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Effects of Instruction on Basic Addition Fluency for Second Grade Students

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Abstract

The purpose of this action research is to determine the effect of instruction on basic addition fluency. The Number Corner curriculum was used to instruct, supplement, and assess students' ability to increase their addition facts per minute. A sample of 22 students participated in this action research study. There were several programs including Scout Them Out, Quick Facts, and other activities assigned by the curriculum, that helped make up the whole intervention. This took place in scheduled increments over a three-month period. The study gathers qualitative data which helped determine that the curriculum was successful in helping students increase their math facts per minute, and aids in increasing basic addition fact fluency.

Effects on Basic Addition Math Facts for Second Grade Students

Research conducted in countries with higher performance ratings concludes that something more must be done in order to improve math education in the U.S. (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010, p. 3). The Common Core State Standards for mathematical practice (CCSSM) in an attempt to resolve this issue, provide research-based standards that demonstrate what students should know and be able to do to be successful in mathematics. The standards also "describe a variety of expertise that mathematics educators at all levels should seek to develop in their students" (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010, p. 6).

The Department of Education of Iowa (Iowa DOE) has adopted a great deal of the CCSSM for their own state standards and both sources will be used interchangeably to reflect the math standards discussed below. For example, Under the Domain, Operation and Algebraic Thinking for first grade, students will be able to "Add and Subtract within 20," 1.OA.C (Iowa DOE, 2010, p. 17). According to the Iowa DOE, (2010) standards within this cluster state that students should:

> Relate counting to addition and subtraction (e.g. by counting on 2 to add 2), 1.OA.C.5. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten, decomposing a number leading to ten, using the relationship between addition and subtraction, and creating equivalent but easier or known sums, 1.OA.C.6. (p. 17)

In second grade, the standards under add and subtract within 20 means something different entirely. Under the standard 2.OA.B.2, students should be able to "fluently add and subtract

within 20 using mental strategies," listed in 1.OA.C.6, and by end of Grade 2, know from memory all sums of two one-digit numbers" (Iowa Department of Education, 2010, p. 21).

In order to be compliant with the standards, one must first analyze their meaning in order to truly comprehend what students should be able to do. For example, the word fluency, as seen in many K-8 math standards has been a popular and yet controversial topic of conversation amongst educators. As stated in the standards above, second graders should be able to fluently add and subtract within 20, but what does fluency mean? The following are definitions from a variety of sources that attempt to define the word fluency. "Baroody (2006) describes basic fact fluency as the efficient, appropriate, and flexible application of single-digit calculation skills and…an essential aspect of mathematical proficiency" (as cited in Kling & Bay-Williams, 2014, p. 490). Boaler (2015), a Professor of Mathematics Education, shares that "fluency comes about when students develop number sense, when they are mathematically confident because they understand numbers" (para. 14). "Fluency refers to knowledge of procedures, knowledge of when and how to use them appropriately, and skills in performing them flexibly, accurately, and efficiently" (Kilpatrick, Swafford, and Findell, 2001, p. 121). "Parish, drawing from Fosnot and Dolk (2001) defines fluency as knowing how a number can be composed and decomposed and using that information to be flexible and efficient with solving problems" (as cited in Boaler, 2015, para. 7).

The phrase, know from memory, as stated in the CCSSM also trigger discussions. The author of *Memorization Versus Memory*, from memory, as the ability to "rely on strategy" (Hockman-Chupp, 2015, para. 11). It is important to note that this is different from memorization because the recall of facts simply does not require the use of a strategy. Automaticity is a word often used when educators try to describe fluency. It should however be used when trying to

describe what it looks like to be working from memory. “Automaticity comes through learning, repetition, and practice, until it becomes a natural response” (Hockman-Chupp, 2015, para. 11). Boaler (2015), uses the following example to describe when automaticity is appropriate for the learning process, “it is useful to hold some math facts in memory. I don’t stop to think about the answer to 8 plus 4, because I know that math fact. But I learned math facts through using them in different mathematical situations” (para. 3). The ability to recall facts is simply the “limitation of memorization without number sense” (Boaler, 2015, para. 2). When students are taught to memorize and recall facts, there is a great deal of limitation to what students are actually learning about numbers. Students are only able to develop more complicated mathematical concepts “when they have number sense, and deep understanding of numerical principals;” this does not come from rote memorization and quick drill of facts often seen in education settings (Boaler, 2015, para. 14). National Council of Teachers of Mathematics (NCTM) President, Linda M. Gojak (2015), remarks that the definition of fluency according to the Principles and Standards for School Mathematics, “reminds us that a student cannot be fluent without conceptual understanding and flexible thinking” (para. 3). The best way for students to develop fluency is to build on their number sense and use of strategies. In fact, research proves that when students are able to learn and practice regularly on basic skills through engaging activity, they are more likely to build their number sense and conceptual understanding than if asked to simply memorize the basic facts (Boaler, 2015, para. 18).

