EFFECT OF REFLEX® PROGRAM ON MATH FACT FLUENCY SCORES OF STUDENTS RECEIVING SPECIAL EDUCATION SERVICES

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Abstract

The purpose of this study was to analyze the effectiveness of the Reflex® math fact fluency program with students receiving special education services for specific learning disabilities in the area of math. The research addresses the research question “Is there a significant difference in math fact fluency scores of students receiving special education services before receiving daily Reflex® program practice and after receiving daily Reflex® program practice? The research was conducted using data collected from a pre-intervention assessment of basic addition and subtraction math facts and post-intervention assessment of basic addition and subtraction math facts. Findings were analyzed using Microsoft Excel and A Statistical Package (ASP) software. Findings indicate that daily Reflex® program practice to address fact fluency deficiencies in math skills does not show effectiveness for students receiving special education services in the area of mathematics. No significant improvement was demonstrated through pre- and post-assessment statistical analysis. Implementation of further study of effective instruction in math fact fluency is merited. It is recommended that the school district consider similar action research in general and special education classrooms in grades K-6. Results may further indicate effective instructional practices to increase math fact fluency scores of students.
ABSTRACT

TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND

STATEMENT OF THE PROBLEM

PURPOSE OF THE STUDY

DEFINITION OF TERMS

REVIEW OF LITERATURE

METHODOLOGY

PRESENTATION AND DISCUSSION OF FINDINGS

CONCLUSIONS

REFERENCES
Introduction

Background, Issues and Concerns

There have been concerns about student performance on math fact fluency tests and knowledge of math facts. Math fluency is a clear objective for every grade at the elementary level. It is important to ensure that students are mastering the objectives put forth by the Common Core State Standards, and therefore, need to master and identify math facts. Many districts have implemented the use of the Reflex® program for students at elementary levels. The Reflex® program combines research-proven methods with innovative technology to enable students of all ability levels to master math facts. The purpose of implementing this program is to increase students’ abilities to master basic math facts in order to master more advanced mathematical skills.

Many elementary students who receive special education services in math have not yet mastered their basic math facts, and may benefit from this program in order to increase math fact fluency. Students with math disabilities often have difficulty retrieving math facts automatically. Many students rely on manipulatives or counting on their fingers to solve basic math facts. Students that rely on these timely methods often make mistakes, which lead them to the incorrect answer. In addition, these timely methods use cognitive functioning that could otherwise be used to solve more complex problems in mathematics. It is important that students receive instruction in math fact fluency so that they may be able to retrieve math
facts automatically in order to use cognitive processes for more complex mathematical tasks.

*Practice under Investigation.* The practice under investigation is the implementation of the Reflex® program to increase basic math fact fluency scores of students who receive special education services in the area of math.

*School Policy to be Informed by Study.* The school district has spent a large amount of resources implementing a math fact fluency program in order to assist students in increasing their knowledge of basic math facts. The focus of this action research should assist in informing the school district as to the success of this ongoing educational practice.

*Conceptual Underpinning.* Every student learns differently. Students with math disabilities often display characteristics, which inhibit their ability to recall and retrieve basic math facts. Some of these characteristics include cognitive factors that could include perception, memory, attention, and reasoning. These students need to be able to learn basic math facts in a variety of ways so that they may be able to retain and retrieve the information presented. Depending on each individual student, certain strategies may need to be implemented to be able to master skills in the area of math fact fluency.

The Reflex® program increases student achievement in math fact fluency. The program provides an efficient and effective approach to fluency development by allowing students to master their math facts in all four operations through a series of short practice sessions. The program covers the complete process of fact mastery.
and continuously differentiates instruction and adapts practice to each student’s current ability and needs throughout the entire session.

**Statement of the Problem.** Many students receiving special education services for a specific learning disability in mathematics are deficient in their basic math fact fluency. If there is a difference in performance of students who receive special education services in the area of math on the math fact fluency test after completing the Reflex® program, teachers need to implement the Reflex® program or a similar program to increase student achievement in math fact fluency.

