

Impact of Hands-On Activities in Second Grade for Improving Math Fact Fluency

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Abstract

This action research study was conducted to investigate the effect math bag activities might have on students' ability to recall addition and subtraction facts more fluently. Participants in this study included a classroom of twenty students. Half of the students participated in fifteen minutes of various hands-on math fact activities each day in addition to their regular whole group classwork. The activities allowed students to physically manipulate game type pieces to solve equations using addition and subtraction. The remaining students in the class continued with the regular math curriculum but did not participate in the hands-on portion of the research. Students were given a pretest and posttest to determine growth. Findings indicated that implementing hands-on addition and subtraction fact activities daily, increased the fact fluency overall.

Examining Math Fact Fluency Through Hands-on Activities

For fifteen years my district had been teaching math using the Saxon Math program. This program had a daily math fact lesson, daily practice pages, and fact homework for each lesson. Still some of our students were not fluent with their basic addition and subtraction facts. Our district also gave us access to several online programs the students could also use to gain math fact fluency through technology. This year, our district switched to the McGraw-Hill *My MathTM* program. The new program does not have a outlined daily math fact practice portion to the program so the teachers in our district were concerned about what to do in order to help our students gain fluency of their math facts. A decision was made to add daily math fact worksheets and continue the weekly computer based activities to help increase our students' math fact fluency.

This addition to the *MathTM* program should help our students continue the same level of math fact fluency they had have over the past few years but I did not feel it was enough. I wanted to help all my students improve their fluency. Gaining math fact fluency is so important to master because it will help them in the future as they encounter more complex mathematical problems. The simple addition and subtraction part of the equation should come automatically to them so they can concentrate on the more difficult aspects of the problem. I searched everywhere I could think of to try and figure out a way to increase my students' fluency and started thinking that maybe there was not just one sure strategy that was a fix-all method, but maybe a combination of methods would work the best. I believe that adding hands-on math activities to our regular worksheet and technology based practices will enhance an increase the ability for students to recall basic addition and subtraction facts. Math games that give students

meaningful practice help move students along through the different phases of math fact fluency (Bay and Kling, 2014).

The purpose of this study is to investigate the effect hands-on math activities might have on a students' ability to quickly recall addition and math facts from zero to twenty. My hope is, adding a fifteen minute a day hands-on activity, will increase a students' ability to recall math facts more fluently. The research question that guides this study is: What are the effects of adding hands-on basic math fact activities in a second grade classroom to increase math fact fluency?

Literature Review

Educators today need to make sure their students are college and career ready by the time they graduate high school. Every teacher has heard these words repeated over and over again. The Common Core State Standards (CCSS) were created to help make this a reality. Educators at all levels should seek to develop the skills outlined by the standards in their students (National Governors Association Center for Best Practices [hereafter NGA, 2010]). In order to prepare our students for the future the CCSS were put into place insure students develop the skills needed to be productive citizens. In mathematics, the CCSS put a plan into place to not only help students understand mathematical concepts, but also be able to quickly and accurately recall basic addition, subtractions, multiplication, and division facts.

Mathematics instruction for many years has had classrooms that use rote methods of instruction that require memorization. There is some indication that the teaching of mathematics has shifted over the years (Clements & Battista, 1990). The constructivist theorists contend that providing too much guidance during skill development may impair students' ability to think on their own and learn the needed skill. Others, such as the behaviorist, say direct instruction makes

students more successful. Many teachers are using this more student centered approach in their teaching enabling students to construct their own meaning of math problems (NCTM, 1991).

Some students understand the mathematical concepts right away, but others need more time working with the numbers in order to fully understand what the numbers represent. Difficulty in math curriculum later in education is likely to be the result of students' failure to develop proficiency in the early levels of the primary grades (Pool, Carter, Johnson, & Carter, 2013). Although there is a general agreement on the need for improvement in math fact fluency for elementary students, there are disagreements on how this should be accomplished. Some professionals argue new concepts need to be thoroughly explained and students should be provided with different learning strategies in order to make the most gains (Poncy, McCallum & Schmitt, 2010). There does not seem to be a one key fits all strategy for helping students acquire the math fact fluency that is needed. There are many ways to help students practice math fluency although, many teachers often only offering one way of practice during class time.

What is Math Fact Fluency?

Math fact fluency is the ability to recall the answers to basic math facts automatically and without hesitation. Fact fluency is gained through significant practice, with mastery of basic math facts being a goal. Both conceptual understanding and the ability to solve facts accurately under untimed conditions are prerequisites for automatic recall of facts. Once the understanding and ability to solve the facts have been obtained, the student must practice the facts in order for them to be answered both quickly and accurately. The usual speed for automatic recall of facts is less than two seconds per fact (Spear-Swerling, 2006). Students who can fluently complete math facts are better able to fluently complete subsequent advanced math tasks. Students who lack fluency are more likely to avoid assigned math tasks than fluent students because the tasks are

perceived as too difficult to complete successfully (Poncy et al., 2010). Because students learn in different ways and at different speeds, teachers must be able to present mathematical skills in a variety of ways.

Instructional Techniques

Teachers know in order for students to become proficient in mathematics, they need to understand the basics. In a second grade classroom, many students practice basic addition and subtraction facts by doing drills. Some teachers also incorporate computer based games to help keep their students interested in practicing the math facts without realizing it is work. Other teachers have found using manipulatives help increase the math fact fluency in their students. Each technique comes with its own benefits and successes. Many researchers have noticed three main practices in teaching mathematics but often disagree on which instructional technique works the best (Ando & Ikeda, 1971; Ashlock, 1971; Bezuk & Cegelka, 1995; Carnine & Stein, 1981; Garnett, 1992; Garnett & Fleischner, 1983).

Rote memorization. One way to help students achieve mastery of the basic math facts is through drill and practice. This can be done with flashcards or written drills and can be an effective method in teaching students to learn the facts (Van de Walle, 2006). Each day, many students are shown flashcards to recall facts or presented with a worksheet with 20 to 100 problems to solve, usually in a time limit. Prior to being tested on the material, teachers spend time teaching special tricks to help students memorize the facts such as the adding nine trick used in addition. For the Adding nine trick, students are told when adding any one digit number to nine, just write down the number that is one less than the one you are adding to nine and put a one in front of it (Larson, 2001). Next, students are given worksheets to practice this skill over and over again until mastery has occurred.