Too often the terms fluency and fast have been misrepresented as synonymous. An example of this comes from a study by Linda Gojak (2015), when presenting students with a basic addition fact, one student used her fingers to compute (para. 5). This was “certainly not the action of a students who is fluent with addition facts” (Gojak, 2015, para. 5). When asked rather,

what does this student know about those numbers, she described Make 10, a common, basic addition strategy, and was able to reach her answer efficiently. Gojak (2015), described this student as having the ability to "use her understanding of place value, addition, and the associative property to arrive at a correct response, she was efficient, accurate, and flexible in her thinking—all in a matter of seconds" (para. 6). Students need to understand that doing math does not mean solving problems quickly. Educators also need to show, in isolation of doing so quickly--the link and strong, valuable connection between conceptual understanding and mathematical skill (Kilpatrick, et al., 2001, p. 122). If students learn basic facts in isolation they will fail to connect them to future problems, they will be unable to transfer that knowledge to other problems or do so void of using strategy efficiency (Kilpatrick, et al., 2001, p. 122).

Enriching Addition and Subtraction Facts Mastery through Games, an article by Bay-Williams and Kling (2014), reviews the phases students go through in gaining mastery of basic facts (p. 489). According to tradition, most educational programs for math in the elementary level move students from the modeling and/or counting phase to the mastery level or automaticity too quickly. Without the ability for students to "create, share, evaluate, and practice efficient strategies for finding unknown facts from facts they have already mastered" students will not grasp the transfer necessary to develop true fluency (Bay-Williams & Kling, 2014, p. 240). The CCSSM demonstrates this understanding by stating that second graders will fluently add and subtract within 20, which suggests that students will solve such problems using strategy (Bay-Williams & Kling, 2014, p. 240). The Common Core also acknowledges that by the end of second grade, the facts that students will know from memory, will be those that students were fluent in at the end of first grade—clearly an appropriate transition from fluency to automaticity.

The teacher researcher, in an attempt to achieve the goals of the second grade Iowa Common Core and Common Core Standards for Mathematics, will use the Number Corner curriculum published by The Math Learning Center. In February Number Corner, The Math Learning Center (2016), says "students will follow a systematic approach to developing and demonstrating fluency with addition facts to 20" (p. 1). The Addition Quick Facts timed assessments and Scout Them Out practice exercises introduced in this curriculum, will challenge students in the area of computational fluency. The Principles and Standards for School Mathematics states "computational fluency refers to having efficient and accurate methods for computing" (Gojak, 2015, para. 2). "Computational Fluency workouts are filled with activities, games, and practice pages to help students work efficiently, flexibly and accurately with numbers" (The Math Learning Center, 2016, p. v). According to The Math Learning Center, (2016) the Quick Facts routine is "an opportunity for timed practice different from traditional timed drills—students set their own goals, attempt to beat their previous time, and monitor their progress" (p. v).

Literature Review

According to Baroody, (2006) students learn mastery of basic number combinations through a series of three phases. These include "Phase 1: Counting strategies, Phase 2: Reasoning strategies, and Phase 3: Mastery" (Baroody, 2006, p. 22). In his article, Baroody (2006) debunks commonly known conventional methods for teaching students the basic facts. One strategy, often seen in educational settings, is the rote memorization of facts through drill and practice routines. For example, students who show signs of quick recall of a combination of facts might fail to remember long-term what those combinations are. The research is presented in the number sense view. Rather than seeing mastery as only obtained through learning individual

facts, the number sense view proves that "mastery that underlies computational fluency grows out of discovering the numerous patterns and relationships that interconnect the basic combinations" (Baroody, 2006, p. 24). This level of learning the basic facts refers to Baroody's (2006) second phase of developing mastery. When students are developing answers using reasoning strategies, they are building on their fluency in order to gradually reach automaticity. The transition of the strategies in the Quick Facts program presented in the Number Corner Curriculum follows these phases. According to Bay-Williams and Kling (2014), in describing Baroody's first phase, "a major developmental milestone for children acquiring fluency with their basic facts is moving from counting all to counting on" (p. 241). Counting on, described later, is the first strategy students are taught in the Quick Facts program. Doubles and combinations of ten are the next strategies for developing Phase two. When students continue to develop their understanding of the strategies and get to the point where they just, know from memory all of the facts, then they have successfully reached automaticity, Phase 3—Mastery.

Strategy-based approaches to learning basic facts proves to have many benefits (Isaacs & Carroll, 1999, p. 508). Not only are students able to learn their facts effectively and more likely to retain them but they are taught how to organize the facts in order to apply them later on. When mathematics learning steps away from rote memorization the outcomes leave students with more confidence and stronger understanding. However, educators must also use caution when using strategies-based instruction. "Children might learn strategies by rote, so that mindless memorization is replaced by equally mindless strategies (Cobb, 1985)" (as cited in Isaacs & Carroll, 1999, p. 508). Teachers must also avoid a narration of the strategies and rather dig deep into each to build lasting conceptual understanding.

Isaacs and Carroll (1999) state “the traditional rote approach to the basic facts, with frequent drill and timed tests, has serious disadvantages” (p. 508). These authors suggest that students learn basic facts gradually, that are eventually mastered and committed to memory, and are later transferred to more difficult facts. Students’ knowledge of numbers starts from the very basics of counting all, to gradually counting on and extends to learning parts and wholes of numbers. Later students are ready for developing understanding of the doubles and parts of ten. When and how often to practice these skills becomes a great topic of question. Practice too early can be detrimental to students. Rather, ensuring “brief, engaging, and purposeful practice distributed over time is usually most effective” (Isaacs & Carroll, 1999, p. 508). A possible instructional sequence provided in this article groups subtraction and addition facts together by strategy rather than sum. Before moving on to teaching subtraction, the following strategies in order are what Isaacs and Carroll (1999) recommend for teaching single digit addition:

1. Basic concepts of addition; direct modeling and "counting all" for addition
2. The 0 and 1 addition facts; "counting on"; adding 2
3. Doubles (6 + 6, 8 + 8, etc.)
4. Complements of 10 (9 + 1, 8 + 2, etc.)

