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Robert B. Zaharias

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Goal-Setting Theory in Relationship to Mastery of Basic Multiplication and Division Facts

By

Robert B. Zaharias

Action Research
Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Special Education At Cardinal Stritch University Milwaukee, Wisconsin 2012
This Action Research has been approved for Cardinal Stritch University by

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Date ______________________________
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Chapter 1
Introduction

Statement of the Problem

The problem the researcher faced was the inability of eighth grade students with special education needs to automatically recall basic math facts. Students lacked prerequisite skills or the knowledge of basic math facts and faced mounting challenges with future mathematical skill acquisition. Students were expected to demonstrate proficiency in the area of math on Wisconsin Knowledge and Concepts Exam and MAP assessments. Many problems on the math portion of the WKCE required a student to combine knowledge of basic math facts with problem solving ability.

Purpose of the Study

The purpose of the study was to determine the effectiveness of setting goals to improve student mastery of basic multiplication and division math facts. This project had been designed to support students’ learning of basic math facts by combining the use of goal setting and repeated timed activities in multiplication and division with the strategies for learning basic math facts taught to student(s) from the required school math curriculum.

Research Question

The research question asked if goal setting combined with repeated timed test activities in multiplication and division would increase students’ recall of basic multiplication and division facts. I established a timed math assessment that also used goal setting to determine if students’ recall of basic math facts could be impacted. Students were allowed to use a
multiplication chart if they felt it would increase their recall speed. The hypothesis was that with this focused approach to learning math facts, while including student input on goals, would increase recall of basic math facts.

Significance of the Study

This action research project was important in that it addressed the need for students to master the basic multiplication and division facts and introduced students to the effectiveness of setting goals to improve their achievement. It has been my observation that students that do not master basic facts can become discouraged and come to dislike math. Students who do master the basic facts tend to do better and have a more favorable opinion of math. The mastery of basic multiplication and division facts gives students the background for future achievement in the study of mathematics while goal setting skills can have many positive applications in life.

Definition of Terms

Goal: The object or aim of an action (Locke & Latham, 1990).

Measure of Academic Progress Assessment (MAP): adaptive computer-based achievement tests in reading, mathematics, language arts, and science. (Northwest Evaluation Association, 2011)

Wisconsin Knowledge and Concepts Exam (WKCE): a standardized test used to measure students’ achievements in math, science, social studies, reading, writing, and language through the use of multiple choice and short-answer questions.
Limitations and Assumptions

The research was conducted in an urban public K-8 school with approximately 600 students in a large Midwestern city. The student body was approximately 25% Asian, 2% Native American, 33% African American, 15% Hispanic, and 22% Caucasian. This school also had a 12% special education population, 22% of the students were English Language Learners, and 82% of the students received free or reduced lunch. The participants were two Caucasian female students with special education needs in the eighth grade. Both students had current Individual Education Plans (IEP’s). Both students tended to have regular attendance and were generally well behaved. Both seem eager to learn and want to do well in school.

Limitations of this study included student attendance, small group size, time and duration of the study, and the location where the study took place. I was able to work with these two students in a small group outside of the classroom where distractions would be minimal. I also had an opportunity to establish a good working relationship with the students and their parents. The duration of the study was a six-week period which may have been too short to generate reliable data.

Summary

With more emphasis being placed on student achievement on standardized tests, it is important that students have the basic skills to be successful. This study was designed to gather evidence to investigate the researcher’s hypothesis that including student input on goal setting while using repeated timed tests would increase student recall of basic math facts.
Chapter 2
Review of Literature

Educators have struggled for years with how to motivate their students in ways to achieve the greatest academic gains. How do we help students to retain basic multiplication and division facts? Teachers have used incentives, consequences, and variations of both to achieve their goals. Goal-setting may be one tool educators can use to increase motivation and on task performance. Goals establish a direction for an on-going activity, identify expected results and heighten performance levels by setting targets to be achieved (Rouillard, 1998). This action research study focused on goal-setting in mathematics. Goal-setting theory with specific challenging goals has been shown to increase participant performance (Locke & Latham, 1990).