This type of drilling facts and writing facts may be an effective way to achieve math fluency (Pool et al., 2013; Strother, 2010). Some argue this is often thought of as an old fashion type of teaching math fact fluency however, some research indicates students using flashcards and written practice daily become more fluent at a faster pace than students using other methods (Clements & Battista, 1990). Although this builds math fact fluency, it does not help the student understand what the numbers represent (Strother, 2010). Continued practice of writing the answers to math facts quickly is one way of practice for math fluency, there are other avenues that can be taken as well.

Technology. Others educators believe, considering the students of today's technology filled society, that computer based programs are a better way to help students become fluent with basic math facts. Research shows a positive effect of computers on student achievement in many curricular areas, especially in the area of mathematics (Duhon, House, Stinnett, 2012). The use of technology gives students an opportunity to investigate mathematical ideas. Classroom that use technology tend to have higher achieving students, see more collaboration between students as well as more creative projects, and have students with a more positive attitude about school (Page, 2002). Student learning is improved when technology is used. Many studies have shown increases in performance when a students' education is enhanced with technology. Technology can be a powerful tool in the hands of children. They love playing the game-like activities. The use of technology as a tool during investigations allows students to reduce their computation time (Grouws & Cebulla, 2000). Online math facts of many types can be found to appeal to all students. There are games that simply drill with flashcard type activities, some with exciting bells and whistles, and some that give rewards such as access to another game when mastery is

achieved. Although, this type of fluency practice often appeals to students, solely using technology based activities limits some students when using math in the real world.

Hands-on Activities. In contrast to drilling math facts, hands-on instruction gives more value to the development of mathematic concepts (Clements & Battista, 1990). Manipulatives are pictures, drawings, or concrete objects that can be physically handled by students in order to demonstrate or help figure out a mathematical concept (ETA Hands to Mind, 2010; Van de Walle, 2013). Manipulatives are tools that are used to help students understand mathematical concepts more completely (MCTM, 200, NGA, 2010). The NGA require and encourage the use of Manipulatives can be used in teaching fact fluency as well as mathematical understanding. Mathematics achievement increases when manipulatives are put into good use in the classroom (Clements, 1999; NGA, 2010). Not only does the use of manipulatives improve math fluency and understanding but the use of manipulatives over long-term provides more benefits (Sowell, 1989). Activities that consist of sorting activities, dice games, card games, and file folder type games along with regular drill practice with flashcards, written worksheets, and computer programs should assist in helping students acquire the skills needed to become successful in mathematics.

Playing games helps ensure students grow to have an understanding of math facts. Games with dice and cards allow students to add up the numbers. Students need frequent practice of math facts in order to master them (May, 1998). As students play games they practice the basic facts and rapid recall as well as figure out what the numbers represent. A game can be problem-based but not appear as threatening to the students (Van de Walle, 2006). The game element of the practice will interest the students, encourage them to practice and learn the mathematics concepts, and most of all, will help them become more fluent math fact students.

Hands-on activities help students stay interested in learning the basic facts but probably will not give the results necessary if it is the only practice used.

Achievement in mathematics can be increased by the long-term use of hands-on activities (Stroder, 2010). Researchers have discovered that using hands-on materials in the classroom increases achievement in students that use the manipulatives long term (Suydam & Higgins, 1977; Parham, 1983; Sowell, 1989). Using hands-on materials over time, can provide valuable support to students in helping them build links between the object, the symbol, and the mathematical idea presented (William, 2011). When students are exposed to hands-on material on a weekly bases, they have shown to have a significant improvement of a grade level ahead in mathematics (Wenglisnsky, 2000).

Even though experts disagree on the best way to teach mathematics, they do agree that the lack of math fact retrieval can lessen participation in math class discussions (Woodward & Baxter, 1997), success in mathematics problem-solving (Pellegrino & Goldman, 1987), and even slow down the development of everyday life skills (Loveless, 2003). Recently, educators are leaning more towards believing that students need to learn basic math facts completely. That is, understanding the meaning behind the numbers as well as practice recalling facts fluently. This includes memorizing facts with automaticity for speed and accuracy and with understanding the meaning of what the numbers represent in order to understand more complex tasks of higher mathematics. It makes sense that using a combination of different math fact activities will help students learn the basic math facts fluently and completely.

Meeting the Standards

A well-supported, manipulative based instruction,, along with other best practices help create learners as owners of their own learning (ETA Hands to Mind, 2010). A second grade

classroom that uses a combination of written drills, flashcard practice, and computer generated math fact practice in combination with hands-on thought provoking activities that help the students make a conceptual understanding of the mathematics should help increase the mathematical knowledge of the students (ETA Hands to Mind, 2010). Increasing the math fact automaticity of students by adding hands on math fact games and sorting activities to their fact fluency education should help students understand what the numbers represent.

According to the CCSS, second grade students should know the basic addition and subtraction math facts fluently, have the ability to add two-digit numbers, and understand different methods of subtract two-digit numbers (NGA, 2010). For students to become fluent, requires the employment of multiple of learning strategies. Students need to learn the mathematical process, remember facts, and figure out what the numbers represent (Koshmider & Ashcraft, 1991). The proficiency a student has in mathematics ultimately correlates with later success in the workplace (Loveless, 2006).

The intent of the standards is to have students ready for college or the workplace upon graduation. (NGA, 2010) Without procedural fluency and the ability to recall facts from memory, the students' focus during problem solving will be on basic skills rather than the task at hand. This draws attention away from the learning objectives (Mercer & Miller, 1992). Students need to see a connection and use math in the real world (Bonotto, & Basso, 2001). Using diverse situations will also lead to meaningful experiences for students (Callingham 2004).

Second grade students should have their instructional time focused on four critical areas. Time should be spent extending their understanding of base-ten notation, building fluency with addition and subtraction, using standard units of measure and describing and analyzing shapes (NGA, 2010). The CCSS hope to lead students to not only be able to mentally and fluently recall

math facts, but also be able to understand what the numbers represent and learn how to use that knowledge to think mathematically. The hope is that understanding the mathematical concepts, and not just memorizing the answers, will help them later when they are introduced to a more difficult analysis of numbers.

Methods

This action research was conducted in a second grade classroom for four weeks during the month of February 2015. I collected and analyzed quantitative data during this action research project. I used a random sampling of students to determine the participants in this study.

Participants

This action research took place in a K-2 school in rural Illinois. There were 319 students enrolled in the school with the average class size of 20 students. 64% of the students are from low-income homes and 25% of the population had a learning disability. I chose my second grade class to conduct this study. There were 20 students in the class. Nine students were boys, eleven students were girls, and two of these students, one boy and one girl, had an Individual Educational Plan (IEP) in mathematics. All the students in the study were seven and eight years old. The class was divided into two groups by a random draw. Half of the class was the control group and the other half of the class is the experimental group. Students were assigned an identifying number to ensure confidentiality. The gender of the participants is represented in the identifying number. The first number represented the gender, the second number represented the student identification number, and the third number represented whether the student was in the control or experimental group. The control group students end with the letter C and the

experimental group students end with the letter E. These following participants were involved in this study from the control group: B1C, B2C, B3C, G1C, G2C, G3C, G4C, G5C, G6C, G7C.