The authors also suggest that in order to assess facts knowledge, the teacher must gather evidence from a variety of areas. Combinations of observations, discussions, interviews, inventory tests, and diagnostic tests should give a wide view of each student’s conceptual understanding and use procedural skills (Isaacs & Carroll, 1999, 508).

Combining strategy instruction and timed drills, is shown to be an effective strategy for increasing different aspects of fluency. A study by Nelly Tournaki (2003) compared the effects of drill and practice and strategy instruction of single-digit addition instruction. With second

grade students, graduate assistants who taught drill and practice routines were instructed to have students work quickly to compute basic addition facts with no reteaching. If the second graders participated in strategy instruction they received initial teaching of the strategy and were provided time for practice. The strategies were reviewed often if necessary throughout the intervention. An analysis of the post assessment revealed that the strategy instruction intervention significantly improved student fluency compared to the drill and practice routine. However, students who received both interventions were shown not only to be faster than their peers in the control group but were shown to be more accurate than those receiving no additional intervention.

There is research however to suggest that drill and practice strategies are the most effective way to instruct students on the basic facts. A study of rural elementary school students, by Brian Poncy (2010) alternately used two approaches (behavioral and constructivist) to learn math facts in a second grade classroom. The first strategy, Cover Copy and Compare, stems from the principals of behaviorism. The second intervention, Facts That Last, circulates from the constructivist learning theory that "encourages students to make meaning of new materials by relating it to what is already known and self-selecting strategies to reach understanding" (Poncy, 2010, p. 919). According to the data, "an upward trend" was presented by both interventions; showing that both were a successful attempt to increase student math fact fluency.

Miller, Skinner, Gibby, Galyon, and Meadows-Allen (2011) also produced data from a study focusing on one particular strategy for increase addition fact fluency with second grade students. The Taped-Problem procedure was used to "enhance simple, addition fact fluency" (Miller et al., 2011, p. 205). Students listened to a recording of basic math facts and asked to write the sum of each fact before the recording revealed the answer. When applied classroom-

wide and over a three-week period, this proved to be effective for all three categories of students, low, medium, and high (Miller et al., 2011, p. 211-212).

One study conducted with students between the ages of eight and ten, over an eight-week period combined methods of peer tutoring and target fluency practice. Greene, McTiernan, and Holloway (2018) conducted beyond paper and pencil methods of increasing fact fluency. Tutors were instructed to use directive feedback practices that improved effectiveness of answering basic addition facts (an important component of building fluency). "The findings indicate that cross-age peer tutoring and fluency-based instruction resulted in positive outcomes for tutees in the mathematics domain, specifically mathematics fluency" (Greene et al., 2018, p. 1).

Methods

Participants

This action research project was conducted at South Prairie Elementary. This school is located in rural, central Iowa. The participants for this study were a classroom of 22 second grade students. 17 students are Caucasian, one student part Asian-American and Caucasian, two students African-American, and two students part Hispanic and Caucasian. All students spoke English as their first language. Only one student has an Individualized Education Plan (IEP) for reading and behavior. Two other students are also on IEP for behavior. Students range from ages seven to nine. There are 12 girls and 10 boys in the class.

Data Collection

The purpose of this research is to determine if students could improve their basic addition facts fluency using the Number Corner curriculum. This action research will take place over a three-month period, during the times designated as Number Corner, lasting no more than 15 minutes. Number Corner will take place every school day, except for early-out Wednesdays,

vacations, holidays, and any times designated by other school activities. Students will practice strategies with activities such as Scout Them Out at assigned in increments throughout the weeks. The Quick Facts assessments will be performed twice each week, every Tuesday and Thursday. Students will be tested on categorized skills of addition facts, decided by the curriculum (Appendix D). Periodically, the teacher researcher will also conduct activities assigned by Number Corner, intended to help students develop multiple aspects of fluency. These intervention activities such as, The Tens & Nines Game, Tens & Nines, Doubles Up, Up to Ten Game Record Sheet, and Fact Strategy Game Record Sheet are included in the curriculum but were not used for data collection by the researcher.

Number Corner Checkup. Prior to implementing the intervention all students took the one-minute timed pre-test as a part of the Number Corner Check-up 1. The timed assessment is a set of 20 basic addition facts or single-digit addition, that have sums ranging from zero to twenty. Students earn a final score of 0, 1, 2, 3, or 4 based on a range of correct problems answered in one minute. For example, a student getting between 14-15 problems out of 20 correctly would earn a score of two of four total points. According to the Number Corner Assessment Guide students are considered Consistent 4, Proficient 3, Approaching 2, or Not Yet 1-0. The teacher researcher will use this data to pull students at random from each of the scoring categories. Students will take this post-test at the end of the intervention, the teacher researcher will analyze this data in the same manner and place students in similar categories based on their score. The pre and post-assessments will also be analyzed against one another to help the teacher researcher make conclusions about the intervention.

Quick Facts. Students are introduced to the Quick Facts (QF) routine in the first week of the action research process. Students are taught the basic expectations for this activity using

Quick Facts Count On Form A (see Appendix A). QF forms are provided in the Teacher Masters for Number Corner; the teacher researcher must copy and organize these QF checks, according to the direction provided in the manual, prior to starting the program.

