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Increasing Subtraction Automaticity using the Think Addition Strategy and Taped Problems

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An Action Research Report

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Abstract

The purpose of our research project was for kindergarten and first grade students to reach grade level proficiency in subtraction automaticity. The study took place in a public elementary school kindergarten classroom of 19 students and a first grade classroom of 18 students. The students were taught the Think Addition strategy and practiced Taped Problems to increase their subtraction fact automaticity. The data sources included an observational checklist, attendance tracking sheet, and district power point assessment and rubric. The data from the intervention showed an increase in subtraction fact automaticity. The teacher observations revealed students using the new subtraction strategy introduced during the intervention. Using the Think Addition strategy and Taped Problems helped students achieve proficiency in grade level subtraction fact automaticity.

With high expectations on the forefront of education, student achievement is a highly discussed topic. It was through such conversations that a dilemma became apparent in our elementary school: our students are not automatic in their math facts. Across grade levels, students do not know their math facts. In kindergarten and first grade, common core standards require students to be automatic in addition and subtraction basic fact recall. This fact knowledge will increase their success in later grades where they learn more difficult operations such as multiplication and division. We realized that our mission, as primary teachers, would be to solidify students' fact automaticity (fluency) at an early age. We looked at our current student data and determined that many of our students were grasping the concept of addition and could display automaticity when answering addition facts. However, many students were not making timely gains in the area of subtraction fact automaticity. Thus, we decided to make subtraction fact automaticity the goal of our action research project. Our research led us to two interventions to try in our classrooms: Think Addition and Taped Problems (TP). Our action research question is "What effect will the combination of Think Addition and Taped Problems have on increasing subtraction fact automaticity in a kindergarten and first grade classroom?"

What basic math skills will help students become strong mathematicians? According to the Common Core State Standards Initiative (CCSSI), Kindergartners should fluently subtract within 5 and first graders should fluently subtract within 10 (National Governor's Association, 2012). Automaticity (fluency) when recalling basic facts is a key component in problem solving because it "enables the child

to complete the arithmetic problems efficiently and effectively" (Ramos-Christian, & Schleser, 2008, p.544).

Subtraction automaticity, however, is under some criticism. Subtraction automaticity at these primary grades is not developmentally appropriate for all students if they have not mastered their addition facts. Studies have shown that addition is an easier skill than subtraction for students to acquire (Kamii, Kirkland, & Lewis, 2001, p. 33). Once students have mastered addition, they use their knowledge of addition to understand subtraction (p.34). Piaget argues that children initially think in positive terms. Subtraction is more difficult because it is a negative action in the brain (Kamii, & Lewis, 2003, p.230). In spite of this, states that have adopted the common core standards expect Kindergartners and first graders to achieve subtraction automaticity at their level. Because of this information, educators may prefer to use addition when molding their subtraction automaticity interventions.

When teaching subtraction, the think-addition approach may help create a link between addition and subtraction (Leutzinger, 2002). Before teaching students the think-addition strategy to use with subtraction, students must be proficient in their addition facts. With the think-addition strategy if a student has a subtraction problem (5-2) the student will think of this problem as an addition problem (x+2=5) (Duhon, Key, Lee, & Poncy, 2010, p.78). Vos explains this concept through a method called the missing addend (2009, p. 15). Thinking of a subtraction problem as an addition problem with a missing addend allows the student to see the relationship between addition and subtraction (2009, p. 15).

Subtraction is more difficult than addition for primary grades and according to Baroody, Eiland, Purpura, & Reid (2012, p.27). The think-addition strategy often does not help students with subtraction because of the complex level of thinking that must be made to turn the problem around. Instead, one could use three other strategies to teach subtraction. Students will realize that addition and subtraction problems have the same parts if they keep the addend in the same location when transferring to an addition problem (6-3=x so x+3=6 not 6-3=x so 3+x=6). Students may also use a number line to predict where the difference is located. Then the students will double check by backtracking on the line. The last strategy is for students to label each section of the math problem using the words whole and part. This will help students when they are turning subtraction to addition problems and seeing the labeled words follow each number; each part makes a whole (Baroody, Eiland, Purpura, & Reid, 2012, p.27).

Subtraction by addition, however, is not the only approach used to develop subtraction fact automaticity. While the following strategies do not necessarily increase understanding, they increase automaticity. Vos states that for a math program to be considered successful, it must include a focus on "achieving automaticity recall of basic number facts" and that educators must seek out many different types of interventions from one year to the next (2009, p. 105). Therefore, other methods must be explored.

One strategy under consideration is the Cover, Copy, Compare (CCC) process. In this particular approach students will view a problem or fact family. The student will then cover, copy, compare (CCC), and evaluate their work next to the original problem or fact family. If the student has successfully written the problem, the student may move on to the next one. If the student has made an error, the student crosses out their original

problem or fact family and rewrites it with corrections. In one study, CCC was compared to Facts that Last (FTL).

The FTL method required students to answer several questions for each fact family. The questions focused on the "part-part-whole relationships of math-fact families" (MaCullum, 2010, p. 920). The class listened as peers explained their thinking. After the guided discussion the teacher used flashcards that corresponded with a student worksheet to test the students' understanding. The FTL process allowed students to use fact families to learn addition and subtraction facts, similarly to CCC. Not only did students retain more subtraction facts through the CCC intervention, but students prefer the CCC method over the FTL method (MaCallum, Poncy, & Schmitt, 2010, p.923).

Although CCC proved very effective in MaCallum, Poncy, & Schmitt's (2010) study, there are other strategies worth attention. Taped Problems (TP), for example, have been found to produce a higher increase in subtraction fact automaticity then CCC. In one study, conducted by MaCallum, Poncy, and Skinner, (2012) TP proved to be the intervention with the greatest result in increased subtraction fact automaticity.

The TP process instructed students using a voice recording. The recording read subtraction problems to the students. The subtraction problems were listed on a worksheet in front of each student. The students wrote the answer to each problem and then listened for the recording to tell them the correct response. If the students were correct they left the problem as it was, if the students were incorrect they put an "X" through their answer and wrote the correct answer below the incorrect answer. The TP intervention lasted exactly 6 minutes and consisted of 72 problems, or 12 problems per minute. They had exactly 5 seconds for each problem. The students improved by 13.5

Digits Correct per Minute (DCM) when using the TP method (MaCallum, Poncy, and Skinner, 2012, p.749).