These following participants involved in the study represented the experimental group: B1E, B2E, B3E, B4E, B5E, B6E, G1E, G2E, G3E, G4E.

Two students (B2C and G7C) had documented learning disabilities in mathematics. They receive core mathematics instruction with a special education teacher. The both receive additional math fact instruction in the regular education classroom.

Procedures

Two different testing materials, twenty different hands-on manipulative based activities, and a journal kept by the teacher were used over the course of four weeks to collect data for this study. These instruments helped provide data to determine if practicing addition and subtraction facts using hands-on activities affected the student's ability to recall math facts through twenty more fluently.

Addition and Subtraction Pretest and Post-Test. Timed addition and a subtraction tests, retrieved from superteacherpages.com, were conducted prior to implementation of the hands-on activities (Appendix A). Students were administered a pretest that included forty-three addition facts. The students were timed for one minute and the data recorded. The students were again timed for one minute and the data recorded. The same test was given at the end of the hands-on activities. These tests were used to determine students' growth.

Hands-On Activities. The hands-on activities, which were teacher created materials, were used only by the experimental group (Small sampling in Appendix B). The experimental group was grouped into pairs. They were given three different math bags to complete, each

school day, for fifteen minutes. The math bags were rotated through the groups. The activities consisted of sorting, matching, and puzzle type activities with different levels of difficulty. No writing was involved in these activities, only hands-on manipulatives. Some activities required the students to come up with the sum or difference and some required students to find the missing addend with a variety of whole to part and part to whole thinking. Students were given a number line and/or linking cubes if needed to solve the problems. During the four weeks, each activity would have been completed two to three times by each pair of students. The students in the experimental group were given a partner to work with during the research period. The partners were to work on activities I created and put into bags. Each bag was labeled A1, A2, A3, B1, B2, B3, etc. through the letter E. The students were to begin working on the activities in order. Example: Students that were assigned math bags that were in the A group, completed math bag A1, followed by math bag A2, and finally with math bag A3. If they completed all three activities, they were to repeat math bag A1 again.

Figure 1.

Math Bag Rotation Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
Math Bag	Student Partner Groups				
A	1	2	3	4	5
B	2	3	4	5	1
C	3	4	5	1	2
D	4	5	1	2	3
E	5	1	2	3	4

Note. The participants were grouped together with a partner to complete the daily activities. The students kept the same partner throughout the study.

The activities in the math bags consisted of various activities that cause the students to think mathematically using addition, subtraction and comparing skills. Communication with their partner was required. They both had to agree on an answer before moving on to the next problem. If they disagreed, the students needed to communicate their reasoning for the answer they believe was correct to one another. They could use a number line to help prove their thinking. After two weeks, one activity in each set was replaced with a new activity and the others remained the same. Each activity was used two to four times. After four weeks, the students in the experimental group as well as the students in the control group were given the same test as a posttest that was given as a pretest. The scores were recorded.

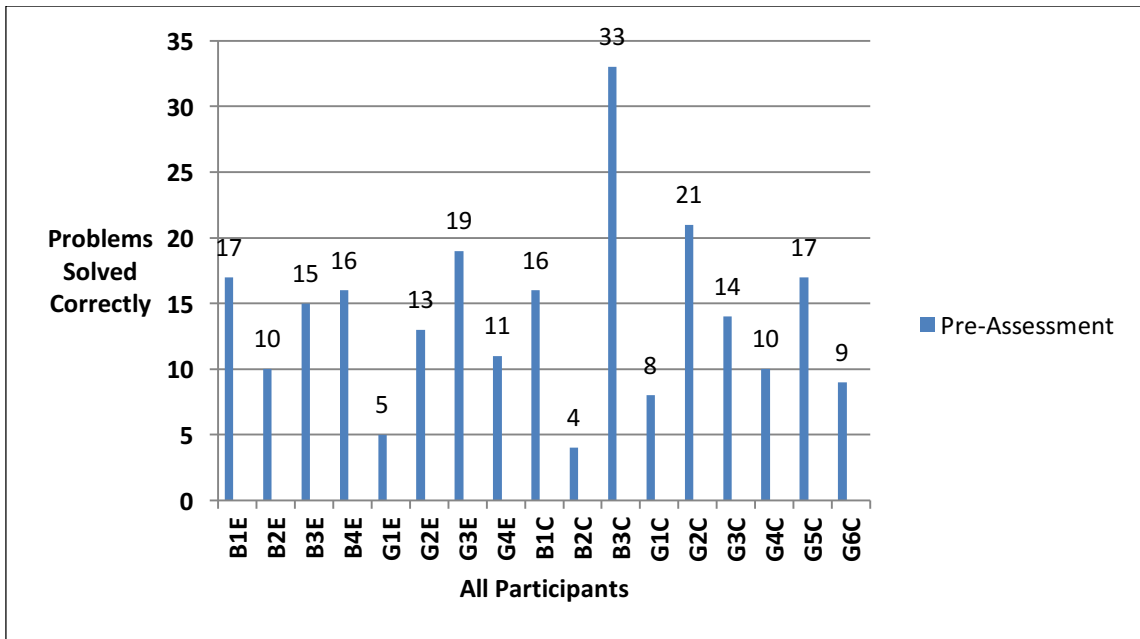
Teacher Journal. Information about the hands-on activities was kept in a teacher journal throughout this study. Notes were kept on which activities were used, how the students worked cooperatively, special struggles, and successes the students had, as well as any expected or unexpected noteworthy observations made by the teacher. A few conversations between the experimental students were recorded in the journal.

Results

The main purpose of this action research was to determine if implementation of daily hands-on math fact activities had an effect on a students' ability to increase addition and subtraction fact fluency. The students were selected by a random draw, resulting in six boys and four girls for the experimental group leaving three boys and seven girls in the control group. Each student in both the experimental group and the control group (Figure 2) were given a pretest to establish a baseline.

Figure 2.

