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The Effects of Differentiated Mathematics Rotations on Basic Facts

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An Action Research Report

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The Effects of Differentiated Mathematics Rotations on Basic Facts

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Advisor _____ Date _____

Abstract

The purposes of this research were to examine the effects of differentiated mathematics rotations on student achievement, in the area of addition and subtraction fact fluency to ten, and how mathematics rotations influenced students' feelings towards mathematics. The study was conducted over a six-week period in a first-grade classroom in a Midwestern state. Data collection methods included student feedback, addition assessments, subtraction assessments, and teacher observational checklist. The results of the study indicated an overall increase in both addition and subtraction fact fluency and students expressed more positive feelings towards mathematics. Both teacher researchers will continue to use mathematic rotations as the main framework in their classrooms to increase student achievement and continue to create more positive feelings towards mathematics. Further research topics include the effects of mathematics rotations on other mathematics standards and the effects of mathematics rotations throughout all grade levels.

Keywords: differentiated instruction, fact fluency, mathematics rotations

Teachers utilize many types of teaching strategies within a small group setting. Small group instruction provides a better opportunity for individual feedback compared to whole group instruction (Burton, 2010; Sammons, 2010). Whole group instruction is when a teacher lectures while students sit silently and attempt to listen and understand. Whole-group instruction typically leaves advanced level students bored, lower leveled students confused, while only leaving a few students engaged (Bottini & Grossman, 2005; Hanim, Mohd, & Zainol; 2012, Sammons, 2010). Whereas small group instruction allows teachers to teach each group lesson according to the needs of each specific group (Burton, 2010; McHugh, 2007; Sammons, 2010). One type of instructional strategy used within a small group setting is mathematics rotations. Throughout the past few years our grade level colleagues have noticed a need for more individualized mathematics instruction due to low achieving basic fact fluency. According to the teacher researchers' 2013-2014 school year, the Middle of the Year (MOY) data revealed 13% of the students scored proficiency in the area of subtraction and 69% of the students scored proficiency in the area of addition. Due to these concerns, this research project is based on implementing mathematics rotations to improve first grade students' mathematics scores. This study took place in an elementary school within a Midwestern state that involved 16 students, nine girls and seven boys.

Most teachers agree each student that enters a classroom comes with their own life experiences, knowledge, personality, and abilities (Gregory, 2008; McHugh, 2007; Tomlinson, 1999). Although each student is a unique learner, it is a teachers' responsibility to create lessons around learning standards so that each student is challenged appropriately (McHugh, 2007). The use of differentiated instruction allows

teachers to guide instruction to their students' ability, needs, and interests (Burton, 2010; Edwards, Carr, & Siegel, 2006; McHugh, 2007; Sondergeld & Schultz, 2008). Theroux stated,

> Differentiated instruction is defined as a means of creating multiple pathways so that students of varying abilities, interests and learning needs experience equally appropriate ways to absorb, use, develop and present concepts as a part of the daily learning process. (as cited in Smith, 2012, p. 3)

Since the launch of Common Core State Standards Initiative (CCSSI) in 2010, Reading and Mathematics have become more rigorous and the learning expectations have been set higher for each grade level. These standards were created to ensure that students are ready and well prepared for college and entering the workforce (CCSSI, 2010).

Although our district has implemented CCSSI, the mathematics curriculum that is provided by the school district does not match the entire first grade CCSSI. It is our goal to use differentiated mathematics instruction to help utilize CCSSI within the curriculum. Differentiating is a teaching strategy that can be utilized in all classrooms. According to the researchers, using differentiating instruction and flexible grouping allows teachers to meet the needs of all students (Burton, 2010; Sammons, 2010). The use of differentiated instruction and flexible grouping helps to create a student-centered classroom. It allows students to actively participate and to feel more comfortable within a smaller setting (Sammons, 2010).