In a similar study comparing CCC to Math To Mastery (MTM), CCC was once again determined the weaker intervention. CCC and MTM both "include modeling, practice, immediate corrective feedback, and reinforcement components" (Mong & Mong, 2010, par. 7). However, MTM and CCC differ in one key area. During the CCC interventions, the worksheet is the source of the modeling and feedback components. The MTM process provides feedback and correct answers by an interventionist. While both methods yielded increase in students' Digits Correct Per Minute (DCPM), MTM proved to have greater results than CCC. However, despite the fact that MTM provided higher scores, CCC is preferred by the students in the study (Mong & Mong, 2010, par. 26). The students felt that they could achieve their greatest math results through CCC even though MTM proved to help their achievement scores.

The setting of our project takes place in two classrooms in an elementary school of 437 K-5 students. One classroom was a kindergarten class of 19 students ranging from ages five to seven of which eleven were girls and eight were boys. Out of the 19 kindergartners, two students were on Individualized Education Plans (IEPs) and received special education services. Throughout the year up to seven students received Title I Reading services. By the end of the year, only two students remained in Title I. One student received services for reading through our gifted and talented program known as Levels of Service (LOS). Two students received enrichment reading services through LOS. Three students received enrichment services for Algebra and one student received enrichment services for Geometry.

The other classroom was a first grade class of 19 students. Eight students were girls and eleven were boys. However, one student's family opted out of the action research project. The 18 students remaining consisted of five students that started the year on IEPs receiving special education services. The year ended with two students on IEPs. Eight students received Title I Reading services throughout the school year. By the end of the year six students still received Title I services. One student received services for reading and math LOS services due to their gifted and talented status. A full time aide was present every day and worked with two students each day because of the needs of their IEP's.

In a primary classroom addition and subtraction basic facts are the building blocks of future success in mathematics. When necessary, educators must choose effective and efficient class wide interventions to reap the greatest benefits and reach the largest numbers. With this information, educators can go forth trying any strategy they deem acceptable for their class. From this research we will determine what effect the Think Addition strategy and Taped Problems have on kindergarten and first grade students' subtraction fact automaticity. The next section will outline our research process.

Description of Research Process

The goal of this six week intervention was to increase correct responses to solve subtraction problems in a timely manner. The students participating in the study were kindergarteners and first graders. The data collection sources used were attendance, observation, district baseline assessment, district summative assessment and common formative assessments.

The study began with a district mandated subtraction baseline. This particular assessment was performed on each student individually. The baseline assessment used a timed power point that changed slides every five seconds. Each slide had a different subtraction problem that was read to the student via a voice recorder. Students wore headphones and said their answer aloud to the test proctor- in this case, the classroom teacher. The teacher kept track of the students' correct answers. Kindergarten had subtraction problems with numbers up to five (examples: 5-3=, 3-0=). Kindergartners had seven problems for the assessment (see Appendix A). First graders had subtraction problems with numbers up to ten (examples: 9-7=, 10-2=). First graders must have answered Part One of the assessment correctly, which is 12 subtraction problems using digits within five (0-5). If they passed, they moved on to Part Two which consisted of 24 subtraction problems using digits within ten (0-10) (see Appendix B).

During the baseline assessment, the teacher kept a checklist of observational data that included what methods students used for problem solving. The five different things on the checklist were: Did the student respond within the allotted time?; Did the student use manipulatives?; Did the student use a counting strategy?; Were their answers correct or incorrect?; Additional comments. The purpose of the checklist was to keep track of student problem solving methods and progress towards the goal of fact automaticity.

Alongside the district baseline during week one, the Think Addition strategy was introduced. This strategy was taught and reviewed daily throughout the six week intervention during our calendar routines. Think addition was explained to the students by using a flipchart as a resource for the students to visualize changing a subtraction problem to an addition problem with a missing addend (see Appendix C). Students would

then count on from the known addend to get the sum. The number counted was the missing addend, as well as the difference of the subtraction problem. The teacher used the gradual release method to teach this strategy. First, the teacher modeled turning a subtraction problem into an addition problem by thinking out loud and using math talk. Next, the teacher had students pair up and explain how to change a different subtraction problem into an addition problem with his/her partner. Finally, the teacher checked understanding by randomly calling on individual students; the teachers listened to their explanation of their problem solving. This strategy was developmentally appropriate given this age group's strengths in addition.

During week two, implementations of Taped Problems (TP) began. TP refers to a recorded voice reading a subtraction problem to the students. Week two was the students' first experience with TP. First, the procedures for TP were shown in a whole group setting where students were given worksheets with subtraction problems that provided space to write their answer. A recording played for the students that matched the subtraction problems on their worksheets. During week two the students had 20 seconds to write in their answer before the answer was read off. Students were told to put an "X" over their answer if they got it wrong and write the correct answer beside it. This was to give them an opportunity to write the correct answer and see what the subtraction sentence should look like which also gave them an opportunity to memorize that subtraction problem. The students left their answer as was if it was correct.

The students started with 20 seconds per problem, to give them an opportunity to be successful. Twenty seconds was enough time for many students to answer the subtraction problems correctly on their first attempt with TP (see Appendices D and E).

Each class used TP twice a week during week two. The TP sheets used had the same problems on each page, but were placed in a different order to keep students from simply memorizing the order of the answers. The students did not use privacy folders for the first round of TP. However, privacy folders were added to the TP process after round one due to wandering eyes and the temptation to copy a neighbor's answer. During week three, the time limit was 16 seconds with the same TP. A Common Formative Assessment (CFA) was given in week three. The CFA's purpose was to record progress over time and is documented in the district's Power Grade Book. The CFA is the same assessment as the district's baseline used in week one. During week four the students had 12 seconds to complete each problem.

During week five, students were allowed eight seconds to write the answer to their TP. Additionally, students were given a CFA using the same district power point as used in the baseline. Finally, in week six, students were given five seconds to answer each of their TP. They were also given individual summative assessments using the district power point used in their baseline. The CFA in week five and the summative assessment in week six were added to the Power Grade Book.

This research process was used to measure and observe student subtraction fact automaticity. Through our measurements and observations we hope to see an increase in correct responses within the given time limit. Next, we will analyze the results obtained in our data collection sources.