**Purpose of the Study.** The purpose of this study is to determine the effectiveness of the Reflex® program in increasing math fact fluency scores within a subgroup of students receiving special education services in the area of mathematics.

**Research Question.** Is there a significant difference in math fact fluency scores of students receiving special education services before receiving daily Reflex® program practice and after receiving daily Reflex® program practice?

**Null Hypothesis.** There is not a significant difference in math fact fluency scores of students receiving special education services before receiving daily Reflex® program practice and after receiving Reflex® program practice.

**Anticipated Benefits of the Study.** The results of this study will inform school district teachers and administrators with data to determine if implementation of the Reflex® program is successful with increasing math fact fluency of special education students who receive services in the area of mathematics. A further benefit of this study will be to increase math fact fluency among current students receiving special
education services in the area of mathematics. These improvements may lead to increases in math skills, and possible increases in district and state assessments.

**Definition of Terms.** Common Core State Standards: an educational initiative in the United States that details what K-12 students should know in English language arts and mathematics at the end of each grade. Reflex® program: an online, individualized math program that helps students of all ability levels develop fluency with their basic facts in addition, subtraction, multiplication, and division. Specific learning disability: a condition creating difficulties in acquiring knowledge and skills to the normal level expected of those of the same age and cognitive ability. Math fact fluency: the ability to recall the answers to basic math facts automatically and without hesitation.

**Summary.** Students who receive special education services in the area of math often have difficulty retrieving basic math facts automatically. School districts need to use research-based methods of teaching math facts in order for students to increase their math fact fluency. The Reflex® program combines research-proven methods with innovative technology to enable students of all ability levels to master math facts. This study will inform school districts with data as to if the implementation of the Reflex® program will help to increase math fact fluency scores among students who receive special education services in the area of math.
Review of Literature

Current research implications suggest the importance of incorporating effective interventions in order to increase the accuracy and automatic responding to basic mathematics facts for students with skill deficits in basic math skills (Mong & Mong, 2010). It is estimated that approximately 5-8% of school-aged students have skill deficits in math and that math skill deficits were also found to be the second highest factor in the identification of a learning disability (Mong & Mong, 2010). The Reflex® program is a math fact fluency development system that, 1) Covers the complete process of fact mastery, from initial acquisition of previously unknown facts through to automaticity, 2) Continuously differentiates instruction and adapts practice to each student’s current ability and needs, throughout the entire session, 3) Generates a fun, motivational environment for students, one that encourages frequent use and reinforces the connection between effort and success in mathematics, and 4) Provides educators with intuitive, insightful reports to monitor fluency gains and system usage (Explore Learning®, Reflex®, 2014).

Cognitive processing theorists argue that we have a limited cognitive capacity, which can make it difficult to attend to simultaneous multiple tasks, unless some of these tasks require little time, cognitive effort, working memory, and/or conscious attention (Poncy, Skinner, & Jaspers, 2007). This theory indicates that enhancing automaticity with basic math facts may free up cognitive resources such as attention and working memory that can be applied to more complex tasks in mathematics (Poncy, Skinner, & Jaspers, 2007). Learning disabilities can result from
deficits in the ability to process information in one or all of the mathematical domains, or in one or a set of individual competencies within each of the domains (Geary, 2004). Cognitive theorists argue about distinguishing poor achievement from these students due to inadequate instruction versus poor achievement due to an actual cognitive disability (Geary, 2004).

One consistent finding in cognitive theory research is that children with learning disabilities in mathematics differ only from their typically achieving peers in the ability to use retrieval-based processes to solve simple arithmetic and simple word problems (Geary, 2004). In addition this research suggests that memory retrieval deficits of children with learning disabilities in mathematics reflect a cognitive disability, and not a lack of exposure to arithmetic problems, poor motivation, low confidence or a low IQ (Geary, 2004). This research has revealed differences in the strategic and memory-based processes used by children with learning disabilities in mathematics and their typically achieving peers. It has also shown that children with learning disabilities in mathematics may not show the shift from procedure-based problem solving to memory-based problem solving that is typically found in typically achieving children, which suggests difficulties in storing mathematics facts and retrieving them from memory (Geary, 2004).