According to multiple authors, during work with the teacher, the teacher will teach each group lesson according to the needs of that specific group (Burton, 2010; McHugh, 2007, Sammons, 2010). Planning differentiated lessons are extremely crucial

when teaching students. Teachers need to make sure when planning that they are organized, have access to data, and have established clear expectations for the students (Sammons, 2010). According to Sammons, there are six steps to prepare a lesson for small groups during math rotations. First, you must determine what skill will be taught based upon the standards. Next, the teacher should administer a pre-test to help form differentiated groups. The teacher will choose and create lessons based on certain skills for each group. Lastly, the teacher should collect and organize all learning tools needed for each lesson (Sammons, 2010). Mathematics rotations allow teachers to observe each student and their learning to give them a better understanding of how they learn and their learning needs.

The goal of this action research project is to improve basic mathematics facts by implementing mathematics rotations in a first grade classroom. When implemented appropriately, small group instruction will keep students engaged, teach students to work cooperatively, permits students to learn independently, and allows teachers to differentiate. A teachers' ultimate goal is to help students continuously progress in their learning and succeed not only within the classroom, but outside the classroom as well. Taylor-Cox (n.d.) makes a powerful statement, "differentiated math instruction is the key to the future success of mathematics education for ALL students!" (p. 7). With this in mind, we decided to pose the question: What effects will differentiated mathematic rotations have on student achievement and feelings towards mathematics?

Methodology

Before beginning the research, the teacher researchers created a consent form of approval for student participation (Appendix A). There were a total of two students who

opted out of our study. Prior to teaching with mathematics rotations, the teacher modeled expected behavior and helped students build stamina. Stamina is the ability to do something for a specific length of time. Students are expected to work at each rotation for 15 minutes. Mathematics rotations will only work effectively through consistent practice and proper modeling. The process consisted of introducing a variety of mathematics rotations. These rotations allowed the teacher researchers to teach small groups of students according to their specific needs. There were four different mathematics rotations and each rotation was 15 minutes in length. These mathematics rotations consisted of the following: work with the teacher, math facts, hands-on games with a partner, and math bag. Students were given the opportunity to do mathematics on the computer one day during the week. The students used educational mathematics websites such as www.starfall.com and www.abcya.com. The teacher assigned specific games for students to work on during computer time.

The teacher introduced one rotation at a time with the use of anchor charts (Appendices B-F). These charts were displayed and referred to throughout the learning process. It took approximately one week to practice each rotation and build stamina.

The research process began after the discussion and practice of expectations. The study lasted six weeks and the data collection started at the beginning of January 2015 and was completed in the middle of February 2015. The students spent a total of 30 hours (one hour a day, five days a week for six weeks) working on basic mathematics facts with the use of mathematics rotations. Throughout the implementation of mathematics rotations, there was ongoing assessing. These included the following data sources: student feedback (Appendix G), addition assessments (pre-test, CFA's, and post-

test) (Appendix H), subtraction assessments (pre-test, CFA's, and post-test) (Appendix I), and an observational checklist (Appendix J). The goal of our research was to measure the effectiveness regarding mathematics rotations on the standard of basic fact skills in the area of addition and subtraction. It also provided evidence of students' feelings regarding mathematics.

The first data source used was a student feedback assessment. Students were given a series of statements regarding how each student felt towards mathematics prior to using mathematics rotations. This was a paper and pencil assessment that was provided in a whole group setting. Each student utilized privacy folders to help promote veracity when answering each question. This assessment consisted of four statements. These statements included the following: *I love math, I do math at home, I am good at math,* and *My favorite thing to do in math is* ____. The first three statements were answered through a smile rating scale (happy face = positive feelings, neutral face = neutral feelings, and sad face = negative feelings). Lastly, students completed an open-ended statement; *My favorite thing to do in math is* ____. All four statements were read aloud to the students. The students were not timed during this assessment and the teacher aided in any writing assistance that was needed. Once the assessment was completed, it was collected immediately by the teacher. This information was then used to identify students' feelings towards mathematics. The student feedback form was also used at the end of the study.