Analysis of Data

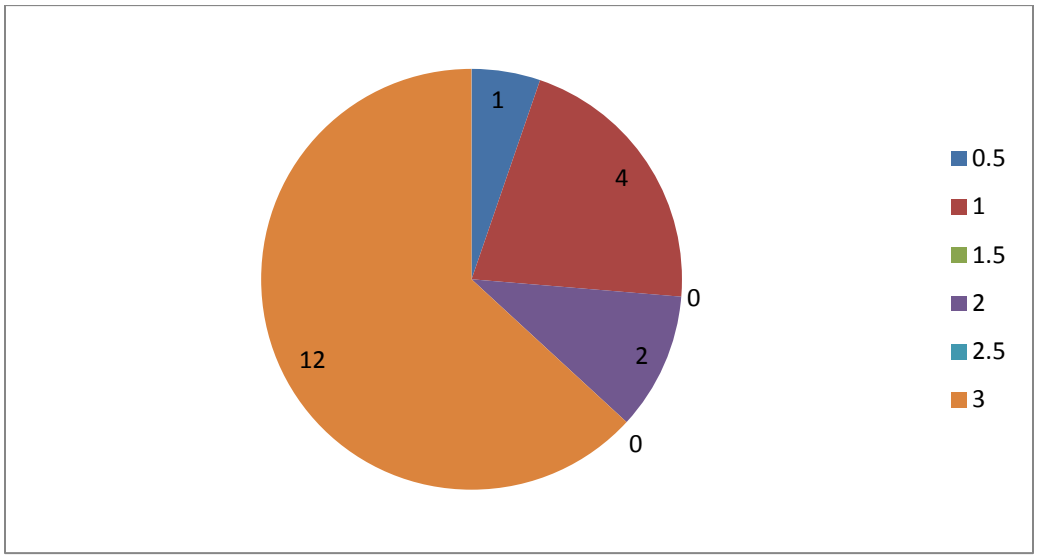
Three forms of data collection were used for this action research project. Attendance was recorded daily to track student exposure to the Think Addition strategy and to track which students had practice with taped problems. Teachers also used an observational checklist. This checklist was used to gain insight on how students would solve subtraction problems. Data were also taken from district assessments, which included: a baseline, two Common Formative Assessments (CFAs) and one summative assessment. These assessments were graded using a district rubric.

Attendance was recorded during the six week, 30 day intervention in order to determine if students were given ample exposure to the Think Addition strategy and Taped Problems (TP). If students were absent more than five days they would not have as much practice with the strategy, which may show a decrease in their understanding and summative score. In the kindergarten classroom eleven students were present each day whereas eight students were absent a range of one to three days. In the first grade classroom 12 students were present each day and six students were absent a range of one to five days.

In first grade, the teacher was out ill for three days during week five. Therefore, in spite of having good attendance overall, every student missed an additional three days of Think Addition practice and one TP session. When the teacher returned, Think Addition practice and TP sessions continued as usual.

A baseline assessment was given individually during week one of this research project. Each student had five seconds to solve a subtraction problem shown on a PowerPoint presentation and was graded from a district rubric with a grading scale of

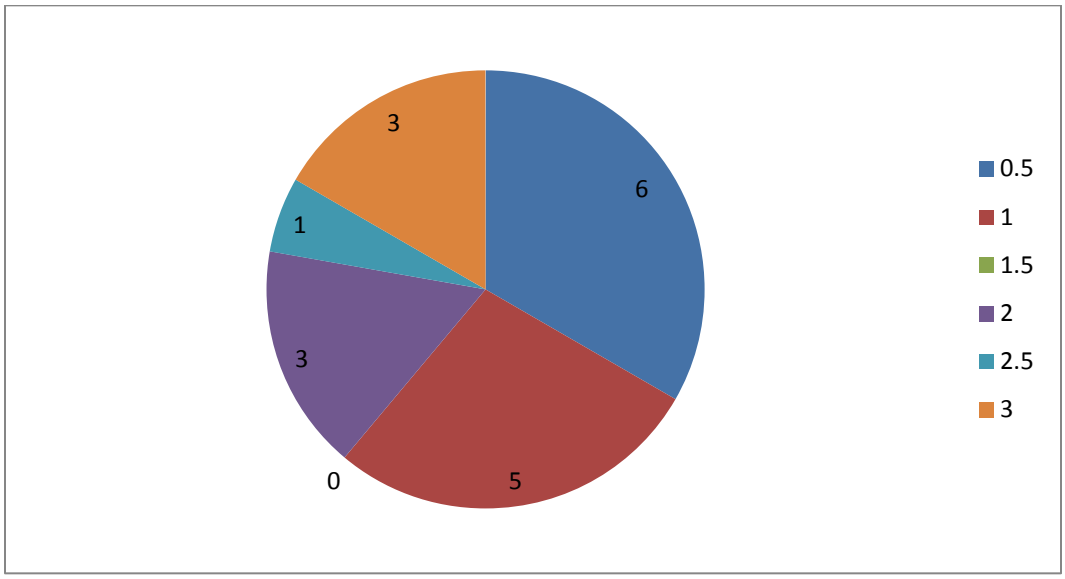
0.5-3.0 (see Appendix F). In kindergarten only one student did not answer within the allotted time; this student answered two out of seven answers correctly. This student's strategy was to say the first number of the problem as the answer. For example, if the problem was 5-2, the student would reply "5." All other students answered within the allotted time but no all correct. Two kindergartners confidently answered but with random numbers. One student added the subtraction problems giving the correct answer for addition. Another student answered the subtraction problems correctly but before the voice recording started to state the problem. Three students answered the problems with ease and the remaining eleven students answered all or majority of the problems correct by using their fingers to help them by counting backwards. The results according to the rubric of the kindergarten baseline are shown in Figure 1. No observations were made of students using the Think Addition strategy during week one of the baseline assessment.



0.5=Less than 20% accuracy, 1.0=20% accuracy, 1.5=40% accuracy, 2.0=50% accuracy, 2.5=70% accuracy, 3.0=85% accuracy

Figure 1. Kindergarten baseline assessment results.

The first grade baseline during week one was similar. Students' responses were scored against a district rubric with a 0.5-3.0 point grading system (see Appendix G). Using the observational checklist, it was noted that twelve of the eighteen students were able to answer within the allotted five seconds while six needed additional time. Nine students used their fingers as manipulatives to solve the subtraction problems. Three students appeared to guess instead of using a strategy for several problems. Three students counted on from the minuend to find the missing difference. Five students recalled answers from memory and used very little time to respond. The pie graph below in Figure 2 shows the results of this baseline.