Timed Pre-Assessment for All Participants

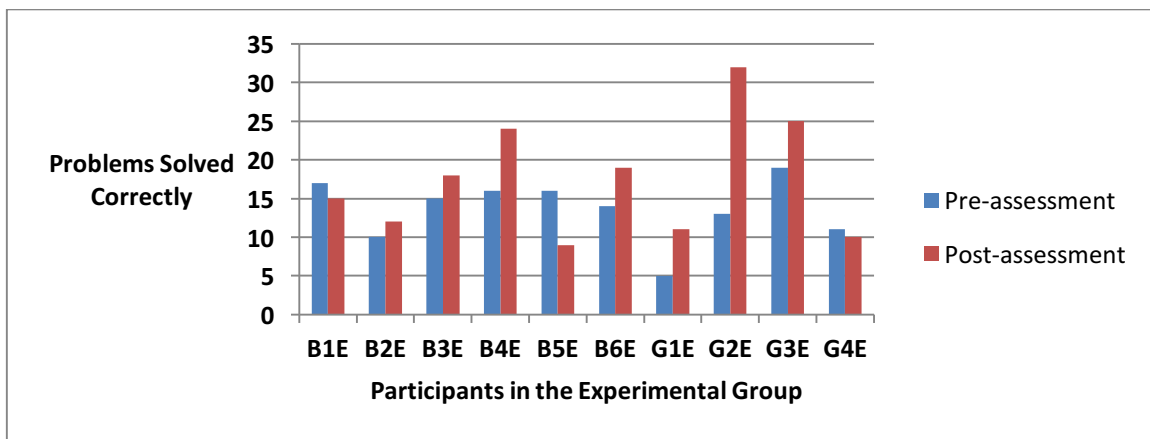


Note. The participants ending in E indicate the experimental group and the participants ending in C indicate the control group. B indicates a boy participant and G indicates a girl participant.

The overall score of the experimental group on the addition pre-assessment was 136 with a mean score of 14. The students were given one minute to answer as many problems as possible and were able to correctly answer 136 problems. The overall score of the control group on the addition pre-assessment was 141. The students were able to correctly answer 141 problems with a mean score of 9.5. The test included writing the answer to addition facts through twenty. The students were given one minute to answer as many problems as possible. On the addition pre-assessment, the control group answered five problems more than the experimental group.

Figure 3.

Comparison of Pre-Assessment and Post Assessment for Addition Facts of Experimental Group



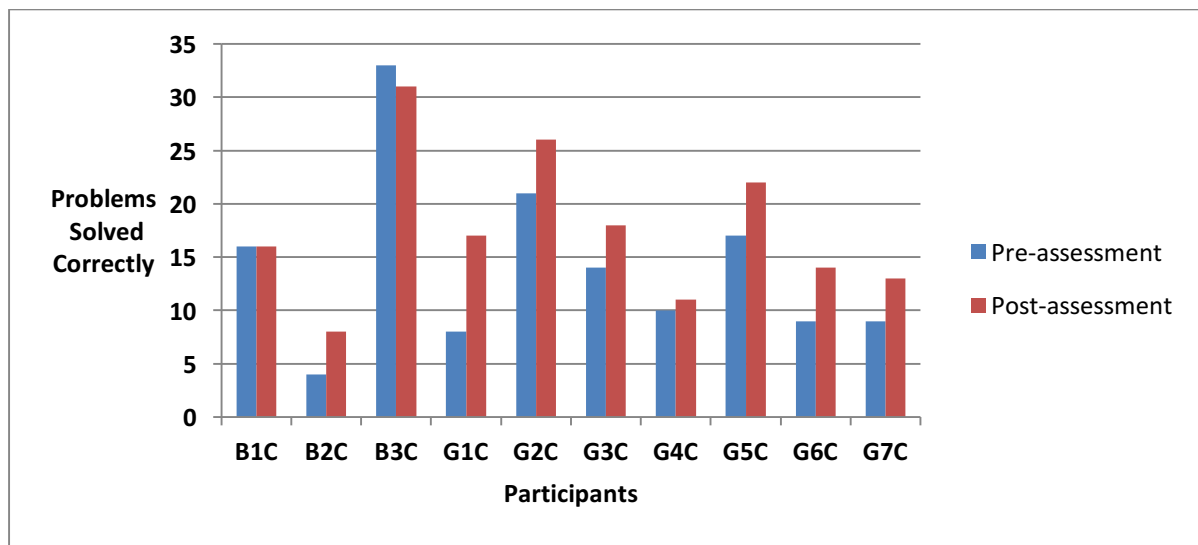
Note: The B indicates a boy participant and the G indicates a girl participant.

Overall, the participants in the experimental group, whom received the daily math bag practice, improved their performance (Figure 3). Three participants, B1E, B5E, and G4E, showed a decline in their ability to answer addition problems through twenty after the four week period of daily math bag practice. Participant B1E showed a two question loss, participant B5E showed a seven question decrease, and participant G4E showed a one question loss. The participant making the greatest gain was G2E. She showed a 19 problem increase. An increase in two correctly answered questions was obtained by participant B2E and an increase of three correctly answered questions was obtained by participant B3E. Participant B4E demonstrated an eight problem growth and participants G1E and G3E were each able to solve six more problem correctly in the one minute timed tests. In analyzing this data through a t-test, the data demonstrated a .05 level of significance, which shows a statistical significance between the two sets resulting in a positive influence on the results. The amount of growth between when the experimental group took the pre-assessment and the post assessment increased. This increase

shows growth in the addition fact fluency was obtained. The mean score for the pre-assessment was 12. The mean score for the post assessment was 15. This shows a growth of 3. Overall, the students in the experimental group showed improvements in their addition math fact ability with an increase of 39 problems. In this study, using the math bag activities on a daily basis, helped improve the students ability to complete addition facts more quickly.

Figure 4.