The next data sources analyzed were the addition and subtraction assessments. These assessments included the following: pre-tests, CFA's, and post-tests. The standards assessed included 1.OA.6A Add numbers within 20, demonstrating fluency

within 10 using strategies and 1.OA.6B Subtract numbers within 20, demonstrating fluency within 10 using strategies. To ensure that all students were measured along the same criteria these assessments were provided using a PowerPoint presentation in an isolated, one-on-one setting in which each slide was timed for five seconds. The addition assessments consisted of 22 fact problems to solve and the subtraction assessments consisted of 30 fact problems to solve. While in a one-on-one setting, the student verbally stated the answer to each slide as the teacher recorded the students' responses onto the recording sheet. If a student was unable to keep up with the PowerPoint and demonstrated frustration, the teacher could stop the assessment and restart at the last correct fact. The assessment resumed at a later time if necessary. The assessments were scored based upon the addition and subtraction rubrics (Appendices K and L). The school district follows a number grading scale (Appendix M). According to the school district, each student is expected to achieve a minimum score of 1 at the beginning of the school year. 1 represents that the student demonstrates beginning knowledge of the skill. By the middle of the school year, students are expected to score a minimum of 2 in all assessments. The end of the year expectancy then progresses to a 3 to demonstrate proficiency in that area. As our research took place during the middle of the school year, students were expected to score a minimum of a 2.

Observational checklist was another data source that was utilized. This data source was used to record individual findings from the students' daily work. Every Friday, while the students worked through each rotation, the teacher walked around and collected notes while examining students' daily work and strategies used during the different activities. This allowed the teacher to take notes regarding how students were

solving the different mathematics equations. The teacher was then able to identify a deeper understanding of each student and their thought process. The observational checklist also assisted the teacher to identify what areas to target in each group lesson.

The next portion of this action research paper will discuss the analysis of the data that was given to determine if mathematics rotations had an effective impact on students' addition and subtraction fact fluency skills. Furthermore, we will share the findings of the students' feelings towards mathematics and the impact of mathematics rotations.

Analysis of Data

Throughout the research process, results were analyzed from multiple data sources. These included the following: student feedback, addition assessments (pre-test, CFA's, and post-test), subtraction assessments (pre-test, CFA's, and post-test), and an observational checklist. The initial data source analyzed was the student feedback assessment. This assessment included both qualitative and quantitative data, which included four statements. These statements were established around the students' general feelings regarding mathematics.

Figure 1 represents the results regarding students' responses to the survey about mathematics prior to implementing mathematics rotations and at the end of the six week study. According to the students' responses, the statement "I love math," only half of the class responded a positive feeling. The next statement, "I am good at math," resulted in majority of the class responding with a positive feeling. The third statement, "I do math at home," almost half of the class responded that they enjoy practicing mathematics at home.

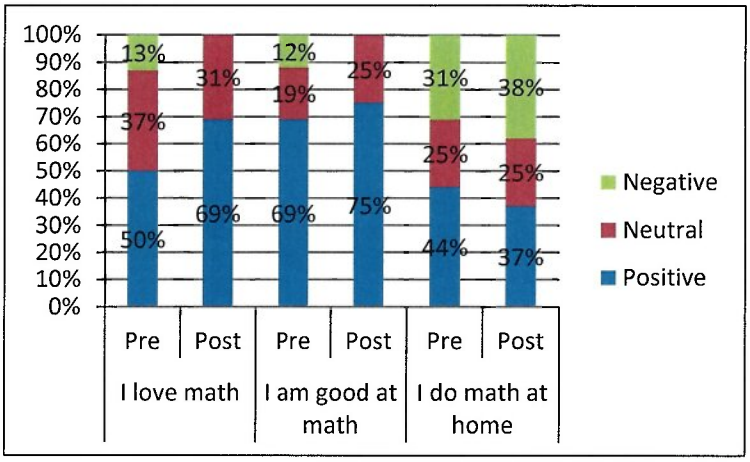

Figure 1. Pre and post student feedback. This figure illustrates first grade students' responses regarding their feelings about mathematics.

This statement was given to see how the positive effect on mathematics rotations influenced students performing extra mathematics practice at home. According to the open-ended statement, a majority of the class stated their favorite thing about mathematics was writing numbers. There were two students that identified adding and subtracting as their favorite activity in mathematics.