0.5=Less than 85% on part one, 1.0=85% or higher on part one and less than 50% on part two, 1.5=At least 50% on part two, 2.0=70% accuracy, 2.5=80% accuracy, 3.0=90% accuracy

Figure 2. First grade baseline assessment results.

All students receiving between 1.5 and 3 passed part one of the baseline assessment, which consisted of subtraction problems using digits up to five. Part one is

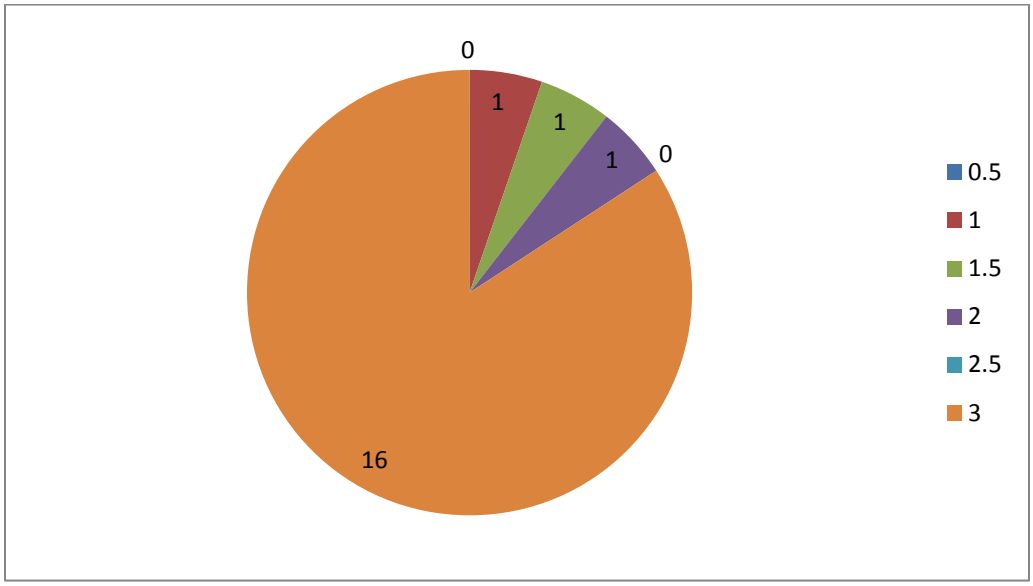
considered the proficiency standard for kindergartners. The results reveal that three first grade students are already considered proficient. When it comes to fluently answering subtraction problems. One student received a 2.5, meaning that the student correctly answered between 20 and 21 subtraction problems correctly. Three students received a 2, meaning they scored between 17 and 19 out of 24. There were no students in the 1.5 range, which would have meant they received between 15 and 12 answers correct. Five students scored a 1 which means they were able to score ten out of eleven correct on part one of the assessment, however they scored less than twelve out of 24 on part two. Six students received a 0.5, meaning that they were not able to answer ten out of eleven subtraction problems correct from part one.

During Week two kindergarten and first grade students practiced the Think Addition strategy in a whole group setting daily. During this week no assessments were given, although students did practice TPs twice. Students had 20 seconds to solve the TPs but no observations were taken as this was just practice.

Week three continued with the practice of the Think Addition strategy. Students were becoming more detailed and accurate while using math talk to solve subtraction problems and describe their strategies. The time to write an answer for TPs was reduced to 16 seconds. Students completed one TP and were given a CFA to check for progress.

During this first CFA kindergarten students were all able to write an answer within the allotted time. Three students used their fingers to help them solve the problems; these students were still using the takeaway method to solve subtraction. These students are not yet proficient at these problems. Three other students also used their fingers to solve but these students used the Think Addition strategy to solve. Two of

these students answered all seven problems correctly and one student did not answer correctly because he would include the smallest number of the problem as he counted on using the Think Addition strategy giving him the wrong answer. Thirteen students answered all seven problems correctly without using manipulatives. Figure 3 shows the results of the first CFA. Note that in the rubric if a student answers six or seven problems correctly, this is considered proficient at a 3.0.

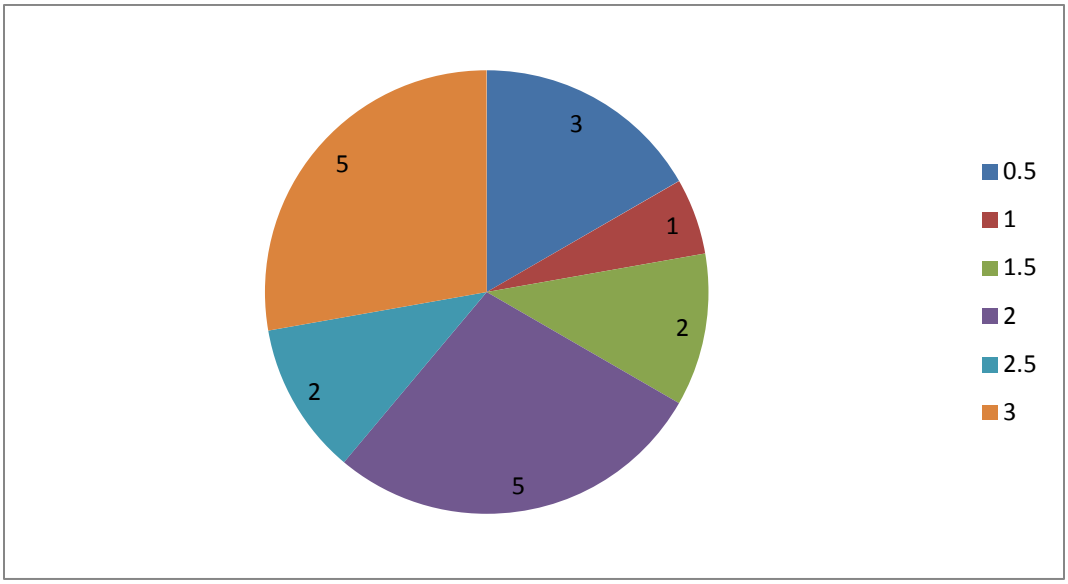


0.5=Less than 20% accuracy, 1.0=20% accuracy, 1.5=40% accuracy, 2.0=50% accuracy, 2.5=70% accuracy, 3.0=85% accuracy

Figure 3. Kindergarten CFA 1 week 3 assessment results.