Comparison of Pre-Assessment and Post Assessment for Addition Facts of Control Group



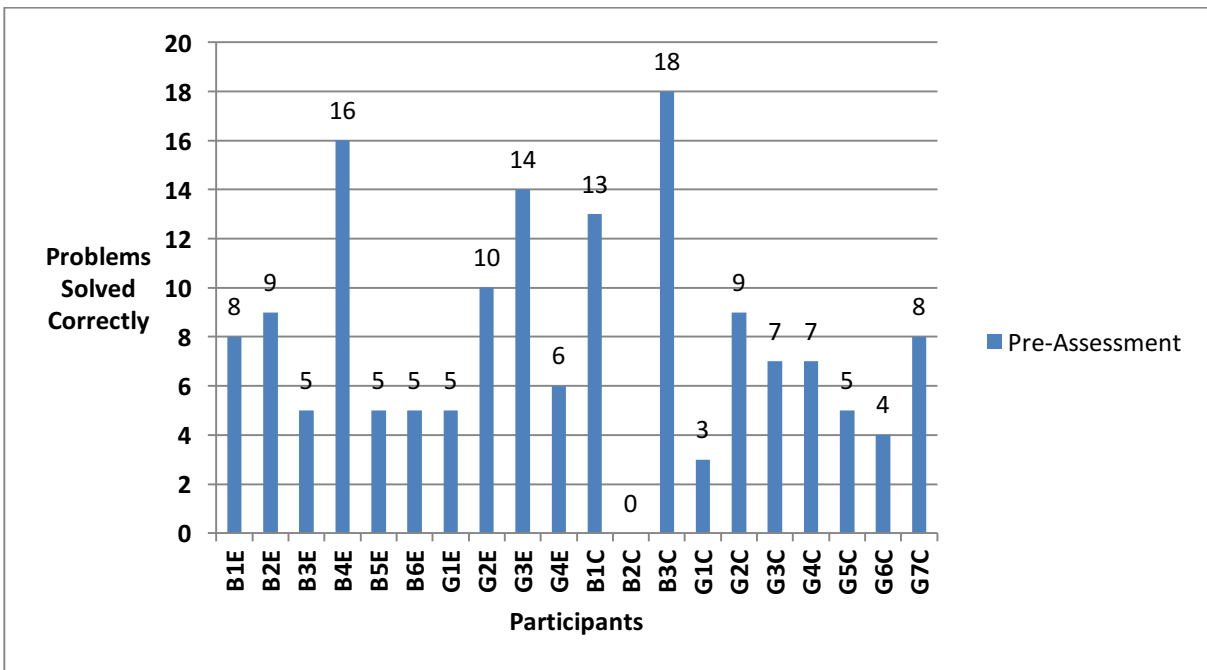
Note: The B indicates a boy participant and the G indicates a girl participant.

For the control group, students also showed an increase in the ability to complete more addition math fact problems through twenty than they did four weeks prior (Figure 4). Participant G1C showed the greatest improvement. She had a nine problem increase. Three participants, G2C, G5C, and G6C had a five problem improvement. Three other participants, B2C, G3C, and G7C, showed a four problem increase in their scores. Participant B3C showed a decrease of two problems, G4c showed an increase of 1 problem, and participant B1C did not show any change at all. The overall performance of the control group showed a 35 problem increase in performance. In analyzing this data through a t-test, the data demonstrated a .003

level of significance, which shows a high statistical significance between the two sets resulting in a positive influence on the results. The amount of growth between when the control group took the pre-assessment and the post assessment increased. This increase shows growth in the addition fact fluency was obtained. The mean score for the pre-assessment was 10. The mean score for the post assessment was 15. This shows a growth of 5. This study shows that students using typical worksheet and math practices in a whole group setting, will increase their addition fact skills. Furthermore, in this study, the control group made greater gains in math fact fluency than the experimental group made using the math bag activities. The control group increased their fluency by a mean of 5 and the experimental group only showed an improvement of 3 using the mean score.

Figure 5.

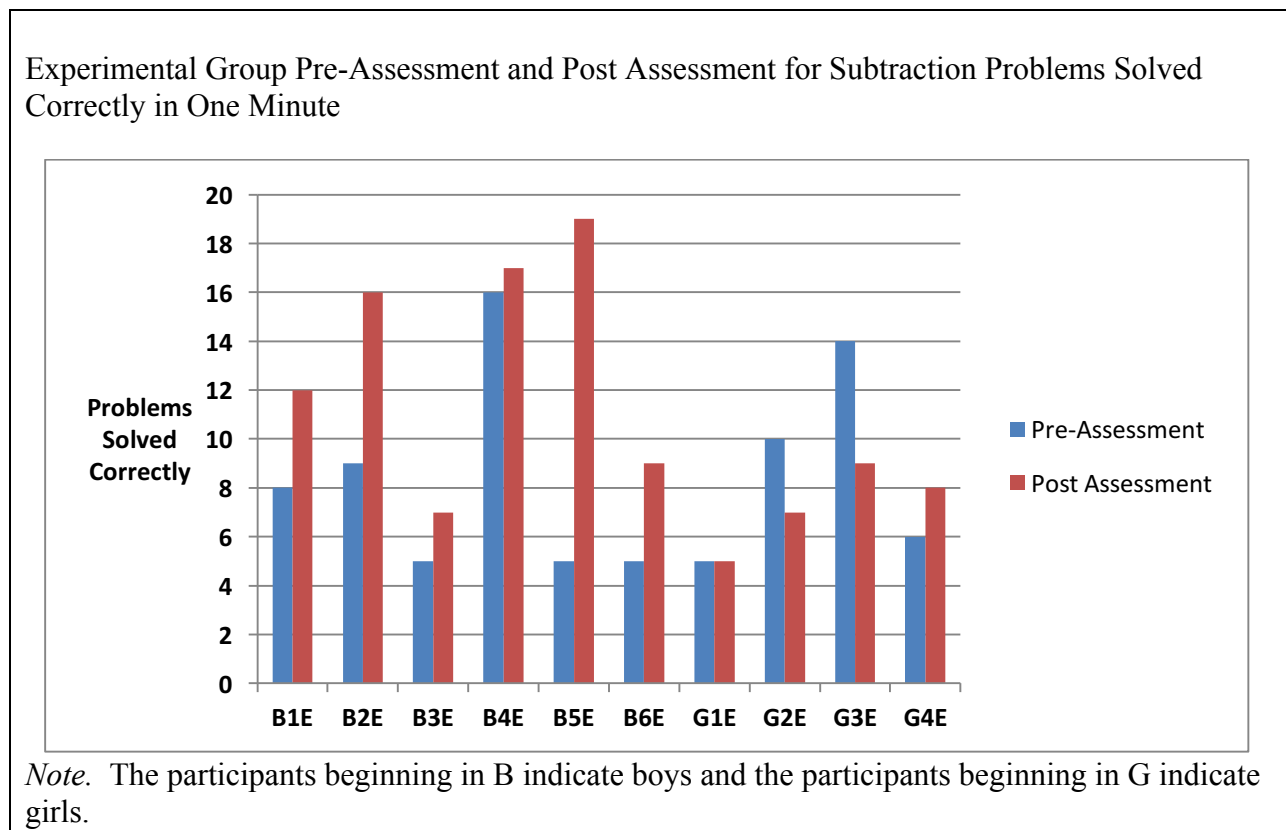
Timed Post Assessment for All Participants



Note. The participants ending in E indicate the experimental group and the participants ending in C indicate the control group. B indicates a boy participant and G indicates a girl participant.

