Effects of Mathematical Intensive Intervention in a Tier 3 RTI Environment in a Rural East Texas Elementary School.

by

Shannon M. Ryan, B.S.

A Proposal Presented in Partial Fulfillment

of the Requirements for the Degree

Master of Education

SCHOOL OF EDUCATION
EAST TEXAS BAPTIST UNIVERSITY

May 2012

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CHAPTER 1

INTRODUCTION

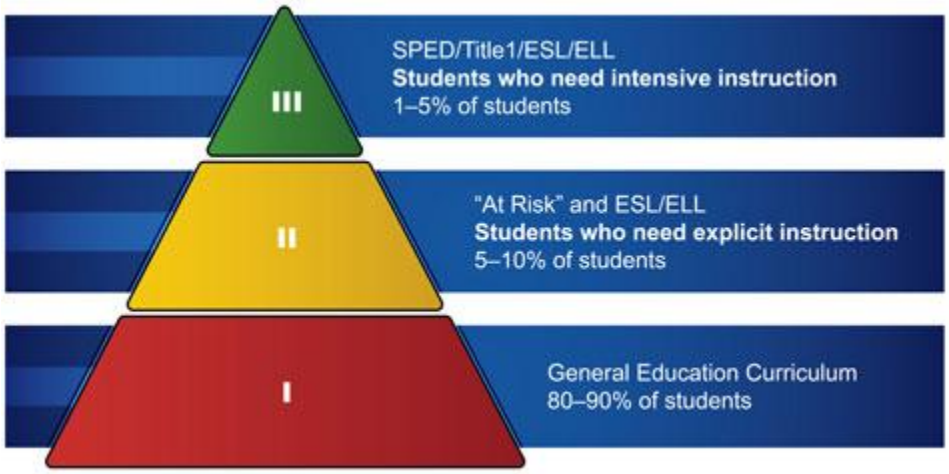
The students in Mrs. Smith's 4th grade classroom engage in mathematics at least 45 minutes every day. On most days the lesson begins with a sponge activity in which students engage in a math problem to get them warmed up for the upcoming lesson. After the allotted time for mathematics is over students rotate to reading class and spend their day moving from class to class. Mrs. Smith's class is no different from the other five teachers in 4th grade or the six teachers in 3rd grade at school X. In fact, one thing they have in common is that approximately 20% of their students are having trouble with mathematics and reading (Burns, Appleton, & Stehouwer, 2005). This is a trend seen throughout many elementary schools, not just at school X. These abilities range in severity from those needing Tier 2 Response to Intervention (RTI) help, to those who require special education pull-outs (Tier 4). The overwhelming question is can anything be done for these students? School X responded by hiring educational consultants to come into the schools and pull all of the struggling students out for 45 minute intense subject area sessions in the hopes of improving student understanding and ultimately raising classroom grades and test scores. According to W. Stephen Wilson (2011) the possible benefit from this intervention could extend itself as far off as college for these elementary students.

Response To Intervention as a Theoretical Model

Response to Intervention (RTI) was designed to change the way in which students were identified for special education. RTI processes can vary by school; schools may have three tiers

in their RTI structure, or they may have four tiers. Some schools do not include special education students in their RTI model while some schools do. Tier 1 is comprised of all students receiving classroom instruction with the class, Tier 2 involves small group work added as an intervention measure. Students who do well with Tier 2 stay here and may even move back to Tier 1 over time. Some students stay with Tier 2 as the extra intervention is necessary to stay on the same level with their peers. Students who do not do well in Tier 2 are then moved into Tier 3. Tier 3 provides more intensive intervention and is done outside of the regular classroom (See Figure 1). "Tier 3 is reserved for those students who are struggling to the extent that they require intensive intervention, which might include additional instructional time, small instructional grouping, adapted instructional content, and different materials" (Bryant, Gersten, Scammacca, & Chavez, 2008). In some schools Tier 3 is where special education students are classified, and in some schools a 4th tier is added to describe those students who are identified as special education. For the purpose of this study those students who receive intervention as part of the experiment will be classified as receiving Tier 3 intervention, intervention that is intensive and occurs outside of the classroom.

Figure 1.



(Reading Response to Intervention 2012).