During week three, the first grade observational checklist showed evidence of more advanced mathematical thinking. For example, only three students were unable to answer the subtraction problem within the allotted five seconds, while six students could not respond within the five seconds on the baseline. Two fewer students used their fingers as manipulatives to answer the subtraction problems then in the baseline. The two students who had previously used their fingers counted on from the minuend to the

subtrahend to find the missing difference using the Think Addition strategy. The number of students using this strategy went from three in the baseline, to six in the first CFA. Two students continued to guess random numbers for their answers. The five students who recalled facts on the baseline assessment, were still able to recall the answers to these problems on this CFA. See Figure 4 for CFA 1 results.



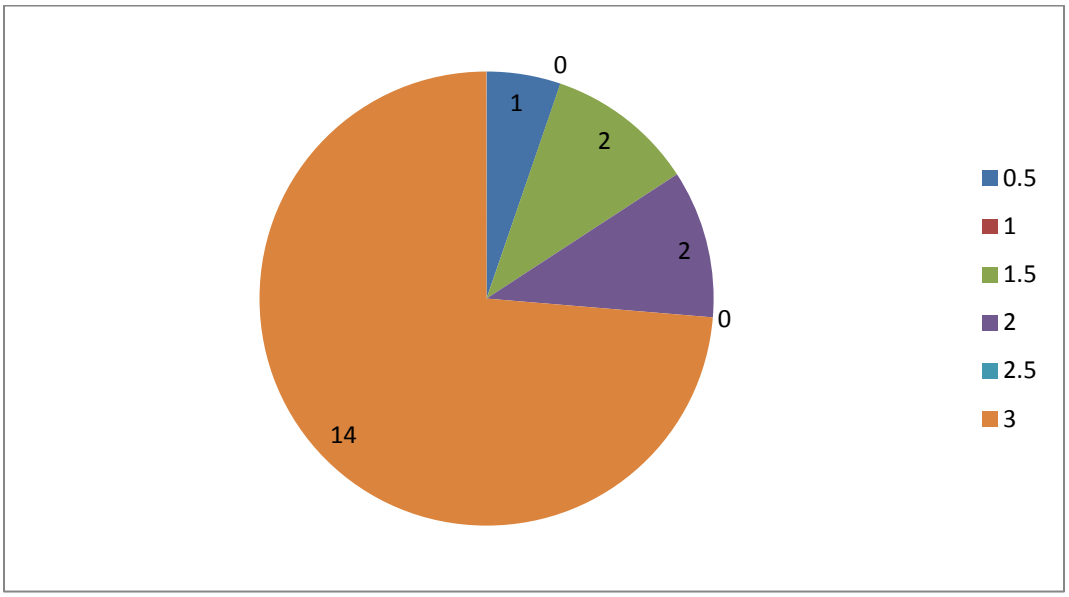
0.5=Less than 85% on part one, 1.0=85% or higher on part one and less than 50% on part two, 1.5=At least 50% on part two, 2.0=70% accuracy, 2.5=80% accuracy, 3.0=90% accuracy

Figure 4. First grade week three assessment results.

Week four continued with kindergarten and first grade students practicing the Think Addition strategy in a whole group setting daily. During this week no assessments were given, although students did practice TPs twice. Students had 12 seconds to solve the TPs but no observations were taken as this was just practice.

During week five kindergarten and first grade students were given eight seconds to solve their TPs. Think Addition was still reviewed daily with more student lead discussions using math talk.

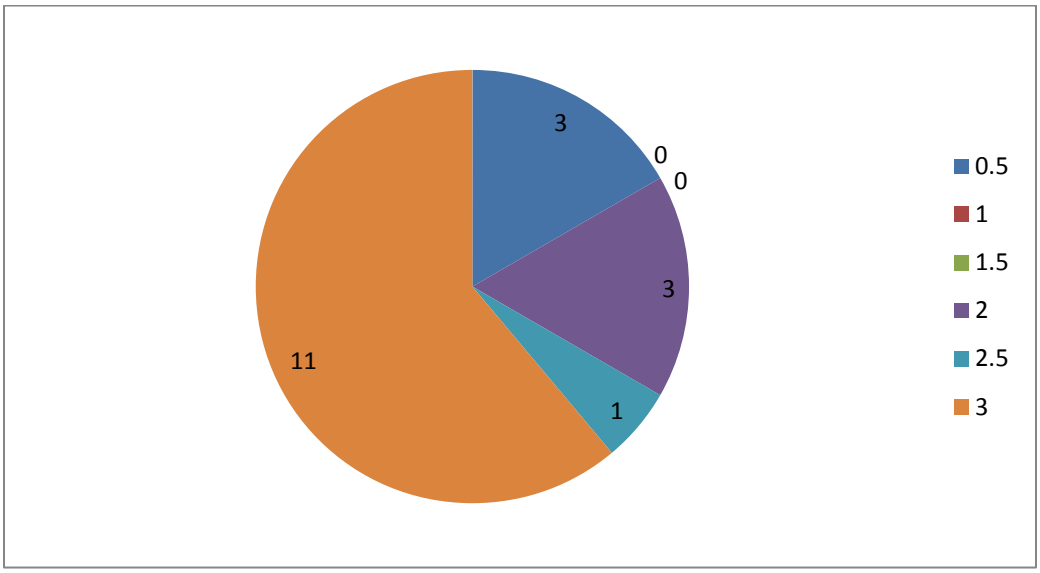
Kindergarten students have made great gains during their second CFA. Fifteen students answered within the allotted time of eight seconds with all seven problems correct with the use of no manipulatives. Two students used their fingers and the takeaway method to try and solve the subtraction problems; they are not yet proficient but made gains answering three and four problems correctly. Two other students also used their fingers to solve but used the Think Addition strategy. These students were more accurate in answering correctly, knowing six and seven problems. See Figure 5 for CFA 2 results.



0.5=Less than 20% accuracy, 1.0=20% accuracy, 1.5=40% accuracy, 2.0=50% accuracy, 2.5=70% accuracy, 3.0=85% accuracy

Figure 5. Kindergarten CFA 2 week 5 assessment results.