Goal-setting Theory

Why set goals? Locke and Latham (1990) stated that: “Goals give people direction to their actions and create self incentives to persist in their efforts until their performance matches their goals.” (p.77) Goals have two directional effects that are relatively automatic. First, they orient the individual toward goal-relevant activities and materials and away from goal-irrelevant ones. Second, they activate stored knowledge and skills that the individual possesses that are relevant to the task. Having a goal means to use it as a standard for evaluating one’s performance. If one does not use a goal in this way, it is not really a goal or one is not really committed to it. In short goals are associated with higher self-efficacy. They motivate individuals to search for suitable task strategies, to plan and to use strategies that they have been taught (Locke & Latham, 1990). Skinner (1974) felt that goal setting was related to behaviorism. When people meet goals they have set, they are reinforced and motivated to
repeat the behavior again. Skinner (1974) stated: “When a bit of behavior has the kind of
consequence called reinforcing, it is more likely to occur again. A positive reinforcer
strengthens any behavior that produces it.” (p.46)

**Effects of Goal-setting**

A study by Schunk (1985) focused on the effects of goal setting on self-efficacy and skills
of learning disabled children. His study was aimed at determining if participation in goal setting
enhances self-efficacy and skills. Schunk cites Bandura (1977) who defines self-efficacy as
“personal judgment of one’s performance, capabilities in specific situations that may contain
ambiguous, unpredictable, and stressful features.” (p.307) Although self-efficacy was originally
used to help explain coping behaviors in fearful situations, Schunk (1985) felt it could be used in
other contexts including cognitive skill acquisition. He felt self-efficacy affects the level of skillful
performance.

With this in mind Schunk (1985) studied the effect of goal-setting on enhancing
achievement behaviors. His participants were 30 sixth-grade students, ages 12 to 14 years old.
All children had been previously identified as learning disabled in mathematics. The students
were placed into three treatment groups. The first treatment group was allowed to set their
own goals. The second treatment group was assigned goals. Finally, the third group was told to
do their best. All students were given pages of subtraction problems to solve for five daily
sessions.

Results of this study showed that participation in goal-setting enhanced self-efficacy and
skill development. Allowing children to establish goals yielded high initial expectations for goal
attainment. “Children’s initial sense of efficacy, for performing well was likely validated by
observation of their goal progress, as well as by their attainment or a close approximation.” (Schunk, 1985, p.314) He also stated, “Participation in goal setting may be more beneficial for children who possess cognitive deficiencies and hold low expectancies for success than for children who approach tasks with greater self-assuredness.” (p.314) This study supports the important relationship between self-efficacy and future achievement. However, due to the short term nature of this study, the results need further validation.

A study by Fuchs, Bahr, and Rieth (1989) proposed that participation in goal setting will increase the math performance of students with learning disabilities. According to Fuchs et al. (1989) high achieving students perform better with assigned goals, but low achieving students, like students with learning disabilities who are less confident about their abilities, do better when they participate during goal setting. The authors believed that participation in goal setting would enhance a student’s performance by affecting the student’s commitment to accomplishing a task with a specific goal.

The sample in this study was 20 students with mild handicaps enrolled in an urban southeastern high school. All 20 students had an Individualized Education Plan (IEP), with goals in the area of mathematics and they received their math instruction in self-contained special education classes. These students were assigned randomly to four treatment groups. The four groups were: assigned goal/noncontingent reward, self-selected goal/noncontingent reward, assigned goal/contingent reward, and self-selected goal/contingent reward (Fuchs et al., 1989). Results indicated that the students with self-selected goals improved their math computation performance over time more than students with assigned goals (Fuchs et al., 1989). Findings in this study also indicate that the effects of self-selected goals level off over the course of a
longer treatment (Fuchs et al., 1989). They suggest that further research is warranted investigating whether the effects of self-selected goals can be maintained over time, with appropriate intervention.

A study by McDougall and Brady (1998) investigated the effects of behavioral self-management (BSM) interventions on math fluency and engaged time of five fourth grade students with and without disabilities in general education classes. The results of this study confirmed prior studies that self-management increased academic productivity and engagement during independent practice. However, a unique finding occurred through this study. “Participant productivity and engagement continued to increase when components of full self-management treatment packages were faded.” (p.159) “Strong support for the educational significance and social validity of self-management intervention effects is provided by comparing participants’ math fluency to normative data collected at the end of the study on six randomly selected classmates.” (p.159) In addition they reported “that math fluency gains facilitated participants’ mastery of more difficult math tasks and made instruction easier to implement.” (p.159)

Five fourth graders (age range 9 years 7 months to 10 years 5 months) enrolled in a public elementary school in suburban Houston participated in this study. Three students had no identified disabilities and attended general education classes. The other two students attended general education classes, but did receive special education math services in a resource room. Participants’ materials included worksheets with interspersed addition, subtraction, multiplication and division problems. Students were taught to self-monitor accuracy and on-task behavior.
A weakness of this study was that it demonstrated only limited support for
generalization when participants calculated answers for word problems. Also, while math
fluency did improve, it did not reach the normative range for fourth graders for one of the
students receiving special education services. Researchers might investigate BSM components
that could be modified or combined with other technologies to meet the needs of students
whose performance is resistant to change.