The end results regarding the student feedback is also identified in Figure 1. In regards to, "I love math," students demonstrated a positive increase of 19% and no longer a negative perception towards mathematics. The next statement, "I am good at math", increased slightly regarding positive outlooks. The third statement of "I do math at home," displayed a slight decrease regarding positive outlooks. This may have been a result of students not having the tools at home or possibly the support from family to help promote mathematics at home. Lastly, the open ended statement resulted in 75% of the students stating that they enjoyed solving addition and subtraction, 12.5% stated that they

enjoyed working with a partner, and the remaining 12.5% stated that they enjoyed working with the teacher.

The next data sources analyzed were the addition assessments. These included the addition pre-test, CFA, and post-test. Our pre-tests findings resulted in 4 of the 16 students scored proficient in addition. In an attempt to reach grade level goals, four mathematic groups were created.

The addition CFA was the next addition assessment utilized. This CFA was received at the midpoint of the research. The progress that each student made over the past three weeks was demonstrated through this assessment. Figure 2 illustrates that 15 of the 16 (93.75%) students showed growth and knowledge in the area of addition after the implementation of mathematic rotations. As demonstrated in the same chart, 13 of the 16 (81.25%) students are meeting MOY addition expectations with a minimum score of a 2. Furthermore, 10 of the 16 (62.5%) students are meeting EOY expectations in addition with a score of 3. After the CFA was scored and analyzed, each student was then shown the amount of progress that they each had made over the past three weeks. Through students' body language and different statements, they appeared proud of their accomplishments. The students' body language demonstrated smiles and showed increased volition to better their scores by making statements such as, "I'll practice even more" and "I'll go really, really fast next time."

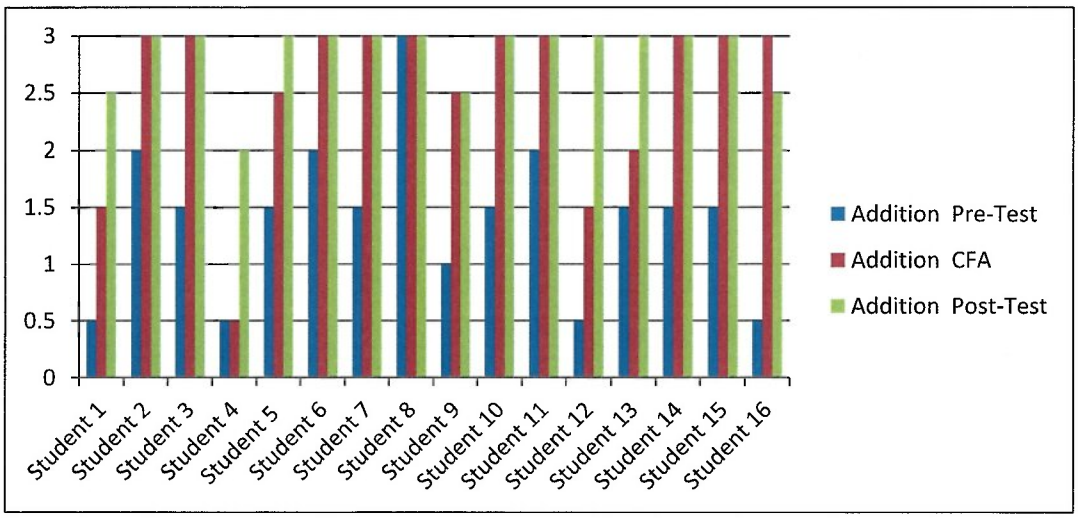

Figure 2. Comparison of first grade addition assessments. This figure illustrates the growth of students' knowledge regarding addition.

Next, the teacher researchers evaluated the addition post-test. By analyzing the results shown in Figure 2, 13 of the 16 (81.25%) students continued to show growth. As shown in Figure 2, Student 8 proved to have mastered the skill of addition by scoring a 3 (EOY expectations) consistently throughout the process. The conference that was held during the observational checklist assessment, which was between the teacher and the student, the teacher asked, "How do you solve your math equations?" The student stated, "I just know them." The teacher tried to dig deeper and asked, "How do you know them?" The student replied, "I practice adding cuz I really like math." Student 16 demonstrated a decrease from the CFA to the post-test. Student 16's results revealed that her knowledge in addition is not consistent and needs more repetition and guidance.