The overall score of the experimental group on the subtraction pre-assessment was 83. The students were given one minute to answer as many problems as possible and were able to correctly answer 83 problems. The overall score of the control group on the addition pre-assessment was 74. The students were able to correctly answer 74 problems. The test included writing the answer to addition facts through twenty. The students were given one minute to answer as many problems as possible. On the subtraction pre-assessment, the experimental group answered nine problems more than the control group. The results of this study show that using the math bag activities daily, can improve math fact fluency in subtraction.

Figure 6.

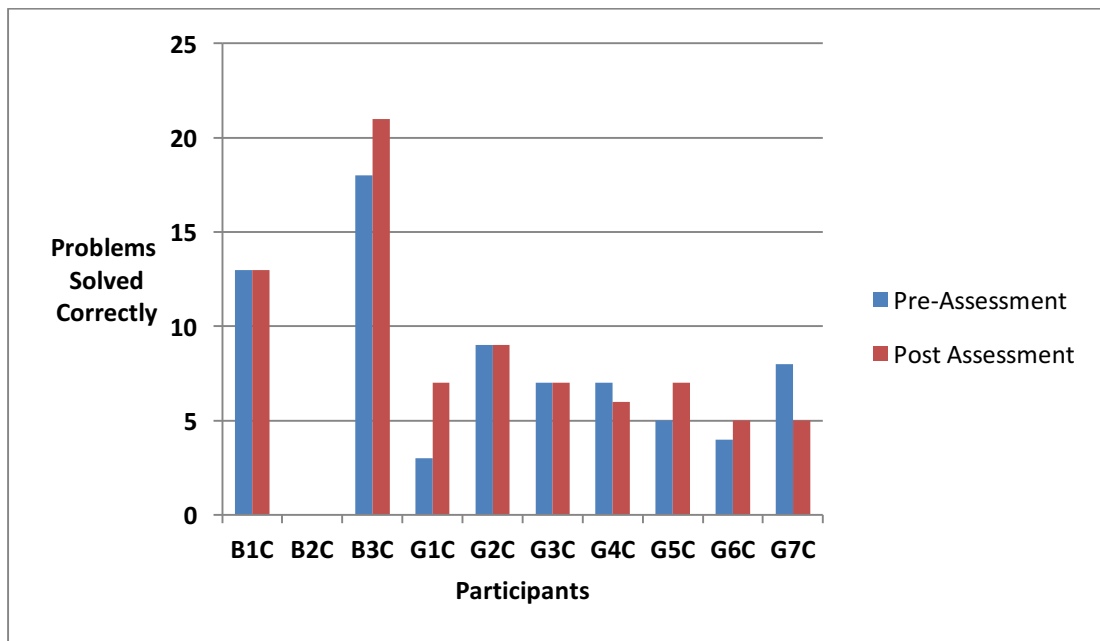


The data showed seven out of the ten students in the experimental group made gains in their math fact fluency for subtraction (Figure 6). Participants G2E and G3E showed a loss of three and five problems solved respectively. Participant G1E did not show any growth in the

ability to recall subtraction facts. The participant with the biggest growth, B5E, showed a fourteen problem increase. Two participants, B1E and B6E, increase their fact fluency by four problems. Two other participants, B2E and G4E, improved by solving two more problems correctly. Participant B2E demonstrated an eight problem increase and participant B4E improved by one problem. In analyzing this data through a t-test, the data demonstrated a .07 level of significance, which shows no significance between the two sets. In this study, there were increases in subtraction fluency when students engaged in daily hands-on activities with subtraction facts, their fluency in subtraction increases.

Figure 7.

Control Group Pre-Assessment and Post Assessment for Subtraction Problems Solved Correctly in One Minute

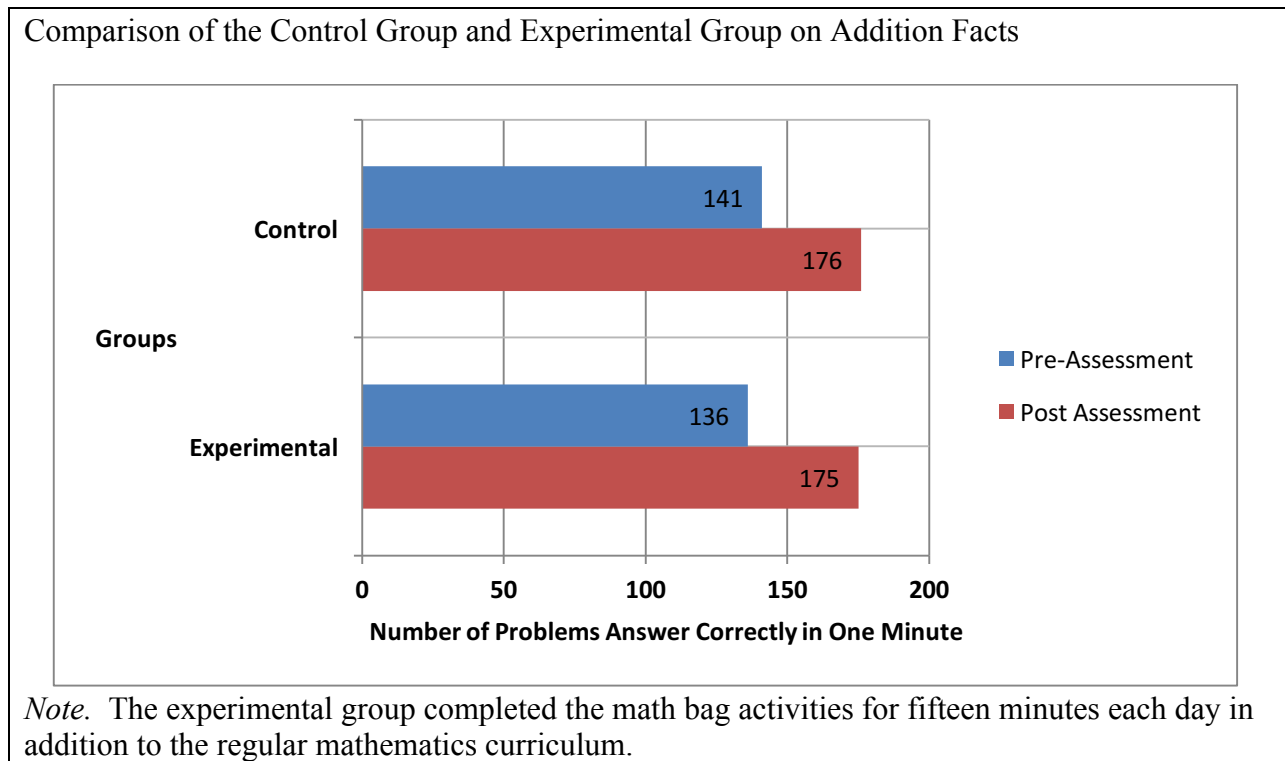


Note. Bar graph for the control group for the subtraction pre-assessment and post assessment scores.

