant scored zero out of six problems in all three sessions. Baseline for Set 3, our participant scored zero out of six for all nine baseline sessions.

The DI flashcard system was implemented for all three sets. For Set 1., DI flashcards generated an increase in performance (M = 5.5 problems corrects; range 4 to 6 problems) The participant mastered all multiplication facts for Set 2. The overall mean was 4.83 with a range of 4 to 7.). DI flashcards produced an immediate increase in student performance. The mean for Set 3 was 5. Our participant mastered all multiplication facts in Set 3 for the last two sessions.

IV. Discussion

Using the DI flashcard system was very effective for improving the math skills for our participant. After beginning intervention, the participant showed progress in correctly answering the multiplication problems from the first session to the last. The results showed that the participant gained efficiency with the multiplication problems. By the end of the study, the participant had mastered all multiplication facts she had missed on her pretest

The present outcomes add to the growing list of research that has found that DI flashcards can be very effective in teaching math. We were able to replicate some of our most recent work in the parochial schools [13] as well as our past studies evaluating DI flashcards in the public schools [10, 11, 16-19] Cleary more research with older students appears needed. There has been only one example of employing DI flashcards at the middle and high school [20-21] in the peer reviewed literature.

V. Conclusion

Based on this case report, the DI flashcard system was an appropriate method for the participant. The participant enjoyed working with the first author and was eager to participate in each session the participant enjoyed the one-on-one attention that she received when the session took place out in the hallway. The participant's mathematics teacher reported the participant's grades improving. DI flashcard system was easy to implement; little materials

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Requests for reprints should be addressed to the authors, Department of Special Education, School of Education, Gonzaga University, Spokane, WA 99258-0025 or via email at neyman@gonzaga.edu or mclaughlin@gonzaga.edu

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AUTHOR'S PROFILES

Hadeel Altharwa

is an International Student who completed a Bachelor of Education in Special Education and ELL training last year. She was born in Saudi Arabia. Shis now a graduate student at the University of Washington in School Psychology. Her interests are in applied behavior analysis, school psychology, and education.

Jennifer Neyman

is a lecturer in the Department of Special Education at Gonzaga University in Spokane, WA. She earned a Bachelor as well as a Masters degree from Gonzaga University in special education. Her research interests involve direct instruction reading and math, classroom management, applied behavior analsysis, and academic interventions. Her research has appeared in several peer reviewed journals. She has taught preschool special education in the public schools.

T. F. McLaughlin

is a full professor in the Department of Special Education at Gonzaga University in Spokane, WA. He has a Bachelor of Education and Master of Science degree in Psychology from Eastern Washington University in Cheney, WA. He received his Ph. D. in Developmental and Child Psychology from the University of Kansas in 1975. He serves on numerous editorial boards and has published a large number of articles and book chapters in the professional literature. He typically publishes with his colleagues and with his undergraduate, as well as. graduate students. He has memberships in the Association for Behavior Analysis, The Council of Exceptional Children, New York Academy of Sciences, and the Association for Advancement of Science. He has been both a general and special education teacher in the public schools.

Gary Johnson

is now fully retired from both public and private education. He enjoys traveling with his wife. He took part in several classroom research projects as a public as well as private Catholic school teacher. His classrooms were model and excellent settings for educational research and training. He taught 30 years in the public schools and 7 years as a special education teacher at St. Aloysius Catholic Schools in Spokane, WA.

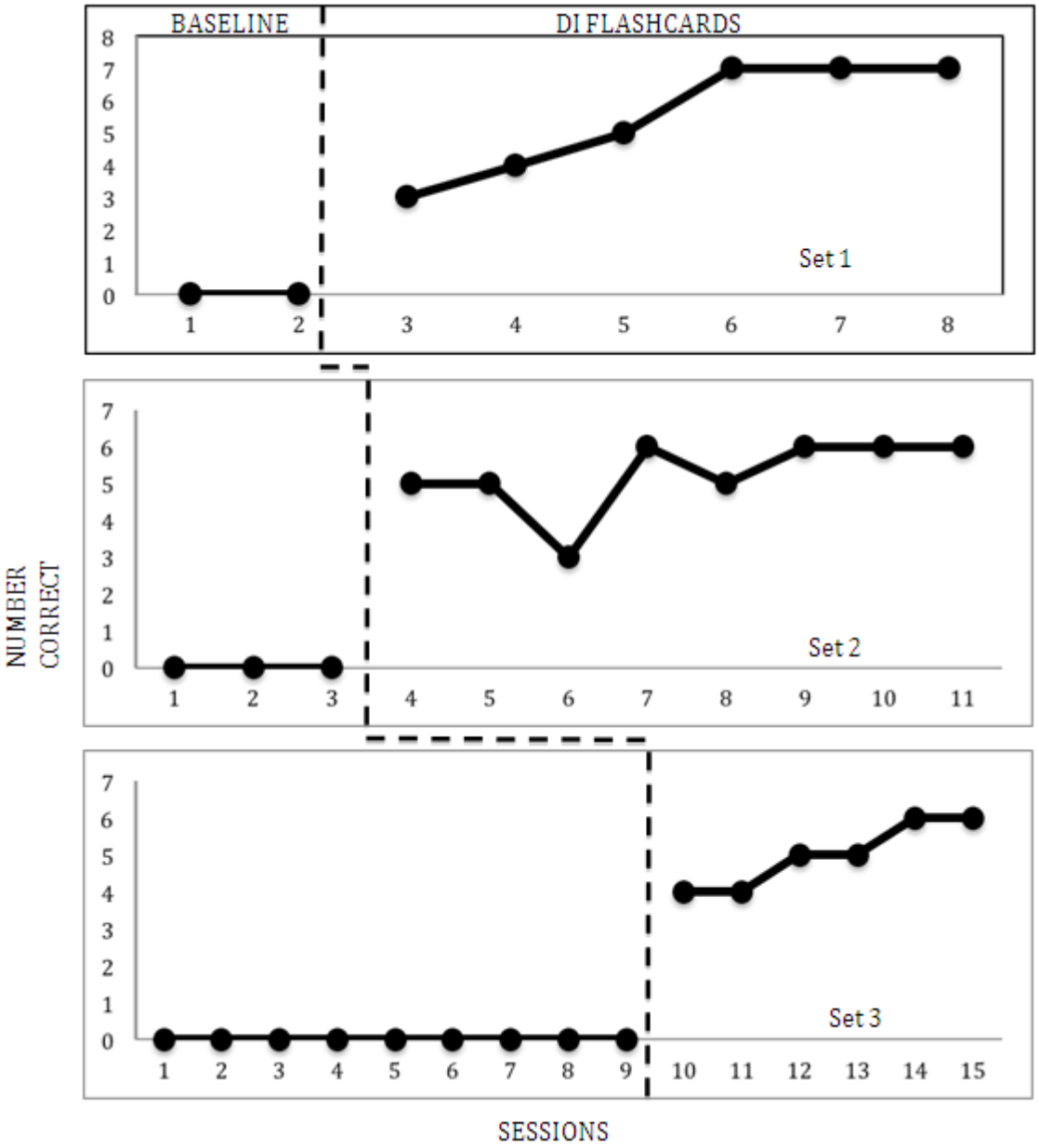

Fig.1. Number of corrects during baseline and DI flashcards.