All students start the QF program at the first level, Count On. This quick check consists of 20 basic addition facts with sums no higher than 20 but follow the rules for the Count On strategy. This means students will encounter a number and will have to count on one, two, or three more from that number to solve the fact. Students are considered fluent if they score at least 18 out of 20 facts correctly during the one-minute timing, and can move on to the next strategy. If students score 17 or less or are unable to finish in one minute, then they will continue working on this strategy during Scout Them Out. Students can try to pass this level again during the next QF routine. Students can attempt the same QF strategy test as many times as it would take to pass. However, the teacher researcher will only require five attempts to avoid student frustration and anxiety.

There are six different levels where students will learn individual strategies for adding basic facts. After students have passed those six then they will work for automaticity by completing a QF test that combines two strategies. For example, the first test has a combination of Count On and Make 10 facts. The expectations for these assessment are the same however, the time is altered, students will get two minutes to complete these 20 facts.

Scout Them Out. During the first week of the action research period, students are first introduced to Scout Them Out using the Number Corner Teacher Guide by the teacher researcher. Students are taught the basic routines and expectations for each activity using Scout Them Out Addition A (see Appendix B). Scout Them Out activities are found in each student's own Student Books for Number Corner, provided by the Number Corner curriculum. Scout

Them Out is routine that gives students the chance to independently practice the strategy they are currently studying in order to pass QF. For this activity, students will encounter an assortment of basic addition facts, they must find and circle the facts that match the rules of their current strategy. Once they have circled them all, students return to the beginning and start solving every problem they circled. There are many Scout Them Out pages, titled Addition A, Addition B, and so on, throughout the Student Book to give students several chances to practice each of the basic facts strategies. These activities are assigned based on the Number Corner pacing guide or up to the teacher researchers discretion. QF and Scout Them Out are never performed on the same day.

This action research study contains quantitative data. Information will be gathered from Number Corner Checkup 1 (see Appendix C) taken both at the beginning and completion of the intervention. Data will be collected in teacher notes to show the dates and attempts students tried to pass each level of Quick Facts. The teacher researcher will determine if the Number Corner curriculum supports computational fluency and effectively increases student fluency of basic facts.

Data Analysis

Prior to implementing the Number Corner program, the class had an average score of 13.5 addition math facts answered correctly out of the possible 20 in one minute. After scoring assessments, the teacher researcher must place students into ranges based on the number of correctly answered facts determined by the Number Corner curriculum. The class as whole had an average score of 2 out of 4 points possible. These ranges determine the score that is then included on the final Number Corner Check-Up 1 assessment score for the pre-assessment (Figure 1).

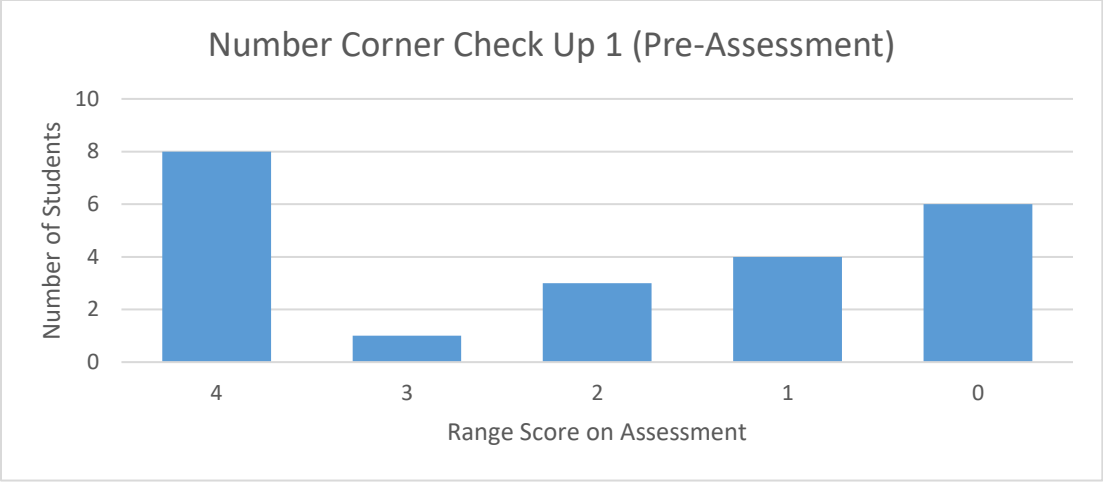

Figure 1. This bar graph shows that students scored in a variety of ranges based on their number of addition facts per minute. While some were already performing at proficient level of fluency, more than half of the class was not.

At the completion of the intervention, the class scored an average score of 18 facts answered correctly out of the possible 20 in one minute. The teacher researcher again, placed students into ranges based on their final score to determine their proficiency of fluency (Figure 2). The class as a whole scored an average of 3 points out of the 4 total.