The data shows four out of the ten participants in the control group increase their fact fluency in subtraction during the four week testing period (Figure 7). Three participants, B2C,

G2C, and G3C showed no increase at all in their ability to recall subtraction facts fluently. Participant G4C showed a decrease of one problem and participant G7C showed a decrease of three problems. Student showing an increase in their subtraction fact fluency are participant G3C with an increase of three problems, participant G1C with an increase of four problems, participant G5C with an increase of two problems, and G7C with an increase of one problem. In analyzing this data through a t-test, the data demonstrated a .18 level of significance, which does not show a statistical significance between the two sets resulting in a negative influence on the results. The students that did not use the math bag activities, did not show a significant improvement on their math fact fluency in subtraction.

Figure 8.

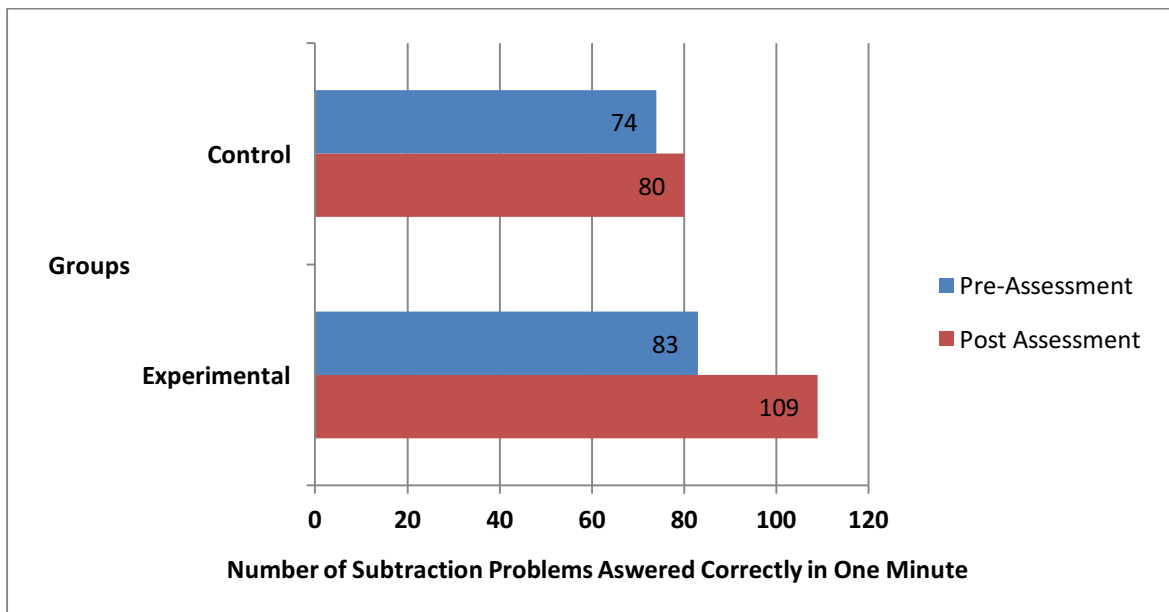


The control group answered a combined total of 141 questions correctly on the pre-assessment and 176 questions correctly on the post assessment (Figure 8). The data shows they

made an increase of 35 problems during the four week research period. The experimental group answered a combined total of 136 questions correctly on the pre-assessment and 175 questions correctly on the post assessment. The data shows they made an increase of 39 problems during the four week research period. The increase in fluency the experimental group had in addition facts, was only slightly more than the increase the control group made. This study did not show a big enough increase in addition fact fluency to add the math bags as a daily activity. Perhaps, the type of skills the math bags presented, did not lend themselves to enough addition practice.

Figure 9.

Comparison of the Control Group and Experimental Group on Subtraction Facts



Note. Bar graph to show the comparison scores from the pre assessment and post assessment on both the experimental and control groups for subtraction.

The control group answered a combined total of 74 questions during the pre-assessment for subtraction (Figure 7). The students had one minute to answer as many problems, with facts through twenty, as they could. On the post assessment, students in the control group were able to complete 80 problems in one minute. This shows an increase of 6 subtraction facts. The experimental group answered a combined total of 83 questions correctly during the pre-

assessment for subtraction (Figure 7). On the post assessment, students in the experimental group were able to complete 109 problems in one minute. The experimental group showed an increase of 26 problems solved correctly. The increase in fluency the experimental group had in subtraction facts was significantly higher than the increase the control group made. This data in this study shows that using hands on activities daily, can improve fluency in student performance more in subtraction than in addition.

Findings and Implications

The specific findings of this research study can impact future classrooms and students. While the data that was collected is limited to one specific classroom, the overall generalizations and observations can be transferred to typical classrooms, and students, in second grade. The observations and findings can be used to further meet the fact fluency needs of all types of learners in the classroom.

Findings

The overall study shows that with daily hands-on math activities, students can be successful in learning their basic math facts fluently. The students enjoyed the activities and asked daily when they were going to get the chance to participate. Making math look more like a game instead of work helps motivate students to want to learn (Leutzinger, 1999). Using games, infused with a focus on acquisition of the strategy, helps students in early grades become more fluent with their math facts (Bay-Williams, 2014, Kling, 2011).

Like similar studies conducted on fact fluency, games help student focus on working with numbers (Kling, 2011). Many of the students in the study showed significant improvements in both addition and subtraction. Although some of the control group showed improvements as well, the experimental group demonstrated a more noticeable increase in the ability to add and subtract fluently by the end of the study.

The highest amount of growth, however, seemed to be with the subtraction facts. The experimental group showed a 20 problem growth in the ability to solve subtraction problems more quickly than the control group. The control group only showed a six problem increase. If this trend continued, the spread between the control group and the experimental group would continue to widen. The students in the experimental group received the chance to apply the strategies they were learning about in class by doing the hands-on activities. Applying what they learn on paper by using hands on manipulatives, help students understand the mathematical concepts better (Buchholz, 2004).