First graders continued to show growth during week five's CFA 2. All but two students were able to answer within the allotted five second time limit. During this second CFA, only three students continued to use their fingers to solve the subtraction problems. Six students used the counting on Think Addition strategy while and nine students were able to quickly recall facts accurately. Three students continued to guess the answer to each problem. The three students that continued to guess consist of two students on IEPs and one student receiving ELL services. These students were reminded to try the strategy practiced in whole group. The teacher practiced the skill with the students alongside the PowerPoint to show them an example. No other students were given this assistance. Figure 6 shows the results of this CFA based on the first grade rubric.

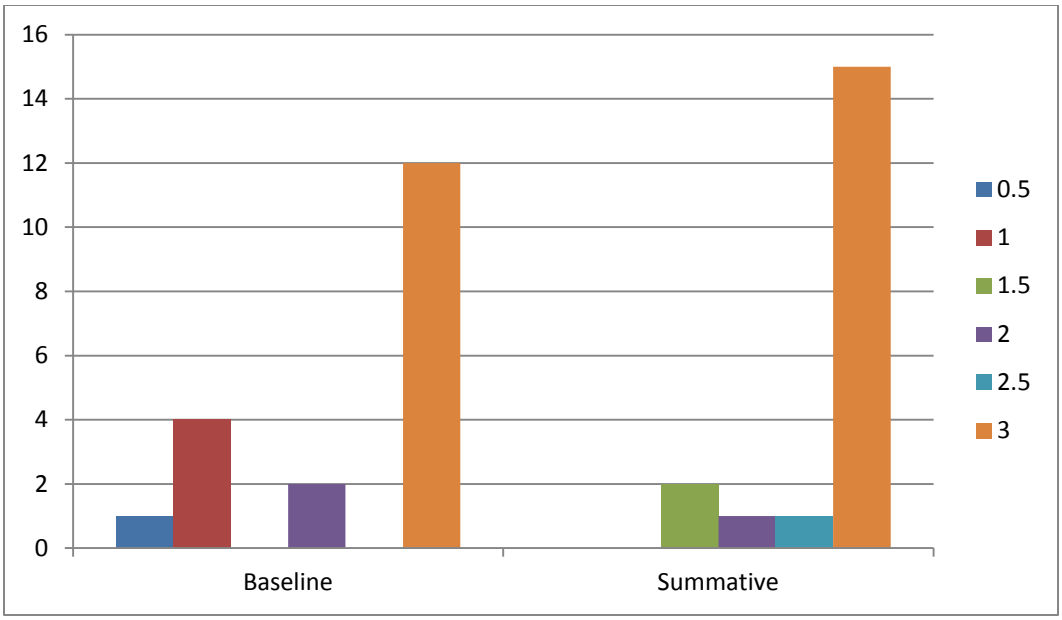


0.5=Less than 85% on part one, 1.0=85% or higher on part one and less than 50% on part two, 1.5=At least 50% on part two, 2.0=70% accuracy, 2.5=80% accuracy, 3.0=90% accuracy

Figure 6. First grade CFA 2 week 5 assessment results.

During week six, the last week of our intervention, kindergarten and first grade students took a summative assessment for subtraction automaticity but answered problems within five seconds. Students also continued to practice Think Addition daily and were given TPs with five seconds to respond.

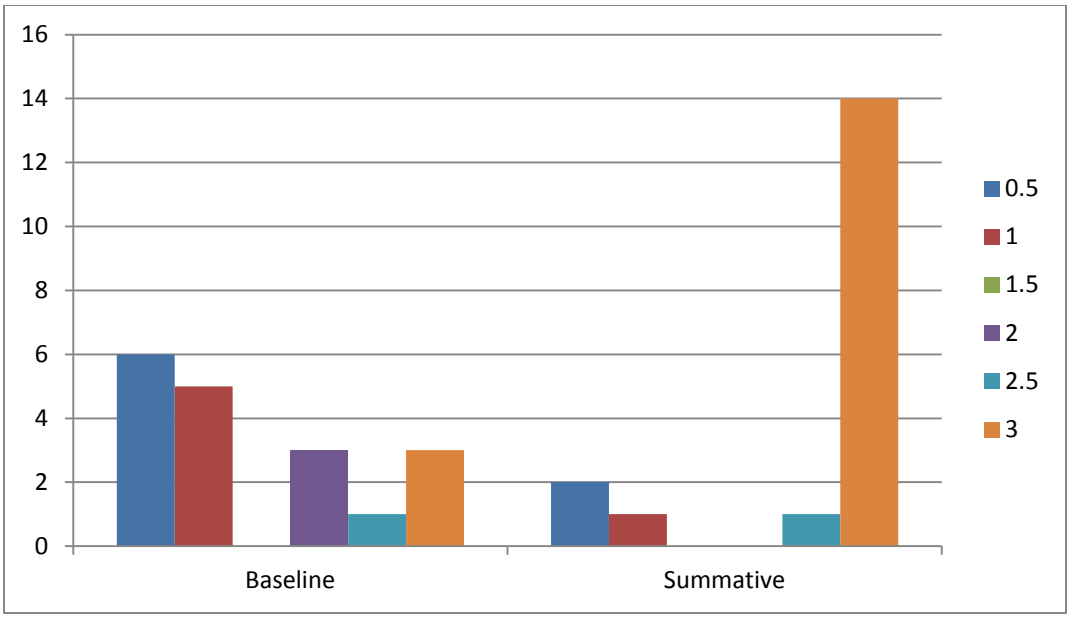
Kindergarten students showed varied results during the summative assessment. All students answered within the five seconds. Thirteen students were proficient at answering all seven problems correctly, using no manipulatives. When talking with these students after the assessment they all used the Think Addition strategy. Two students answered six problems correctly using the Think Addition strategy. Answering six problems correctly still gave them a proficient score of 3.0 according to the district rubric. One student answered only three problems correctly because of not paying attention. This student did not use the Think Addition strategy, but instead guessed. On previous CFA's this student was proficient at subtraction. The remaining three students used their fingers to help them solve the subtraction problems. These students also used the Think Addition strategy which in previous CFA's they used the takeaway method. These students answered three, four and five problems correctly. These three students take more time to answer problems and score below grade level in other curriculum areas as well. They each did raise their score by answering one more problem correct than their previous assessment. See Figure 7 for the kindergarten summative assessment results in comparison to baseline results.



0.5=Less than 20% accuracy, 1.0=20% accuracy, 1.5=40% accuracy, 2.0=50% accuracy, 2.5=70% accuracy, 3.0=85% accuracy

Figure 7. Kindergarten baseline and week six summative assessment results.