Poncy, Skinner and Jaspers (2007) found that increasing students’ accuracy and speed of accurate responding to basic math facts is essential for developing and mastering more advanced math skills. Students who are taught and reinforced for using time consuming multi-step strategies for solving basic math facts, such as finger counting, may rely on these strategies that can interfere and may even
prevent them from learning automatic basic math facts (Poncy, Skinner, & Jaspers, 2007). This research suggests that mental strategies for remembering facts should be replaced with immediate, direct retrieval and for automaticity with math facts to have any value, the answers must be recalled with no effort (Crawford, Otter Creek Institute, 2015).

The Reflex® System states that it provides an efficient and effective approach to fluency development, where students can master their math facts through a series of short practice sessions (Explore Learning®, Reflex®, 2014). Studies have shown that to build fact fluency, the most effective strategy is to give students 10-15 minutes per day of practice (Strother, 2010). The Reflex® System argues that effective learning of new facts requires systematic introduction of a limited number of these facts at a time, using appropriate strategies for each individual student and exercises that promote memory-based retrieval and inhibit the student from using time consuming strategies, such as finger counting (Explore Learning®, Reflex®, 2014). Studies in experimental psychology have supported this system of learning basic math facts. Crawford (2015) identifies experimental results on memory that suggest that facts learned in small sets lead to the process of developing automaticity with math facts that could proceed with less drill than is usually associated with learning all the facts at one time. These studies suggest that automaticity can be attained very quickly if there is not much to be learned. If children are asked to memorize a couple facts at a time, they could develop automaticity with those facts fairly quickly (Crawford, Otter Creek Institute, 2015).
Research Methods

*Research design.* A quasi-experimental research design was used to investigate the research question. Pre- and post-intervention data was collected to analyze any statistical differences after the intervention. The dependent variable used in this research study was math fact fluency rate, or the number of math facts answered accurately in one minute. Students computed a list of addition and subtraction math facts and the instructor indicated the number of problems answered accurately and inaccurately. Students were not provided feedback as to their performance on this measure, as the same measure was used for both pre- and post-assessment data. The independent variable used in this research study was the implementation of the Reflex® program. The independent variable was implemented consistently four days per week for a 15 minute time period.

*Study group description.* One study group was used. The study group was comprised of three third grade students receiving special education services for deficiencies in basic mathematical skills. The group consisted of two males and one female. Two of the students receive free and reduced lunch. All three students in the study group were Caucasian.

*Data collection and instruments.* Pre- and post-intervention data was collected prior to and after completion of the Reflex® program intervention. Students were asked to answer basic addition and subtraction math facts, applying known or learned math fact fluency skills. An identical list of 40 addition and subtraction facts was administered for both pre- and post-assessment data
collection. The implementation of the Reflex® program instruction was administered over the course of a one-quarter school time period (9 weeks). Pre-intervention data was collected in order to establish a baseline for comparison to collected post-intervention data.

*Statistical analysis methods.* Research data were analyzed using Microsoft Excel and A Statistical Program (ASP) software. Summary Mean and Standard Deviation (SD) values were computed for both data sets. Comparative analysis was conducted through the use of a matched t-test in order to identify differences, if any, between the two sets of data. A total of six computations were made. Due to the small study group size, Alpha level 0.25 was used to challenge the null hypothesis.
Findings

Students were given a pre-intervention addition assessment and a pre-intervention subtraction assessment. Both assessments contained 4 sets of 10 basic addition and basic subtraction problems. Students were timed for each set to determine math fact fluency. Students were then given a post-intervention addition assessment and a post-intervention subtraction assessment after the 9-week intervention period. Students were administered the same assessment from the pre-intervention addition and subtraction assessments.