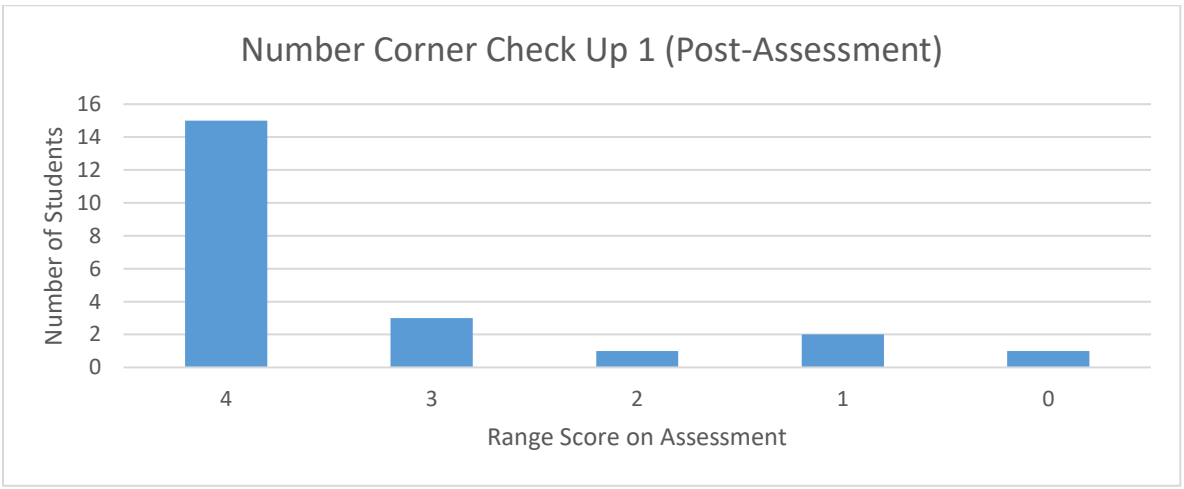

Figure 2. This bar graph shows that over half of the class was fluent at the conclusion of the intervention.

The quantitative data collected from the pre-assessment and post-assessment shows that most students made improvements and no students showed a decrease in fact fluency (Figure 3). Students were placed in ranges determined by their number of facts answered correctly in one minute and then were placed in a final category of proficiency. Any student scoring 2 or lower was considered not fluent. Those categories were labeled as, Consistent 4, Proficient 3, Approaching 2, or Not Yet 1-0. Prior to the intervention, 36.4% of the class were Consistently fluent. 68.2% of the whole class were Consistent at the conclusion. All students scoring 3 or higher were considered fluent. The data also shows there was a significant decrease of students in the Not Yet category. After the teacher researcher scored the pre-assessment, 45.5% of the class was labeled as Not Yet. At the conclusion of the intervention, only 13.6% of the whole class was still considered Not Yet, earning a final score of either 0 or 1 (Figure 4 and 5).

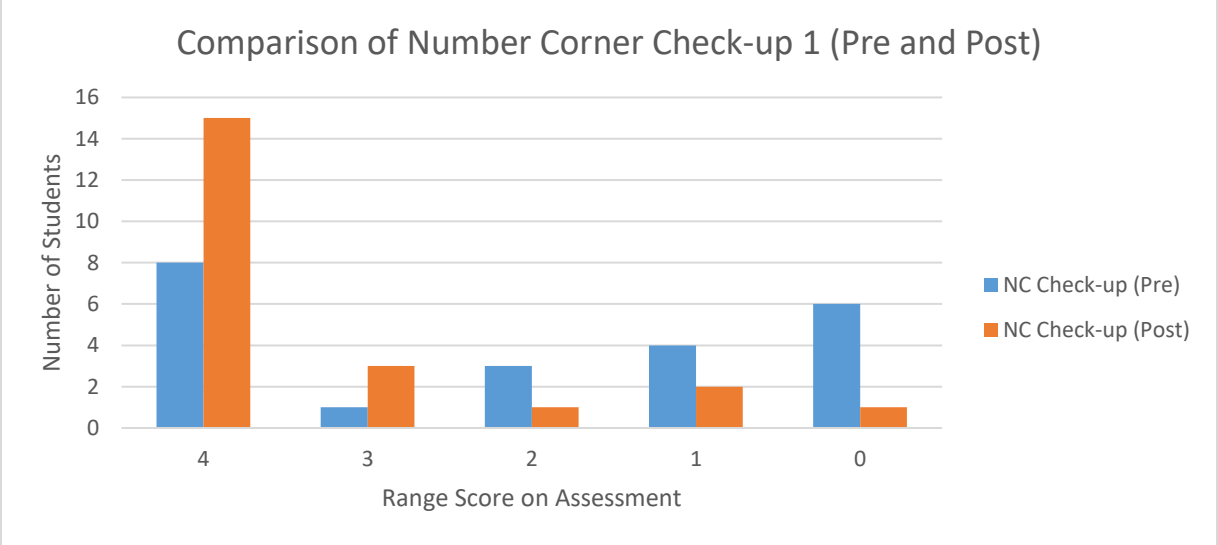

Figure 3. This bar graph shows the increase of students who scored 4 and 4. There is a significant decrease of scores in ranges 0 to 2. There was an increase of students reaching proficiency and a decrease of students in the non-proficient categories.