The results of the first grade observations and assessment showed continued positive results. Three students continued to use their fingers as manipulatives. However, one of those students used their fingers to count on from the minuend using the Think Addition strategy. They were able to take out a step that they had used the week before. Two students continued to guess their answers. Six students counted on using the Think Addition strategy and ten students quickly answered the questions as though by subtraction fact recall. The two students who continued to guess the answers were both students on IEPs. Figure 8 shows the results of this summative assessment based on the first grade rubric.



0.5=Less than 85% on part one, 1.0=85% or higher on part one and less than 50% on part two, 1.5=At least 50% on part two, 2.0=70% accuracy, 2.5=80% accuracy, 3.0=90% accuracy

Figure 8. First grade baseline and week six summative assessment results.

Figure 8 reveals that 14 students have achieved a 3 for this summative assessment which is an indication of grade level proficiency in subtraction fluency. Two students received a 0.5 which means they were not able to correctly answer the ten out of eleven subtraction problems on part one correct. Therefore, they were not able to attempt the 24 first grade level problems alongside their peers. These two students are both on IEPs. One student scored a 1 which means the student correctly answered half of the 24 first grade subtraction questions correctly. This student receives ELL services and had previously not been able to correctly answer ten out of eleven subtraction problems on part one correctly. This was the first assessment where the student was able to attempt the 24 question assessment. One student received a 2.5, meaning they scored between 20 and 21 subtraction problems correctly within the five second time frame.

These data helped to determine whether the interventions were effective. The goal has been to increase subtraction fact automaticity and the results showed many students reached proficiency. The following section will explain our next steps based on our results.

Action Plan

The goal of this intervention was to help kindergarten and first grade students achieve subtraction automaticity at grade level. Data showed a positive impact on student subtraction fact knowledge. The intervention was successful because the majority of students in kindergarten (15/19 or 79%) and first grade (14/18 or 78%) were able to quickly recall their subtraction facts.

The results of this intervention will change our practice. We plan to continue teaching the Think Addition strategy because it helped primary age students subtract quickly in a way that made sense to them. Giving students more time at the beginning of the TP, helped them to gain confidence in subtraction and led to further success.

We would like to try using TP for addition fluency in the beginning of the next school year as well. Students are assessed on addition automaticity earlier in the year than subtraction automaticity. We will begin the addition TP at 20 seconds and gradually decrease time throughout the addition unit. The sooner students can display automaticity in addition, the sooner we can take them to the next level.

We would slightly alter the intervention by allowing room for differentiation. Originally we used the grade level subtraction problems. There were two students in first grade, however, that could have benefited by using the kindergarten problems with digits

within five. Similarly, there were three kindergarten students that would have excelled by using TP with first grade level subtraction problems with digits within ten. In first grade, there were five students who would have shown more progress if they had been given second grade subtraction problems with digits within 20.

One observation made in first grade was that practicing 24 TP was stressful for some students. Practicing 24 TP could be less stressful for students if broken up into three sessions of eight problems. This would still allow students ample practice but would be a more age level appropriate time frame.

Using TP in a small group setting could allow for greater differentiation between ability levels of students. For instance, students who need more practice at 20 seconds could stay at that time frame until ready to decrease time to 16 seconds. Additionally, students who quickly mastered this skill could move on to a shorter time frame or more difficult problems.

Some limitations are related to student behaviors. For instance, we realized the need for privacy folders within the first week. Some students were inclined to copy their peer's answer when they were unable to answer on their own. Another limitation was that several students would guess rather than try a strategy. Since TP was in a whole group setting we could not address the guessing issue individually. Both these issues could be eliminated in a small group setting.

One question that arose was would it be more appropriate to stop the TP at eight seconds? Then we would only record verbal responses at five seconds. The reason this came up is because when students had to write answers for TP within five seconds, they

would often be caught writing when the time was up. This does not show a lack of understanding because the students were able to verbally answer within that time frame. Instead it showed that students at this age level have difficulty writing numbers quickly.

This school year has finished with the highest marks in subtraction automaticity that we as kindergarten and first grade teachers have seen. We feel that this intervention will continue to help our students succeed in the years to come, especially if we are able to use this intervention with addition and differentiate based on student needs. Our hope is to share our methods and data with our peers.