Table 1
Summary of Descriptive Statistics for Pre-Intervention Addition and Subtraction Assessments

<table>
<thead>
<tr>
<th>Intervention Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Addition</td>
<td>3</td>
<td>31.67</td>
<td>3.82</td>
</tr>
<tr>
<td>1 - Subtraction</td>
<td>3</td>
<td>22.50</td>
<td>19.53</td>
</tr>
</tbody>
</table>

The mean score for the pre-intervention addition facts assessment for the intervention group was 31.67. The standard deviation of scores among group members was 3.82. The mean score for the pre-intervention subtraction facts assessment for the intervention group was 22.50. The standard deviation of scores among group members was 19.53. Such a large standard deviation can be explained due to a large discrepancy in scores obtained by participating students.

Table 2
Summary of Descriptive Statistics for Post-Intervention Addition and Subtraction Assessments

<table>
<thead>
<tr>
<th>Intervention Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Addition</td>
<td>3</td>
<td>40.83</td>
<td>18.76</td>
</tr>
<tr>
<td>1 - Subtraction</td>
<td>3</td>
<td>29.17</td>
<td>38.78</td>
</tr>
</tbody>
</table>
The mean score for the post-intervention addition facts assessment for the intervention group was 40.83. The standard deviation of scores among group members was 18.76. Such a large standard deviation can be explained due to a large discrepancy in scores obtained by participating students. The mean score for the post-intervention subtraction facts assessment for the intervention group was 29.17. The standard deviation of scores among group members was 38.78. Such a large standard deviation can be explained due to a large discrepancy in scores obtained by participating students.

Table 3

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>SD</th>
<th>Mean D</th>
<th>t-Test</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>31.67</td>
<td>3.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Test</td>
<td>40.83</td>
<td>18.76</td>
<td>-9.17</td>
<td>-0.95</td>
<td>2</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Note: Significant when $p = <0.25$

As shown in table three, no significant difference ($t$-Test = -0.95; $p$-value = 0.44, Mean $D = -9.17$) in mean scores was found between pre- and post- addition tests. The null hypothesis was not rejected. Students (Pre Mean = 31.67) did not record a significantly higher mean score on the addition facts assessment after implementation of the Reflex® program (Post-Mean = 40.83), when compared to the criterion $p$-value of 0.25.

Table 4

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean</th>
<th>SD</th>
<th>Mean D</th>
<th>t-Test</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>22.50</td>
<td>19.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-Test</td>
<td>29.17</td>
<td>38.78</td>
<td>-6.67</td>
<td>-1.32</td>
<td>2</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Note: Significant when $p = <0.25$
As shown in table four, no significant difference ($t$-Test = -1.32; $p$-value = 0.32, Mean $D = -6.67$) in mean scores was found between pre- and post-subtraction tests. The null hypothesis was not rejected. Students (Pre Mean = 22.50) did not record a significantly higher mean score on the subtraction facts assessment after implementation of the Reflex® program (Post-Mean = 29.17), when compared to the criterion $p$-value of 0.25.
Conclusions and Recommendations

Based upon the above findings, it is not supported that implementation of the Reflex® program to address deficiencies in basic math fact skills is effective for students receiving special education services in the area of math. There is no significant improvement in addition and subtraction math fact skills as demonstrated by pre- and post-assessment statistical analysis. The analysis of these student results do not suggest that the implementation of the Reflex® program should continue to be used by school districts.

It is noted that there is an increase in the mean scores of both addition and subtraction assessments following the implementation of the Reflex® program. The school district may want to consider the implementation of further study of the effectiveness of this particular program. It is recommended that similar action research be conducted in general education classrooms in grades 2-6. As this instructional method is being implemented in these grade levels district-wide, it would provide opportunities to collect data to the effectiveness of this instructional program.
References