Increasing Fluency

Results from a study by Axtell, McCallum, and Mee Bell (2009) show that the Detect,
Practice, Repair (DPR) procedure was effective in increasing the automaticity of division facts in
middle school students when their mean scores were compared to those of a control group. It
can be used as a class-wide intervention and can be tailored for individualized instruction as
part of an intensive special education program.

The weaknesses of this study are that the results of this study were obtained from only
one area of the country (southeast) and from students enrolled in middle to low socioeconomic
status middle schools. So, the results may not generalize to other regions, settings, or grades.

DPR, developed by Poncy, Skinner, and O’Mara (2006) is a multicomponent, class–wide
test-teach-test procedure that integrates brief response time, many opportunities to respond,
immediate feedback, and a self-management component in the form of self-graphing.

A timing procedure is introduced for each problem using a metronome set to 40 beats a
minute giving only 1.5 seconds to respond to each problem. First introduced by Poncy et al.
(2006), it allows for the identification of target problems in which the student is not fluent. The
problems(s) the child cannot complete in the allotted time indicates which skills require
additional training to reach automaticity. The strategy provides feedback to the students, indicating specific skills to remediate.

This study involved 36 middle school students with an age range of 12-15 years. They were enrolled in a four-week summer school program for at risk students. Division was chosen as the target skill for math intervention because participants were middle school age and had some proficiency with all math operations. The staff believed that targeting division would allow for the most growth and that targeting the same skill would allow for ease of implementation for greater treatment fidelity.

The students were randomly assigned to one of two groups. Half of the students were assigned to reading intervention and the other half to math intervention. A folder was maintained for each student in the math intervention. Within each folder were two intervention packets and a student progress chart. The packets contained a sheet of 48 problems. It also contained a grid which allowed the students to track their progress. The DPR procedure was completed every day and supplemented the regular math instruction.

Waite-Stupiansky and Stupiansky (1998) assert that mastering math basic facts can pave the way for higher-level learning. They contend that children are able to reason more quickly and flexibly when armed with the basic facts. According to them, “If children do not have basic addition, subtraction, multiplication, and division facts memorized as they progress to algebra and other higher-level math concepts, stopping to multiply by counting or adding slows them down.”(p.82)

To determine when students are ready to memorize facts, teachers must closely monitor their understanding of the meaning behind addition and subtraction equations. Most
children under the age of seven are still developing this understanding. Some second grade children are still developing the concept of equality, and the notion that addition and subtraction equations are logical inverses of the other (Wait-Stupiansky & Stupiansky, 1998). They note that Piaget called these “operations.” “Before children are operational in their thinking, it is important not to rush them into memorizing series of facts, which might force them to rely on rote memory instead of their emerging logical skills.”(p.82)

Waite-Stupiansky & Stupiansky state that, “In third and fourth grade, as children progress into multiplication and division, they continue to build on what they already know. At first they may calculate the answers to multiplication problems, such as 3X6, by using repeated addition. As they develop an understanding and recognize that two multipliers can be reversed leaving the answer the same, they gain the power to calculate the answer in a more efficient way.”(p.83) Wait-Stupiansky & Stupiansky state that while the acquisition of basic facts is important, it should not be the ultimate goal of instruction. They caution teachers to make sure that children are not memorizing meaningless strings of numbers. “When children understand the meaning behind all those symbols, they won’t forget the facts.”(p.83)

Summary

This study attempts to replicate the successes of previous research studies investigating the effects of goal-setting on the mathematical performance of students. Previous research suggests participation in goal-setting can be especially beneficial to students with learning disabilities. Goal-setting may be one tool educators can use to increase motivation and on task performance. Goals establish a direction for an on-going activity, identify expected results and heighten performance levels by setting targets to be achieved (Rouillard, 1998). Goal-setting
with specific challenging goals has been shown to increase participant performance (Locke & Latham, 1990).
Chapter 3
Methodology

Design

The researcher used a one-group, pretest-posttest design to study the effects of goal setting combined with repeated timed test activities in multiplication and division facts on eighth grade students with special education needs in mathematics. The independent variable was the setting of goals with students on their math assessments. The dependent variable measured was the number of correct answers on the math assessments given to the students. This study took place over a six week time period and math instruction was given regularly at the same time every day.

Sample

The study included two eighth grade students from a K-8 public school in Milwaukee, Wisconsin. They were selected from the researcher’s resource class and both were Caucasian and female. They were 15 years old and received special education services in math. One student had a specific learning disability; the other had a cognitive disability. The researcher received signed parental permission for both students.