Next, the subtraction assessments were analyzed by the teacher researchers. These assessments included the following: pre-test, CFA, and post-test. The pre-test showed that none of the students scored proficient in the area of subtraction (Figure 3).

According to the first grade subtraction CFA in Figure 3, it revealed that 3 of the 16 (18.75%) students were meeting MOY expectations with a minimum score of a 2. The remaining 13 students were below MOY expectation. At the end of the research the subtraction post-test revealed that 16 of the 16 (100%) students achieved a 2 or higher. Comparing the results in Figure 2 and 3, the skills of subtraction appeared to be less concrete for all of the students. Furthermore, at the beginning of the research some students stated, "I don't like subtraction" and "subtraction is hard." However, towards the end of the research students started to demonstrate more of a liking towards subtraction, but still made comments that addition was their favorite. The beginning of the research students would groan at the word "subtraction;" however, towards the end of the research students made comments that they wanted a challenge with subtraction because addition equations were too easy. After comparing the addition and subtraction assessments, Figure 2 and 3 showed that the area of subtraction was more difficult than addition and students will need more practice and guidance with this skill.

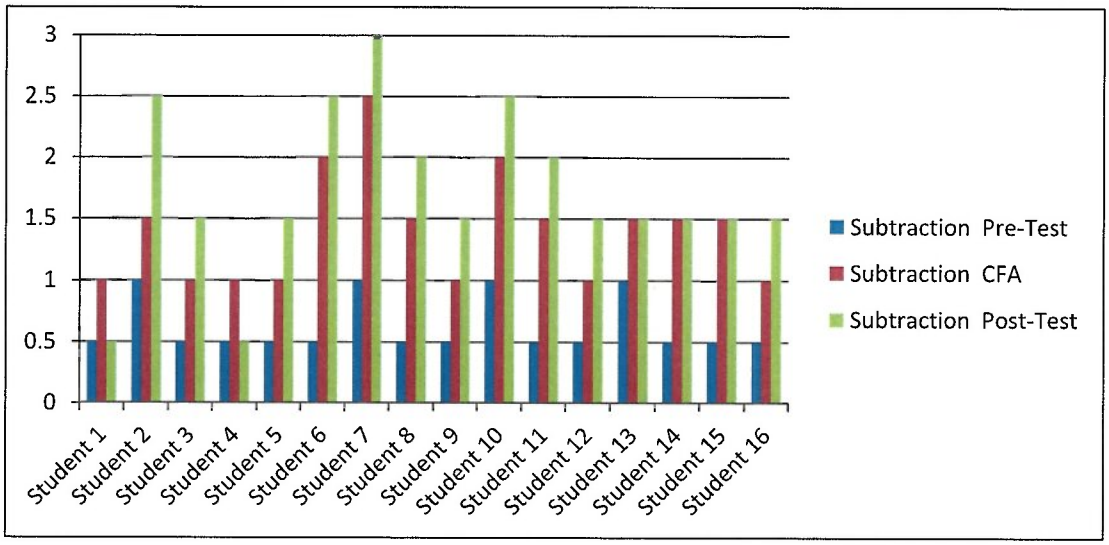

Figure 3. Comparison of first grade subtraction assessments. This figure illustrates students' growth in the area of subtraction.

An additional data source utilized was the observational checklist. During this time conferences were utilized to obtain qualitative data with the use of an observational checklist. This observation was received every Friday through a one-on-one conference with each student for about four minutes. The teacher observation form was used, which allowed the teacher researchers to record notes of students' knowledge and understanding regarding basic mathematics facts. Through this assessment the teacher researchers were able to identify which strategies were being utilized by each student to solve basic mathematics problems. A variety of manipulatives (e.g. cubes and counters) were used by about 4 of the 16 (25%) students, while 6 of the 16 (37.5%) students used counting on strategies. Another common strategy observed was the use of doubles plus or minus one to solve each mathematic fact (e.g. 5+4=9 would mean the same as 4+4+1=9). There were 2 of the 16 (12.5%) students that utilized this strategy. There were 4 of the 16 (25%) students that demonstrated knowledge of fact families (e.g. 1+2=3, 2+1=3, 3-1=2, and 3-2=1). The observational checklist came to be one of the most important assessments utilized. It helped to identify a deeper understanding of each student and their thought process. The teacher researchers were then able to plan each small group lesson according to the students' understanding of addition and subtraction.