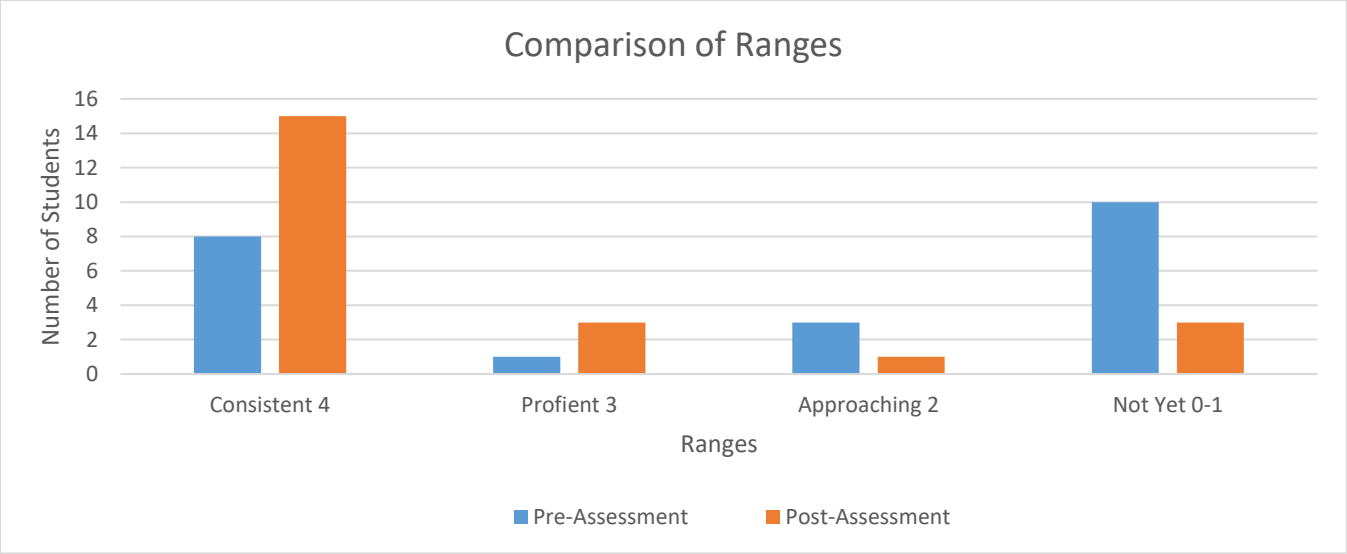

Figure 4. This bar graph represents the final category that students were placed into based on their range score from both pre and post-assessments. This data shows the scores 0 and 1 combined into one category, Not Yet.

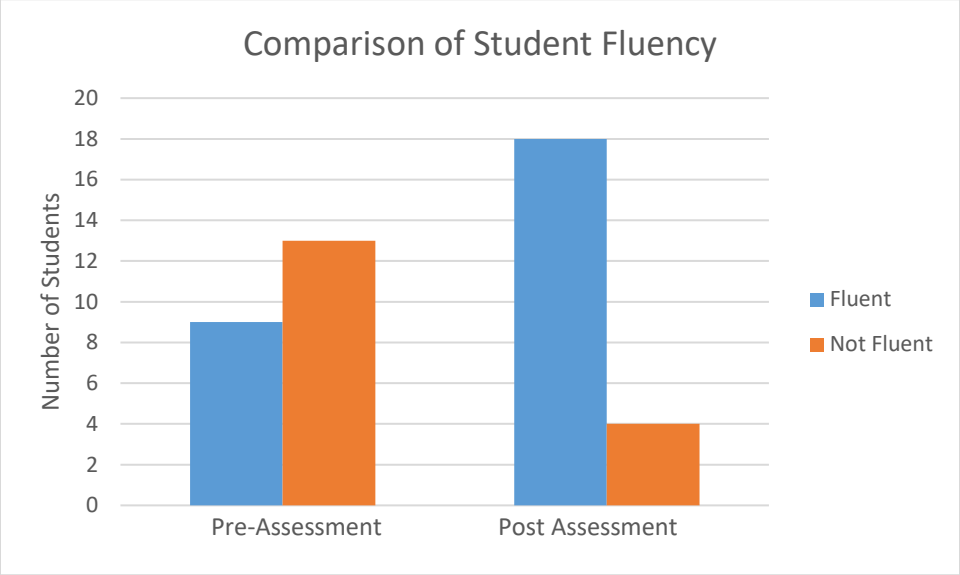

Figure 5. This bar graph compares the students that were labeled as fluent or not fluent determined by the Number Corner Check-Up 1, both pre and post-assessments. It shows the significant increase of students who are now fluent after the conclusion of the intervention.

To analyze the data by individuals, the teacher researcher placed all students into the respective range categories according to their score out of 4. Then at random, two students were chosen from every category (Figure 6 and 7). Since the Proficient category contained only one student after scoring the Pre-assessment, the teacher researcher decided to have only that student represent 3 as their final range score. The quantitative data shows that Student A increased their facts per minute by 1 and remained in the Consistently fluent category. Students C, D, and E all increased their facts per minute scores to 100% on the post-assessment, all earning a spot in Consistently fluent category as well. This quantitative data also shows that Students B and G made no growth. Student B scored at 100% on both pre and post-assessments, leaving no room for improvement. Student G significantly increased her facts per minute by 5 facts but still remained in the Not Yet category.

Student	Facts per min. (Pre)	Range Score (Pre)	Facts per min. (Post)	Range Score (Post)
A	19	4	20	4
B	20	4	20	4
C	17	3	20	4
D	15	2	20	4
E	14	2	20	4
F	5	0	14	2
G	6	0	11	0

Figure 6. This table represents a random selection of students. It shows the change of scores in number of facts correctly solved per minute and the range, between 0 and 4, that each student was placed in based on that final score. Green represents Consistent proficiency, orange is for Proficient, yellow for Approaching, and the red boxes represent the Not Yet category which indicates students either scored a 0 or 1.