Procedures

This research project was designed to answer the question: Can incorporating goal setting in a math class impact students’ recall of multiplication and division facts? The researcher established a timed math assessment that incorporated the use of goal setting.

Prior to the beginning of the project, the researcher assembled two binders with fifteen multiplication assessments and fifteen division assessments in each binder. Each multiplication
and division assessment was identical. The multiplication assessment contained 100 math facts between 1*1 and 9*9 (See Appendix A). The division assessment contained 100 math facts between 81/9 and 0/0 (See Appendix B).

At the beginning of the study, the researcher gave a pre-test which asked the students to complete as many multiplication problems as possible in three minutes. After each student completed the assessment, the researcher corrected it to establish a baseline. The researcher recorded both students’ scores in an excel spreadsheet. For the final three weeks of the study division facts were assessed following the same procedures as used in the first three weeks of the study.

The researcher discussed the importance and usefulness of goal setting. The researcher modeled goal setting, how to select appropriate goals and the difference between an easy, achievable and difficult goal. A starting point for each assessment was to improve from the previously given assessment. First, students were asked to look at test taking strategies. Were there ways they could maneuver through the assessment faster? For example, if a student was wasting time erasing an incorrect answer, she could move on to the next problem without erasing. Second, students were asked to go over the previous assessment and see if they noticed any patterns of mistakes they could correct. For example, if a student was making numerous mistakes dividing by zero she would be asked to practice dividing by zero or to be more careful when she encountered zero. Thirdly, students were asked to think about their attitudes while taking the previous assessment. For example, if a teacher or student from a previous class had upset them, they could make a conscious effort to overlook their distraction and concentrate on the assessment. Keeping these numerous suggestions in mind the
researcher and student conferred the day of the assessment and determined an appropriate goal. For assessments #2 through #10 the researcher selected the goal. For assessments #11 through #15 each student selected her own goal. The goal was meant to be challenging yet attainable. Generally, a goal was selected that was one score higher than the previous assessment score. However, based on students’ attitudes, ability level and effort a more ambitious goal was sometimes selected. For example, if a student achieved 87 correct responses on the previous assessment then an appropriate goal would be between 88 and 97 correct answers on the next assessment. As a general rule to guide goal setting for this project, a goal of one to ten more correct answers than the previous assessment was used.

Data Collection and Analysis

Data were collected daily throughout this study. At the beginning of the project each student was given a binder with her name on it and the thirty basic facts assessments. The binder allowed both students to look at their own progress with access to previous assessments. Both students’ binders were collected daily and the new scores were entered into an excel spreadsheet that was used to record and average scores. As the researcher recorded data into the spreadsheet the graphing feature and tables allowed the researcher to share with both students their growth from the first assessment to the current assessment. Both students were able to see how they were progressing. Also the scores were communicated to both students verbally in one-on-one conferences. In addition the researcher used a journal of observations to record students’ attitudes, effort and other factors that might have had an effect on their performance. For example, if a student had just finished gym class and was tired, this could affect the effort put into taking the assessment.
Chapter 4

Results

Analysis of Data

The researcher compiled the following results after two eighth grade students completed a six-week study to determine whether the use of goal setting in math class could impact their recall of multiplication and division facts. The data analyzed in this study was obtained from the students’ baseline assessments and 14 subsequent assessments in each of the two areas, multiplication and division. The researcher also collected observations of students during class discussions prior to assessments, observations while students took their assessments, and observations after students took assessments. This study was divided into two sections. During the first three weeks of the study the students were assessed on knowledge of multiplication facts. During the second three weeks they were assessed on knowledge of division facts.

To maintain confidentiality, the pseudonyms Linda and Nadia were used to identify the students.

The first set of data analyzed was the pre-test and 14 subsequent multiplication assessments given to the students. Both students were making consistent growth on a daily basis. In fact, both students made substantial progress from their initial assessment to their fifteenth assessment, yet both students had days when their scores declined slightly but subsequently increased. The data collected during this study showed steady consistent growth in the acquisition of the recall of basic multiplication facts. Linda achieved increased fluency in basic multiplication facts.
For example, Linda’s initial score was 87 and her personal best score was 151. This is an increase of 74%. She attained an average score of between 120 and 121. Linda averaged an increase of 4.3 correct responses per day.

Figure 4.1 Linda’s Multiplication Assessment Scores (#1 to #15)

Figure 4.2 Nadia’s Multiplication Assessment Scores (#1 to #15)
Nadia also achieved increased fluency in basic multiplication facts. For example, Nadia’s initial score was 86 and her personal best score was 123. This was an increase of 43%. She attained an average score between 103 and 104. Nadia averaged an increase of 2.5 correct responses per day.