According to the observational checklist, student 16 started addition by utilizing manipulatives. Throughout the study, this child was introduced to the strategy of counting on. This student grasped the counting on strategy quickly; however, is still demonstrating that this skill has not been mastered. This information aided the teacher researcher in developing appropriate instruction for these students to reach their maximum potential. The students who demonstrated a lack of knowledge within fact

fluency were taught using hands on manipulatives to help them count on or count backwards. Instruction for another group included finding the doubles and adding on the rest. The last group was instructed with fact families and the relationship between numbers.

The majority of the students demonstrated a remarkable amount of growth in the area of basic mathematics skills. According to the teacher researchers' 2013-2014 MOY first grade data, students' demonstrated 13% proficiency in the area of subtraction and 69% proficiency in the area of addition. After the implementation of mathematics rotations, 37% of students' revealed proficiency in subtraction. This shows a 24% increase from the 2013-2014 school year. In the area of addition, the research resulted in 100% of students meeting MOY expectations; this is a 31% increase from last year's data.

The implementation of mathematics rotations has improved student achievement and feelings towards mathematics. With these results, teachers will be able formulate appropriate action plans for each individual student to further their growth within basic mathematics skills.

Action Plan

The purpose of this study was to identify if mathematics rotations would have a positive effect on student achievement and feelings towards mathematics. According to the data collected from this study, positive results were discovered. Overall, students have made a significant amount of growth using mathematics rotations, compared to last year's data with the use of whole group instruction. As stated previously, the 2013-2014 school year data, addition fact fluency increased by 31% and subtraction fact fluency

increased by 24%. Due to the positive effects that mathematics rotations had on student achievement and feelings, the teacher researchers will continue to use mathematics rotations as a framework when teaching addition and subtraction mathematics fact fluency. However, the teacher researchers feel that whole-group lessons should still be utilized in the classroom based on the teacher's professional judgment. Some standards may be best addressed in a whole-group setting. The teacher researchers identified three components that may help additional studies related to mathematics rotations. These three components include the following: readdressing procedures, professional development, and instituting an additional follow up assessment.

Prior to the implementation of mathematics rotations, procedures for rotations were established, modeled and practiced for five weeks. Although five weeks seems like a long time, the researchers felt this was one of the main reasons that mathematics rotations had such a positive outcome; however, the teacher does recommend readdressing the anchor charts weekly. This is one area that the teacher felt could have been strengthened and would have caused fewer interruptions and less redirecting. Also, if the teacher observes students continuously struggling with a particular rotation, that specific rotation should be readdressed and practiced as a whole class.

Although mathematics rotations demonstrated positive results, the teacher researchers feel professional training or observing other professionals would further benefit the study. Collaboration with other professionals who have implemented similar mathematics rotations would further benefit the research. Benefits from collaborating may include the following: improved lessons/activity ideas, transitions between rotations,

educational websites for students, implementation of each rotation, and additional assessment ideas.

One assessment utilized for this study was student feedback. The purpose of this assessment was to receive information regarding students' feelings towards mathematics. This assessment was given prior to implementing mathematics rotations and at the end of the study. The teacher researchers found the assessment useful; however, felt that an additional feedback assessment should be created to ask more specific questions pertaining to the different mathematics rotations. Questions may include the following: *Which rotation did you like the best?, What is your favorite math game?,* and *Do you enjoy working with a partner?*. By creating this new assessment, it would provide the teacher with more in depth information pertaining to students' feelings and opinions regarding mathematics rotations.

Throughout the six week study, students were very engaged and interested in mathematics; however, the teacher researchers questioned if student engagement would decline if mathematics rotations were used as the main framework for teaching mathematics. This also relates to the teacher researchers' wondering, "Would mathematics rotations benefit other mathematics standards?" Furthermore, the teacher researchers are curious if the use of mathematics rotations would benefit student achievement in all grade levels. Lastly, the teacher researchers wondered if the assessments would show different results if the addition and subtraction equations utilized were different or in a different order.