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Appendix A

Kindergarten Baseline Assessment

Appendix B

First Grade Baseline Assessment Part One

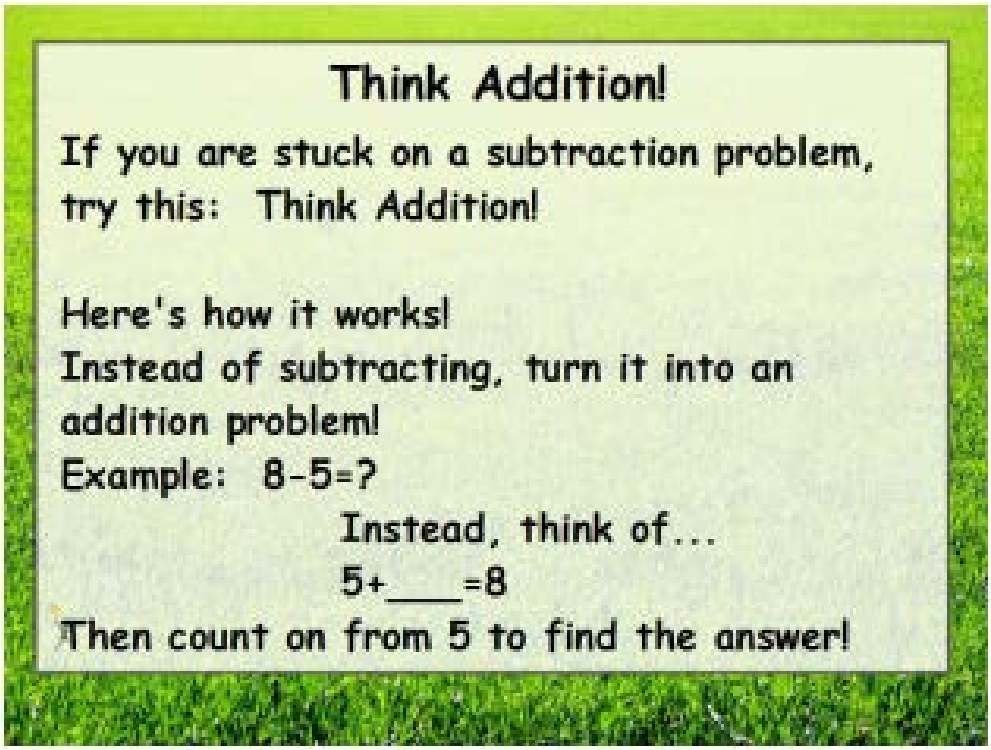
Appendix C

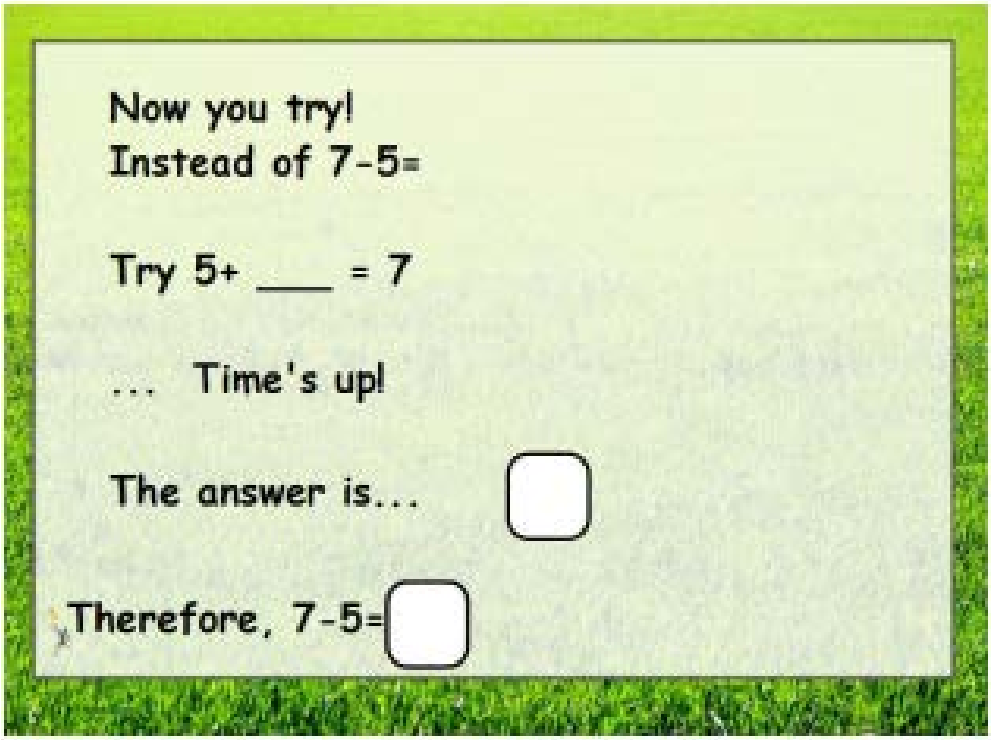
First Grade Baseline Assessment Part Two

Appendix C Continued

Appendix D

Think Addition Flipchart





Appendix E

Kindergarten Taped Problems

Name _____

3-2=_____ 3-1=_____

5-3= _____ 1-1= _____

2-2= _____ 2-1= _____

4-2= _____

Appendix F

First Grade Taped Problems

1. 9-1=_____
2. 8-2=_____
3. 10-2=_____
4. 10-5=_____
5. 6-3=_____
6. 8-4=_____
7. 10-9=_____
8. 10-4=_____
9. 10-8=_____
10. 10-6=_____
11. 10-7=_____
12. 7-3=_____
13. 9-3=_____
14. 8-3=_____
15. 6-0=_____
16. 7-7=_____
17. 6-4=_____
18. 9-7=_____
19. 8-5=_____
20. 9-5=_____
21. 7-5=_____
22. 9-6=_____
23. 7-4=_____
24. 9-4=_____

Appendix G

Kindergarten Rubric

Mathematics Domain 2: Operations and Algebraic Thinking			
K.OA.5 Cluster: Identifying Addition and Subtraction facts to 5			
3.0	Student adds and subtracts facts to 5. 85% accuracy within 5 seconds		**EOY Trigger** Using assessment template or power point assessment
	2.5	Student adds and subtracts facts to 5. 70% accuracy within 5 seconds	Using assessment template or power point assessment
2.0	Student adds and subtracts facts to 5. 50% accuracy within 5 seconds		**MOY Trigger** Using assessment template or power point assessment
	1.5	Student adds and subtracts facts to 5. 40% accuracy within 5 seconds	Using assessment template or power point assessment
1.0	Student adds and subtracts facts to 5. 20% accuracy within 5 seconds		Using assessment template or power point assessment
	0.5	Student adds and subtracts facts to 5. Less than 20% accuracy within 5 seconds	Using assessment template or power point assessment

6/7 – 87%
5/7 – 71%
4/7 – 57%
3/7 – 43%
2/7 – 29%

Appendix H

First Grade Rubric

Domain: Operations and Algebraic Thinking			
Cluster: (1.OA.6b) Subtract numbers within 20, demonstrating fluency within 10 using strategies.			
Grade: First			
3.0	**Use subtraction within 10 to find differences of numbers.**		At least 90% accuracy given 5 seconds per fact on the Summative Assessment – Part 2 (Facts to 10)
	2.5	Use subtraction within 10 to find differences of numbers.	At least 80% accuracy given 5 seconds per fact on the Summative Assessment – Part 2 (Facts to 10)
2.0	**Use subtraction within 10 to find differences of numbers.**		At least 70% accuracy given 5 seconds per fact on the Summative Assessment - Part 2 (Facts to 10)
	1.5	Use subtraction within 10 to find differences of numbers.	At least 50% accuracy given 5 seconds per fact on the Summative Assessment – Part 2 (Facts to 10)
1.0	**Use subtraction within 10 to find differences of numbers.**		**85% or higher on the Summative Assessment – Part 1 (Facts to 5)** **and** Less than 50% given 5 seconds per fact on the **Summative Assessment – Part 2 (Facts to 10)**
	0.5	**Limited understanding or skill demonstrated.**	Less than 85% on the **Summative Assessment – Part 1 (Facts to 5)**

Summative Assessment Part 1

11/12 91%
10/12 83%
9/12 75%

Summative Assessment Part 2

22/24 90%
20/24 83%
19/24 79%
17/24 70%
12/24 50%