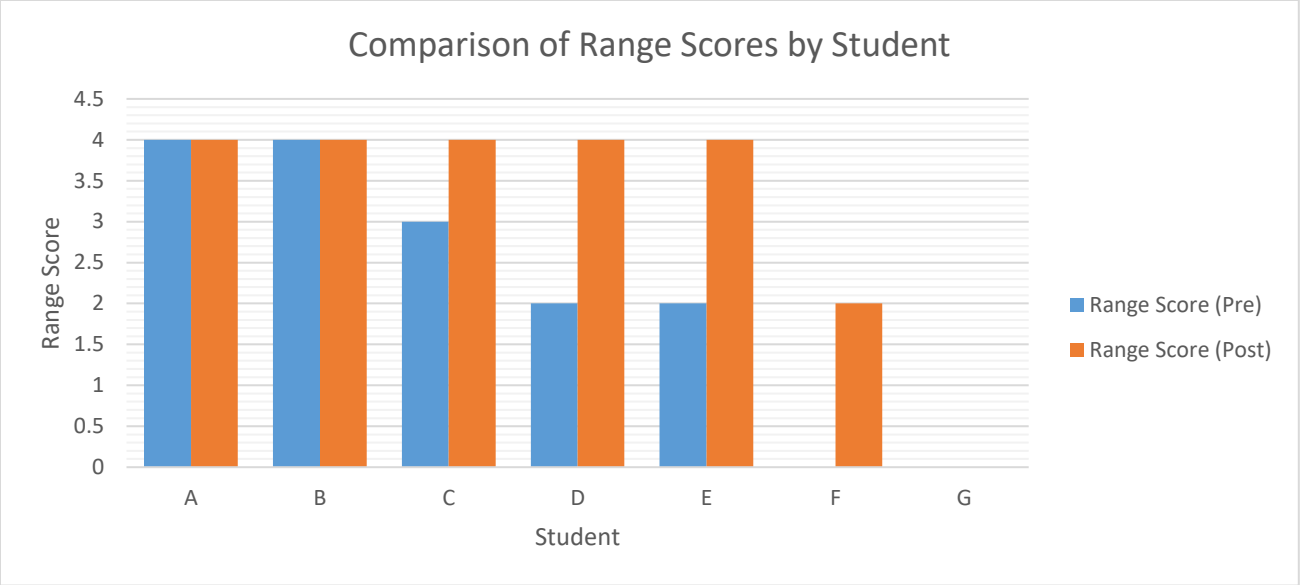

Figure 7. This bar graph visually represents the range scores of the pre and post-assessments from all students selected and labeled as Students A-G.

Discussion

Summary of Major Findings

The Number Corner curriculum was successful at helping students increase their addition facts per minute. However, not all students were considered fluent by the conclusion of the intervention. Students F and G struggled the most throughout the intervention. Student F was often removed from the room during Number Corner due to time spent with their special education teacher. This means that they were often not able to participate in the Quick Facts assessments, Scout Them Out activities, or other activities assigned in the Number Corner program. The teacher researcher then spent time outside of designated Number Corner time to provide one-on-one or small group practice with Scout Them Out and other activities. Student F attempted the first category, Count On, five times, was allowed to move on to Doubles, and passed the second level of Quick Facts within four attempts. However, due to increased absences this student was not able to complete further assessments before the intervention was complete.

Student G had difficulties completing tasks in the time given. When presented with the Quick Facts assessments, Student G was never able to pass the Count On assessment. Student G would become frustrated and angry with themselves due to their inability to solve problems quickly. During Scout Them Out, Student G showed to have accurate and flexible strategies for solving each fact but was not able to do so in an efficient amount of time. At the teacher researcher's discretion, Student G was then required to attempt each level of Quick Facts but only had to do so five times before being allowed to move on to the following skill. However, the expectation was set that Student G would have to revisit each level again to attempt passing before moving on to categories that combined two basic facts skills. Student F did not pass any levels of the Quick Facts assessment before the intervention was completed.

Limitations

Some limitations of this study may impact the results such as the size of the sample classroom, student background, and teacher bias. This intervention was performed with a small group of students. There are limitations due to size of the sample classroom that make it difficult to determine that all second grade students would always succeed from the Number Corner, Quick Facts program. This sample classroom lacks a variety of students; there are some students in the sample class that have special needs and some cultural differences but this creates a limitation as it could make it difficult to determine if this intervention is a good fit for English language learners or students with special needs. Teacher bias also plays a role at determining the validity and reliability of this study, as the teacher researcher was the classroom teacher. There were some determinations made by the teacher researcher such as scheduling and testing that that were modified during the intervention. Most of these were due to the teacher researcher knowing their student's limits and realizing when they were getting frustrated. In wanting to

avoid math anxiety and frustrations with time, the teacher researcher allowed flexibility with certain testing situations and students. There were also school-wide scheduling changes that lead to inconsistencies with preforming all Number Corner activities relating to basic fact fluency.

Challenges

The teacher researcher attempted to collect the data that would best represent student fluency of basic addition facts. However, there is a great deal of data and questions that could spark when looking at the intervention as a whole. The teacher researcher could have chosen to analyze the data presented by each individual student compared to the whole class rather than just a select group of those chosen at random by category. The teacher researcher could have also included the data collected on how many times it took each student to complete each level of Quick Facts. This could help determine which facts are the most difficult for students and therefore be able to more time on them during the intervention or continue practiced based on those skills after completion. Strategies such as taking more detailed notes about how each student was performing on the Quick Facts assessments, noting which students were successful or not with Scout Them Out, and observing more during the other required activities would have been helpful to determine which assignments were the most successful at helping students succeed. There was also no control group that would have helped determine if students could still be successful at increasing their fluency of basic addition facts without this intervention.