The teacher researchers will share these findings and wonderings from this action research project with their colleagues. It will reveal the overall improvement in the area

of addition and subtraction fact fluency and feelings towards mathematics. The framework of mathematics rotations provided the students with engaging activities, collaboration skills, and differentiated instruction.

In conclusion, the teacher researchers highly recommend utilizing mathematics rotations within classroom core instruction. Throughout the research process, there were moments of doubt, excitement, success, and validation. This research has helped support the use of differentiated instruction in the classroom. The use of mathematics rotations has aided in improving student basic fact skills and their feelings towards mathematics. The skills obtained, by the teacher researchers, through this study will continue to influence decisions regarding future teaching practices. As we continue as educators, we will continue to find solutions to raise low student achievement scores. We know now that we can and will apply the things that we have learned in this study to find solutions to future problems.

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Appendix A
Parent Notification Letter

Dear Parents,

My name is Alison Kaubisch and I am a first grade teacher at [redacted]. My colleague, Samantha Bold and I are currently attending St. Catherine University and pursuing a Masters of Education degree. An important part of our program is an Action Research project.

As teachers of [redacted], we have chosen to learn about math rotations because it will help us learn about the benefits of small group math instruction and how to meet the needs for all students. We are working with a faculty member at St. Kate's and an advisor to complete this particular project.

We will be writing about the results that we get from this research; however none of the writing that we do will include the name of this school, the names of any students, or any references that would make it possible to identify outcomes connected to a particular student. Other people will not know if your child is in our study.

When we are done, our work will be electronically available online at the St. Kate's library in a system called Sophia, which holds published reports written by faculty and graduate students at St. Kate's. The goal of sharing our final research study report is to help other teachers who are also trying to improve the effectiveness of their teaching.

If you decide you want your child's data (math feedback, pre-test, post-test, observational checklist, and a rubric checklist) to be in our study, you don't need to do anything at this point.

If you decide you do NOT want your child's data included in our study, please note that on this form and return it by 12-17-2014. There is no penalty for not having your child involved in the study; we will simply delete his or her responses from our data set. All children will receive the same treatment, regardless of your decision on this matter. If at any time you decide you do not what your child's data to be included in the study, we will remove included data to the best of our ability.

If you have any questions, please feel free to contact us at [redacted] or [redacted] You may ask questions now, or if you have any additional questions later, you can ask me or my advisor, [redacted] at [redacted] who will be happy to answer them. If you have other questions or concerns regarding the study and would like to talk to someone other than the researcher(s), you may also contact [redacted], Chair of the St. Catherine University Institutional Review Board, at [redacted].

You may keep a copy of this form for your records.

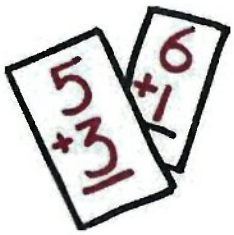
Opt Out

I do NOT want my child's data to be included in this study. Please respond by 12-17-2014.

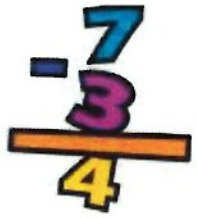
Name of Child	Date
Signature of Parent	Date
Signature of Researcher	Date

If you are not sure please contact me to discuss.

Appendix B
Anchor Chart-Math Facts



Math Facts



Students	Teacher

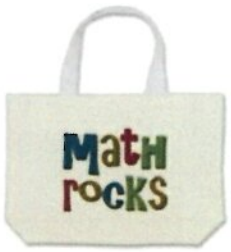
Appendix C
Anchor Chart- Work with a Partner