Research Question

For this regression-discontinuity design (RD) I will research the question: does intensive intervention in a Tier 3 RTI setting improve 3rd and 4th grade student response time and accuracy percentage in the fundamental mathematic skills of multiplication and division? A part of the study data will also be analyzed to determine if there is a significant difference in outcomes of the intervention based upon the student's grade level. For most students Tier 3 intervention is not a category of RTI that struggling students fall into, but for this study, Tier 3 will be utilized for all students that are not involved in a control group. Research on mathematical intervention is sparse in comparison to reading intervention therefore much is still not understood about the effects of RTI and additional intensive instruction where the field of mathematics is concerned. Current research does suggest the existence of two main factors in helping struggling elementary students in mathematics: (1) extended time working with curriculum, and (2) having instruction that involves re-teaching mathematical fundamentals (Ketterlin-Geller, Chard, & Fien, 2008).

For this study I will be focusing on some of the areas defined as mathematical fundamentals by Ketterlin-Geller et al. (2008) multiplication and division. The importance of understanding these fundamentals is outlined in several studies. According to Wilson, (2011) educators in other countries do not doubt the need for mathematical fundamentals, but that there is a growing disconnect between states' requirements and what college level instructors already know; students who do not master their mathematical fundamentals will continue to struggle throughout school and many do not succeed in college mathematics. RTI gives intervention to students who need it the most. In addition the need for intensive instruction as described by RTI will enable identification of special education students as well as prevent the over identification of special education students. This study will involve students who are not identified as special education, and those students who are identified as special education.

Intensive Intervention

There are a myriad of ways to describe intensive intervention. Bryant et al. (2008) list attributes of intensive intervention such as the use of different materials than those used in the Tier 1 classroom, additional instructional time, small group instruction, and even adapted content; Ketterlin-Gellar et al. (2008) list instructional strategies that are beneficial to intensive instruction such as student think-alouds, peer-assisted learning, visual and graphic depictions, hands on learning, and formative assessment. For the purpose of this study, intensive instruction will consist of small group peer-assisted interaction using hands on manipulatives, think aloud modeling, and curriculum that differs from that in the regular classroom. Students will intensely focus on mathematical fundamentals so that facts can be recalled with fluency and accuracy showing sufficient grade level mastery. The program Envision Math will be utilized to provide a research based intensive instruction that differs from what is offered in the Tier 1 classroom.

This program is research based and is in alignment with the requirements of the No Child Left Behind Act (NCLB 2008).

Hypothesis

This RD study involves both extension of time in mathematics and re-teaching mathematical fundamentals. I hypothesize that an additional 45 minutes of math instruction will benefit 3rd and 4th grade students in achieving a higher rate of accuracy and improved shorter response time for multiplication and division problems in a rural East Texas elementary school. In a similar study done by Bryant et al. (2008), 1st grade students did not benefit from intervention whereas 2nd grade students did. While my students are not 1st or 2nd grade, I will be noting the effects the intervention has on the individual grade levels as well as analyzing data to examine if the extra practice and intervention in mathematics will produce positive results in both traditional students and those identified as special education. If the data shows that there is no effect on mathematical improvements for the students, then the null hypothesis, an additional 45 minutes of mathematic instruction will have no effect on the rate of accuracy and skill in multiplication or division for 3rd and 4th grade students in a rural East Texas elementary school will be proven.

Chapter 2

Literature Review

Introduction

This research study will attempt to answer if intensive intervention will have a significant impact on mathematical accuracy and response time concerning multiplication and division for third and fourth grade students. The literature review will cover findings from several studies concerning intensive intervention as well as define key terms and issues surrounding intervention, technology, and mathematical difficulties.

Mathematical Disabilities

The No Child Left Behind Act of 2001 (NCLB) provides government legislation for state run education. NCLB cites reading, language arts, mathematics and science as the core subjects of concern by the federal government (Chapman 2007). Part of this legislation requires that schools show adequate yearly progress in these core subjects putting pressure on schools and teachers for student achievement (Smith & Kovacs 2011). In addition to requiring schools to show adequately yearly progress, the NCLB Act requires students to reach proficiency in mathematics by 2014. In 2005 70% of 8^{th} grade students scored below proficient in mathematics (Ketterlin-Geller, Chard, & Fien 2008). The prevention of mathematical difficulties through intervention has been a process that many teachers have engaged in beginning in the primary school years. This need was precipitated by the fact that 20% of students in elementary school