This program is completed in partnership with the Bridges in Mathematics curriculum and therefor is easily accessible to teachers who already have the program-either purchased by themselves or through their school district. This basic facts program is also expected to last over a three-month period. If used in conjunction with Bridges, the teacher will be able to successfully complete the program. However, the longer period of time raises some questions about its overall

sustainability. Can it keep students interested in learning their facts? Is this period too long to teach students effectively?

Conclusion

The results of this action research indicate that the Number Corner curriculum does support computational fluency and aids in increasing the number of basic facts that students can complete in one minute. Fluency of basic math facts is by a variety of definitions the ability for students to be accurate, flexible, and efficient. Using the Number Corner curriculum teaches students to be all three. The Quick Facts program helps the teacher and students practice efficiency and provides a formative measure by which to determine if students are applying new learning. Scout Them Out was an effective way to provide practice of basic facts skills and a positive teacher tool for offering supplemental instruction. The curriculum as it is written, is an effective tool for both quality instruction and an effective program for helping second graders improve their fact fluency.

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Appendix A: Quick Facts Count On Form A

February | **Computational Fluency Activities 1 & 3** *2 class sets, plus 1 copy for display*

NAME | **DATE**

Quick Facts Count On Form A

1 I completed these facts in (circle one): 0–1 minute 1–2 minutes	**2** I got _____ sums correct.
3a Did you finish the 20 addition facts in 0–1 minute? Yes No	
3b Did you get 18 or more sums correct? Yes No	
If you circled Yes for 3a and 3b, select a new set of facts to work on. If you circled No for 3a, 3b, or both, keep working on the Count On facts.	

1 Complete the addition facts.

2 + 6	3 + 8	8 + 3	5 + 2	4 + 2	2 + 3	8 + 1
2 + 7	3 + 9	6 + 3	3 + 5	4 + 3	1 + 5	2 + 1
1 + 4	6 + 1	2 + 9	7 + 2	1 + 7	3 + 1	

2 Complete the subtraction facts. Think about the addition facts above to help.

11 − 3	9 − 2	5 − 2	3 − 1	8 − 1	11 − 2	8 − 3
6 − 1	7 − 2	5 − 1				

Appendix B: Scout Them Out Addition A

February | Computational Fluency Activity 2

NAME | DATE

Scout Them Out Addition A

1 Circle the strategy you are practicing today.

Count On Make Ten Doubles Doubles Plus or Minus One Add Nine Add Ten

2 Look at the facts below. Circle the facts you can solve using the strategy you chose.

3 Solve the circled facts first. Then solve the rest of the facts if you have time.

6 + 7	7 + 9	10 + 7	9 + 2	7 + 3	6 + 10	3 + 9
9 + 4	8 + 3	8 + 1	9 + 2	9 + 9	5 + 2	2 + 7
4 + 6	10 + 9	5 + 5	3 + 3	6 + 5	8 + 7	6 + 6
5 + 3	1 + 7	3 + 6	7 + 7	3 + 4	9 + 8	4 + 5
8 + 8	2 + 8	5 + 9	9 + 6	9 + 8	3 + 8	8 + 10

4 Use the facts you circled to write four different subtraction problems in the boxes below. Then find the differences.

____ – ____ =	____ – ____ =	____ – ____ =	____ – ____ =

Appendix C: Number Corner Checkup 1

Number Corner Checkup 1 page 3 of 4

6 Solve as many of these addition problems as you can in one minute.

10	0	1	12	4	14	7
+ 1	+ 12	+ 18	+ 2	+ 6	+ 3	+ 3
6	9	7	5	0	8	11
+ 4	+ 3	+ 2	+ 5	+ 19	+ 2	+ 3
2	8	1	3	9	10	
+ 8	+ 3	+ 9	+ 7	+ 2	+ 2	

Appendix D: Categories of Addition Facts

FACT STRATEGY NAME	EXPLANATION	EXAMPLE
Add Zero facts	Adding 0 to any quantity does not change the value of the quantity.	7 + 0 = 7
Add Ten facts	Adding 10 to any quantity preserves the value in the ones column.	7 + 10 = 17
Add Nine facts	Adding 9 to any quantity is 1 less than adding 10.	7 + 9 = 16
Count On facts (+1, +2, +3)	Students can count on with meaning up to 3.	5 + 3 may be thought of as 5 ... 6, 7, 8.
Make Ten facts	Combinations that make 10 are inherent in the number rack and readily visualized.	6 + 4 = 10
Doubles facts	The Doubles facts are visualized on the number rack as two equal rows of beads.	4 + 4 is seen as two groups of red beads on the number rack.
Doubles Plus or Minus One facts	Once the doubles are solidified, students compensate by adding or subtracting 1 to find the near doubles.	6 + 5 may be thought of as "1 more than 5 + 5" or "1 less than 6 + 6."
Leftover facts	After the previous seven strategies are well known, students realize that there are only a handful of facts remaining to be learned. These Leftover facts are often recalled by linking them to previously learned strategies.	To find the sum of 8 + 6, students can think about making 10 and then compensate, taking 2 from the 6, adding it to the 8, and then adding the remaining 4: 10 + 4 = 14.