Work With a Partner

Students	Teacher

Appendix D
Anchor Chart- Math Bag

Math Bag



Students	Teacher

Appendix E
Anchor Chart- Work with the Teacher

Work With the Teacher

Students	Teacher

Appendix F

Anchor Chart- Computers

Computers

Students	Teacher

Appendix G
Student Feedback

Student Feedback

Name: _____ Date: _____

1. I love math!

2. I do math at home.

3. I am good at math.

4. My favorite thing to do in math is _____

_____

_____

Appendix H
Addition Assessment

1.OA.6A - Addition Facts Recording Sheet

Part 1 - Sums to 5

1+1	yes/no
4+1	yes/no
3+1	yes/no
1+2	yes/no
3+2	yes/no
2+2	yes/no
0+0	yes/no
5+0	yes/no

Score: _____/8 Percent: _____

Part 2

	Pre-Test	CFA	CFA	CFA	CFA	Post-Test
7+1						
9+1						
1+8						
6+1						
1+5						
7+2						
4+2						
2+5						
8+2						
6+2						
4+4						
3+3						
5+5						
6+0						
0+9						
0+8						
3+4						
7+3						
5+3						
3+6						
4+5						
6+4						
Score	/22	/22	/22	/22	/22	/22
Percent	%	%	%	%	%	%

Appendix I
Subtraction Assessment

1.OA.6B - Subtraction Facts Recording Sheet

Assessment Part 1 – Facts to 5

2-1	yes/no
4-1	yes/no
5-1	yes/no
1-1	yes/no
4-2	yes/no
3-2	yes/no
5-2	yes/no
2-0	yes/no
3-3	yes/no
5-3	yes/no
4-3	yes/no
5-4	yes/no

Score: _____/12 Percent: _____

Part 2- Facts to 10

	Pre-Test	CFA	CFA	CFA	CFA	Post-Test
9-1						
7-1						
6-1						
8-2						
6-2						
7-2						
10-5						
6-3						
8-4						
10-3						
10-4						
10-8						
10-9						
6-0						
8-0						
7-7						
9-9						
6-4						
8-6						
7-5						
8-5						
9-5						
7-3						
9-3						
8-3						
7-4						
6-4						
9-4						
9-6						
9-7						
Score	/30	/30	/30	/30	/30	/30
Percent	%	%	%	%	%	%

Appendix J
Observational Checklist

Observational Checklist

+ (understands) - (does not understand)

Student	Addition	Subtraction	Comments

Appendix K
Addition Rubric

Pre-Test, CFA, & Post-Test: Addition

Domain: Operations and Algebraic Thinking		
1.OA.6A Add numbers within 20, demonstrating fluency within 10 using strategies		
Grade: First		
4.0	No advanced assessment available.	
3.5	No advanced assessment available.	
3.0	At least 90% accuracy given 5 seconds per fact (Sums to 10)	
2.5	At least 80% accuracy given 5 seconds per fact (Sums to 10)	
2.0	At least 70% accuracy given 5 seconds per fact (Sums to 10)	
1.5	At least 50% accuracy given 5 seconds per fact (Sums to 10)	
1.0	Less than 50% accuracy given 5 seconds per fact (Sums to 10)	
0.5	Less than 85% on the BOY Trigger Assessment	

BOY Trigger
7/8 87%
6/8 75%

Summative
20/22 90%
18/22 81%
16/22 72%
11/22 50%

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Appendix L
Subtraction Rubric

Pre-Test, CFA, & Post-Test: Subtraction

Domain: Operations and Algebraic Thinking
1.OA.6B Subtract numbers within 20, demonstrating fluency within 10 using strategies
Grade: First

4.0	No advanced assessment available.	
3.5	No advanced assessment available.	
3.0	At least 90% accuracy given 5 seconds per fact (Part 2)	
2.5	At least 80% accuracy given 5 seconds per fact (Part 2)	
2.0	At least 70% accuracy given 5 seconds per fact (Part 2)	
1.5	At least 50% accuracy given 5 seconds per fact (Part 2)	
1.0	85% or higher on the Summative Assessment Part 1 OR Less than 50% accuracy given 5 seconds per fact (Part 2)	
0.5	Less than 85% on the Part 1 (Facts to 5-Kindergarten)	

Summative Assessment Part 1
11/12 91%
10/12 83%
9/12 75%

Summative Assessment Part 2
27/30 90%
24/30 80%
21/30 70%
15/30 50%

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Appendix M
Grading Scale