require supports to succeed academically (Burns, Codding, Boice, & Lukito 2010). Approximately six percent of children attending school are identified as having learning disabilities (LD). (Fuchs, Fuchs, & Hollenbach 2007). While identification of LD for reading has been heavily researched, identification for mathematics LD is in its beginning stages (Gersten, Jordan, & Flojo 2005). There are a myriad of learning disabilities with mathematical disabilities (MD) being one. Mathematics disabilities are hard to label as there is no one size fits all disability for the field of mathematics. The ability to identify children who have a LD is considered problematic in the lower elementary grades (Hanley 2005). According to Gersten et al. (2005) students with mathematical difficulties aren't necessarily students that are failing academically they could be students who are in the low average range as well. Additionally, students may perform at an average level in some areas of mathematics, while performing low average or below average in others. Research shows "persistent deficits in the retrieval of arithmetic combinations among elementary-age students are associated with MD" (Bryant et al. 2008). There is a clear connection with MD and the deficit seen between students and the expectations of NCLB. Since the inception of NCLB in 2001, Congress has updated and reinstated the act as of 2008.

Response To Intervention

To assess the learning difficulties particular students are facing, many educational institutions have been using the response to intervention (RTI) model. This model evaluates the student's level of response and the intervention required to get the specific level of response (Duhon, Mesmer, Atkins, Greguson, & Olinger 2009). An important aspect of RTI is that as the intervention (also termed prevention) is increased, the population receiving that intervention decreases (Mellard, McKnight, & Jordan 2010). Primary prevention occurs in the general

classroom, secondary prevention involves small group tutoring in the general classroom, and tertiary intervention occurs outside of the general classroom and involves (Fuchs et al. 2007). The proposed study at hand will evaluate intervention in a tertiary intervention setting while keeping students in small collaborative groupings. According to Duhon et al. 2009 in order to maximize student response to intervention the frequency of interventions must be increased.

Intensive Intervention

Increased intensity of intervention can take different forms such as increased time in the subject area, peer-assisted tutors, thinking out-loud strategies, and visual scaffolds to name a few (Bryant et al. 2008). Allsopp, McHatton, and Farmer (2010) discuss the need for focus on explicit mathematics instruction that includes arithmetic fluency, visuals, addressing mathematical foundational concepts, and effective use of technology within the curriculum. "Fluency is conceptualized as responding both accurately and quickly to a selected stimulus. As a student learns a new skill, he/she will become increasingly fluent in that skill until it becomes automatic. Automaticity refers to the phenomenon that a skill can be performed with minimal awareness of its use." (Axtell, McCallum, Bell, & Poncy 2009). With this type of fluency and automaticity students can apply those skills to new learning and also for problem solving. In order to evaluate fluency, speed and accuracy can be used to represent skill completion (Burns et al. 2010). The core of the intervention curriculum within the scope of this study will be mathematical foundational concepts. Those concepts are generalized as addition, subtraction, multiplication, division, fractions, decimals, and multistep problems (Wilson 2011). The importance of these core skills should not be diminished in light of the amount of technology students have access to, and while intervention is important, it is necessary to reiterate the importance of ensuring the interventions are correctly delivered to the students (Gilbertson, Witt,

Singletary & VanDerHeyden 2007). For this reason a research based program called enVision Math will be utilized in the intervention sessions. In a study done on enVision MATH, students showed a significant growth in mathematical skills their first year and an accelerated growth in math skills their second year. These skills include problem solving, vocabulary, computation, and concepts (Resendez, Azin, Stroebel 2009). This program's curriculum involves not only research based curriculum for students, but training for the teacher in how to successfully utilize the program for maximum benefit also.

Technology and Gaming

In addition to enVision MATH, technology will be utilized during intensive intervention sessions. It is important to note that several forms of technology will be on hand and understanding that technology takes many forms is very useful for understanding the guiding principles of the study. There are two types of technologies available for educator use in the classroom. They can simply be classified as low-tech or high-tech. Low-tech technologies consist of concrete manipulatives and materials that can be used to represent mathematical situations while high-tech applications generally involve software and the use of electronics (Allsopp et al. 2010). Both types of technology will be used; low-tech technology will consist of pattern blocks, counting chips, and fraction squares, high-tech technology will consist of the use of Arcademic Skill Builders (2012). The importance of the low-tech technology is the availability of concrete objects that represent abstract number relationships. Concrete manipulatives are the first scaffolding measures needed when teaching a new mathematical concept, and are invaluable during intervention (Burns et al. 2010).