The second set of data analyzed was the pre-test and fourteen subsequent division assessments. Results showed steady, consistent growth in the recall of basic division facts. Linda achieved increased fluency in basic division facts. Her initial score was 89 and her personal best score was 167, for an increase of 88%. She attained an average score between 122 and 123. Linda averaged an increase of 5.2 correct responses per day.

![Linda’s Division Assessment Scores (#1 to #15)](image)

*Figure 4.3 Linda’s Division Assessment Scores (#1 to #15)*

Nadia also achieved increased fluency in basic division facts. Nadia’s initial score was 103 and her personal best score was 137, for an increase of 33%. She attained an average score between 113 and 114. Nadia averaged an increase of 2.3 correct responses per day.
Beyond improving student recall of basic math facts, this project focused on the use of goal setting as the means to improving math performance. My observations showed that goal setting did appear to positively influence both students. Linda showed more enthusiasm for the use of goal setting than Nadia. For example, Linda’s initial multiplication assessment score was 87. She stated that she wanted to score over 100 on her next assessment. Linda used this motivation to easily surpass her goal on her next assessment (she scored 116). Linda also made larger gains from her initial assessments to her final assessments. While Nadia did say that she wanted to meet her goals she was not as enthusiastic. Other motivating factors were observed. For example, when Linda found out that Nadia scored higher on her initial division assessment (Nadia scored 103 and Linda scored 89), Linda stated that she wanted to score at least 103 on her next assessment. This made it necessary to for me to remind Linda that her goal was to improve on her own assessment score and not compete with a classmate.

This research concentrated on incorporating goal setting in math class to impact students’ recall of multiplication and division facts. As predicted, goal setting did have a positive
effect on students’ recall of multiplication and division facts. Linda increased 74% in correct responses on multiplication facts and 88% in correct responses on division facts. Nadia made a 43% increase in correct responses on multiplication facts and a 33% increase in correct responses on division facts.
Chapter 5

Summary and Conclusions

The purpose of this study was to determine the effectiveness of setting goals in improving student mastery of basic multiplication and division math facts. The results of this study indicated that setting goals could be used effectively with eighth grade students. These findings supported the research of Locke and Latham (1990) that goal setting with specific challenging goals increased participant performance. As part of this study, the researcher first gathered baseline data that was used as a reference from which to evaluate future progress. Both participants in this study made substantial gains in fluency, which past research suggests will facilitate their future mastery of more difficult math tasks and will make instruction easier to implement.

The pre and post-test data support the use of goal setting combined with repeated timed test activities to increase fluency in math facts for students with special education needs in mathematics. Linda made fluency gains of 74% in multiplication facts and 88% in division facts. Nadia made fluency gains of 43% in multiplication facts and 33% in division facts.

There are several possible explanations for the results of this study. It was completed in a resource room where only the researcher and the two students were present. This made it possible to minimize distractions and give the students as much attention as possible. It also made it easier for the researcher to observe when students needed encouragement. Linda made larger percentage gains compared to Nadia. Linda appeared to be more motivated than Nadia throughout the project. She seemed genuinely excited to have goals to aim for. She would voice her desire to reach her goal and her sense of accomplishment when she reached it.
While Nadia also appeared to be motivated by goal setting she did not seem to be as disappointed if she did not reach her goal.

This assessment was given to both students between 1:30 p.m. and 2:00 p.m. every school day. Observations indicated events of the school day also played a part in student motivation. If the students had taken a test in another class, this could have affected the effort they would put forth in taking this assessment. These observations suggest that important tests such as state wide assessments should be given at the beginning of the school day so students are not distracted or fatigued from other school activities.

If this study were repeated, the researcher would have the students set goals outside of math. It became apparent that goal setting was a motivating factor in the fluency gains made. Goal setting could be used to motivate students in other subject areas just as well. Also the duration of the project could be increased from 30 assessments to see if gains could be made over a longer period of time.

This study has practical implications for all educators but especially in Milwaukee Public Schools. M.P.S. has adopted a new initiative in which teachers begin each class period with a clearly stated explanation of what will be taught and how students will know they successfully learned the material. Students will now have clear expectations (goals) and benchmarks with which to judge success. It is anticipated that the use of specific and achievable goals with feedback will lead to higher performance.

While this study was conducted with a small number of students, the use of goal setting with repeated timed tests should be considered as a useful tool to increase math fact fluency in
any math classroom. As previously stated, goal setting could be used to motivate students in other subject areas as well.
References


## Appendix A

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