A special emphasis will be placed on the use of computer games in the study as part of the high-tech technology. Research in this arena is varied and results have differed due to the type of computer game used, the age of the student, or the language preference of the student. One such research study found that male students with English as their minority language had significant improvements in math skills whereas their English speaking male counterpart showed no significant improvement (Kim & Chang 2010). A study done by Lindstrom, Gulz, Haaket, and Sjoden (2010) found that it is difficult to pinpoint if the utilization of the games by the students is related to the intended pedagogical design principles of the games. In short, are the students learning what the designers and teachers have intended? Despite the dismal results relayed in the previous studies mentioned, many more studies involving video games in the curriculum have been received with positive results. One such study focused on a particular web-based mathematics tutoring system and the results were that 70% of students involved in this type of intervention had significant improvement between pretest and posttest scoring (Maloy, Edwards, & Anderson 2010). According to Maloy et al. (2010) the computer gaming could be successfully used in concert with individual and group activities in the classroom. ASB (2012) engaged school districts in pilot studies of their software and the results were significant improvements in skill and confidence.

Collaborative Grouping

While technology can be an excellent tool to utilize in the classroom and during intervention, it is not the only method that should be used. Allsopp, McHatton, and Farmer (2010) discuss that effective use of technology has potential in helping towards students'

improvement, but also state that several other factors should be considered. One such factor is collaborative grouping. During their study, these researchers found positive outcomes with groupings in which students utilized student prompts, thinking out loud, and student feedback. Small group utilization plays a significant role in intervention. In part, smaller groupings of students are effective because a teacher's attention is now focused on fewer students (Mellard et al. 2010). This type of instruction gives students multiple opportunities for immediate and corrective feedback from the teacher as well as the student's peers (Bryant et al. 2008). According to Burns et al. (2010) a student who is fluently slow and inaccurate in mathematics would benefit from such corrective feedback.

Conclusion

The results of current research show in order for intensive intervention in mathematics to be effective, several methods of instructional delivery are required. Peer collaboration, small groupings, technology, and research approved curriculum are at the forefront of need, but proper delivery by teachers is necessary as well. With the use of RTI instructional techniques, students who struggle can benefit from frequency and intensity of instruction thus improving their fluency and accuracy of foundational mathematical concepts. As these skills improve, the problem solving capabilities of students improves, and then students can use their foundational mathematical skills to progress to more sophisticated mathematical equations.

Chapter 3

Methodology

Research Design

This study will be done using a regression-discontinuity design (RD). This design is appropriate because my study participants are not being randomly drafted into the control or study groups; instead participants in this research will be assigned based upon pre study testing measures. Scores from pre study testing will be analyzed and assigned a mean value. This value will dictate which group the participant falls under. Students who score a mean pretesting value of 75 or below will participate in the intensive intervention sessions whereas students who have a pretesting mean value of 76 and above will be placed into the control group. The basic testing for RD design, pretest and posttest for both groups, will be included along with interval testing done each week to monitor progress. An effective intensive instruction would be proven by showing a significant increase in scores above the pretesting value of 75.

Sample

Subjects for the initial study will be enrolled as a 3rd or 4th grade student at School X. Participants for the study will be selected based upon bench mark test scores, progress report scores, report card scores, and if available the previous year's standardized testing scores. All students who have a mean average of 75 or below from their scores will be invited to participate in the study. Students who are invited to participate will be sent home with the required notification and permission slip with a detailed explanation of the study to be conducted. The

control group will consist of students who have a mean average of 76 and above on their testing scores. Students who test positive for the control group will be sent home with a letter of explanation and permission to participate in the study. All participants, teachers, and school name will remain anonymous for the purpose of this study.

Instrumentation

This study will utilize two types of data collection for comparison purposes. The first instrument is technology based. Students will be utilizing the internet to access http://www.arcademicskillbuilders.com for weekly assessment. Arcademic Skill Builders contains mathematical fundamental games for students arranged by content and grade area. Students can engage in games to work on fractions, addition, subtraction, multiplication, division, and more. The purpose of using Arcademic Skill Builders is two-fold. The built in capabilities for reporting is essential for instrumentation and the play aspect of the games is to engage students in a deeper learning. Research has shown that an increase in critical thinking occurs from the use of electronic gaming. (Gillespie, Martin, and Parker, 2010) In addition, research shows that using technology has a positive effect on mathematics for students in a tier setting. (Allsopp, McHatton, and Farmer, 2010) This software will be used to track accuracy in multiplication and division as well as response time on particular problems. The second data collection effort will be paper based. Students will be given 50 multiplication problems and 50 division problems to complete. These tests will be given in small group sessions to more accurately measure response time of the test as a whole. A pretest will measure accurate scoring prior to intervention, a second similar test will be taken at the 9th week of intervention, and the final test will be given at the end of 16 weeks. Current pilot studies provided for viewing at http://www.arcademicskillbuilders.com/pilot_studies give the results of schools within four

districts that tested the software. Students showed a rate of improvement between 24% and 45% between the separate districts.

Procedural Details

My RD study will take place at School X, a rural East Texas elementary school. Students who will participate in the intensive intervention will be identified using previous year's standardized test, benchmark exams, progress reports, and report cards. Students who are identified as scoring a mean score of 75 or below will participate in intervention while students whose mean score is 76 or above will be participants of the control group. Students who will be a part of the control group will receive Tier 1 services in their regular classrooms. These students will participate in the same assessments given to students in the Tier 3 study. All students regardless of score will be assessed using preselected games from Arcademic Skill Builders (http://www.arcademicskillbuilders.com). This website contains fundamental mathematical games that teachers and researchers can have students play to assess accuracy percentage as well as response time by problem. The use of Arcademic Skill Builders (ASB) is one way in which technology will be integrated into the intensive instruction program. Students who are participating in the intervention of the program will receive 45 minute intensive small group instruction on a daily basis. On Fridays all students will access the computer lab at School X and play the pre-assigned games. The data will be gathered over a 16 week period for both the study group and the control group. Data analyzed will either show that students with intervention had a significant increase in accuracy percentage and response time scores thereby accepting the hypothesis, or that the intensive intervention did not result in a significant increase in accuracy percentage and response time in the students thus accepting the null hypothesis.

Data will further be analyzed to assign values of significance comparing grade levels, gender, and students identified as special education versus students not identified as special education.

Validity and Reliability

The software instrumentation to be utilized in this study is the property of http://www.arcademicskillbuilders.com. The owners of the website clearly state that inaccurate information given due to a software malfunction is a possibility, and they are not responsible if this should occur. The developers of the program have done several pilot studies using the program in various schools throughout the country. Data is provided on their website as well as contact information for more detailed information. The reliability of this information seems to be hampered due to the short time frame that data was gathered for the pilot studies, and little evidence as to the type of intervention involved with the pilot studies was given. It should be noted that the results of these pilot studies show a mean improvement rate of 32.5% from the schools listed as participating in the pilot study. The length of m study will add validity to the use of ASB as an intervention tool.

Data Analysis

Data will be gathered over the 16 week period and analyzed using SPSS analytic software. Each Friday students will take assigned assessments on ASB and reports from this website will be generated concerning accuracy percentage and response time of the multiplication and division exercises. Response time will be averaged for each session to allow for one response time score per multiplication session and one response time score for the division session. Gender data will be assigned as a 0 for female and 1 for male. Special Education status will be identified as 0 for special education and 1 for non-special education.

Students who were in the control group will be labeled as 0 while students who participated in the study will be labeled as 1. Individual scores from the 3 paper tests as well as the 16 ASB tests will be entered individually per student. Each student will have an accuracy and response time score for each ASB assignment, and each student will have paper test scores for accuracy and response for each of the three paper tests. The testing utilized will be composed of a two tailed test of significance with a probability cutoff of .05. Two different ANOVA tests will be done; the first test will compare my control students with my study students, and the second test will compare my non-special education students from the study group with the special education students in the study group. A statistical difference between the control group and the study group could prove my hypothesis that intensive intervention does have a positive effect on mathematical accuracy and response time for multiplication and division.

Conclusion

The execution of this study is designed to prove whether or not intensive intervention in a Tier 3 RTI setting will have a positive significant difference in multiplication and division accuracy and response time. The data should show a significant difference between pretest and posttest scores for the study group and a significant difference between pretest and posttest scores for the study group versus the control group. If no significant difference occurs then the null hypothesis will be proven that intensive intervention in a Tier 3 RTI setting has no effect on multiplication and division accuracy and response time.

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