Implications

Teachers should impliment hands-on activities in their classrooms to help increase fluency in basic facts. This study showed the math bags had a more significant increase in subtraction fact fluency than addition fact fluency, although some increase in addition fact fluency was noted. The results of the study indicate most students can benefit from the extra, thought provoking, practice. Many of the addition bag activities allowed students to use either addition or subtraction skills in order to find the missing addend. An example of this is if a problem that was given was $8 + \underline{\quad} = 15$, students could either choose to count up to find the sum which is an adding activity, or subtract the sum from the first addend, which is a subtraction activity. With that being said, using both the additon and subtraction fact fluency bags to improve fact fluency in general is warrented. When students learn how numbers go together, they are more ready to do more complex mathematical processes (Bay-Williams, 2014). Most of the students seemed to really enjoy the activities and looked forward to doing them each day. Parents can also assist in helping their children master their math facts by playing games at home for an extra boost in their addition and subtraction confidence. No matter how the hands-on

activities take place, using them to help students learn, makes a positive impact on student learning.

Limitations

There are a few limitations to this study even though students appeared to be positively impacted due to the practice. First of all, we experienced two snow days, which did impact our ability to do the activities on those days. Another limitation had to do with the method of choosing the control and experimental groups. I chose the groups with a random draw which resulted in a greater number of boys in the experimental group than the control group. The results may have been varied if I had a more even distribution of boys and girls in each group. Another limitation to the study was the entire achieved results were not successful. This study did not prove that the adding the math bag activities significantly improved overall math fact fluency. The addition fact fluency in this study did not have a significant increase. Another limitation was one student, G1E, has been having an especially rough home life and had many break-downs during classtime and refused to participate in the activities with her partner at times. I believe her results would have been higher, had she been a more willing participant. I believe the limitations had a minimal impact on the study overall.

Reflection and Action Plan

The research process was very new to me but is now a valuable tool I will continue to use. More than ever, I now see the importance research plays in the classroom. I also feel I have a better ability to read research done by others, and a better understanding of what the findings mean.

Reflection

This research study was meaningful and important to me as an educator. I firmly believe that students need daily hands-on practice with basic addition and subtraction facts to increase and enhance their ability to not only memorize them, but understand the relationship between the numbers. This year, my district implemented a new math program that is mainly worksheet based. This was a big concern to me so I wanted to find a way to enhance the program and make math more interesting and meaningful. I believe students, especially young students, learn best when they can physically manipulate materials. For these reasons, I wanted to conduct this study.

I believe the students enjoyed the variety of activities they were able to do using the Math Bags. They eagerly anticipated Math Bag time each day. I completely agree with the research that says students need to actively construct materials to decompose and recompose numbers (Kling, 2014). Students enjoy manipulating materials and giving them something they like to do makes the task seem less like work and more like a game. This keeps them engaged for longer periods of time which, in turn, gives them more time to memorize the facts.

If I were to conduct this study again, I would like to make it a quarter or semester long study. I believe giving the skills a little more time to take hold, would be beneficial. I also would like to increase the time on the one-minute timed assessment I gave the students for the pre-assessment and post assessment. I would like to see if giving them more time increased or decreased the results. Some students seemed to have a hard time getting started on the assessment and just when they were getting in the groove, the time was up. Also, I would like to do this study with just addition facts and then another study with just subtraction facts. I would like to see if concentrating on just one skill, helped the students fluency.

Action Plan

I discovered that the students enjoyed practicing the basic addition and subtraction facts through the variety of activities incorporated in the Math Bags. They looked forward to this time every day. The students in the control group that were not given the opportunity to do the activities during the study, watched the others with envy. I felt bad about leaving them out of the fun. They did get to participate at the conclusion of the study, however. Next school year, I plan to begin using the Math Bag activities as a part of my classroom routine. It is difficult finding time in the day, but after this study, I feel it is important enough to find a way.

I will add other activities to my Math Bag time to include commercial board games and other tasks using manipulatives such as 4-Way Countdown, ten frames, and base-ten blocks. I feel rotating these types of activities will keep the students interested and not get bored of the same types of games. I will continue to use the regular required math program and mathematic computer related activities as well. I feel using a combination of the resources available to me will help enhance my students ability to recall math facts more fluently and in turn, solve more complex mathematic problems.

The results of my action research will be shared with my principal, curriculum coordinator, and the faculty members in my school building. I work in a K-2 building where I believe the results of this study will be of interest and helpful. Many of us already believe that hands-on activities help students learn, but the time restraints we are all under has forced us to do away with many of those activities. Hopefully, reviewing the results of this study will help everyone see the benefit and adjustments can be made to allow for more of these activities in each classroom for every student.

I am the type of teacher that is constantly searching for ways to improve my teaching practice to enhance the education of my students. Conducting this research made me understand how I can prove whether the new practice I am trying is successful or not. I learned so much during this study about how research is completed, what it means, and how I can use it in my classroom. I will utilize what I learned to continue to improve the education of my students.

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Appendix A

The Pre-Assessment and Post Assessment Worksheets

Basic Subtraction Facts (0-20)
Score: _____ out of 43
Time: _____ minutes

Name: _____

Subtraction


a. $\begin{array}{r} 20 \\ - 10 \\ \hline \end{array}$ $\begin{array}{r} 16 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 19 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 13 \\ - 10 \\ \hline \end{array}$ 

b. $\begin{array}{r} 8 \\ - 4 \\ \hline \end{array}$ $\begin{array}{r} 17 \\ - 8 \\ \hline \end{array}$ $\begin{array}{r} 19 \\ - 10 \\ \hline \end{array}$ $\begin{array}{r} 15 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ - 5 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ - 3 \\ \hline \end{array}$ $\begin{array}{r} 11 \\ - 4 \\ \hline \end{array}$

c. $\begin{array}{r} 18 \\ - 8 \\ \hline \end{array}$ $\begin{array}{r} 10 \\ - 5 \\ \hline \end{array}$ $\begin{array}{r} 12 \\ - 4 \\ \hline \end{array}$ $\begin{array}{r} 8 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 14 \\ - 8 \\ \hline \end{array}$ $\begin{array}{r} 13 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 18 \\ - 9 \\ \hline \end{array}$

d. $\begin{array}{r} 7 \\ - 2 \\ \hline \end{array}$ $\begin{array}{r} 11 \\ - 8 \\ \hline \end{array}$ $\begin{array}{r} 18 \\ - 10 \\ \hline \end{array}$ $\begin{array}{r} 14 \\ - 5 \\ \hline \end{array}$ $\begin{array}{r} 15 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ - 4 \\ \hline \end{array}$ $\begin{array}{r} 1 \\ - 0 \\ \hline \end{array}$

e. $\begin{array}{r} 11 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 12 \\ - 6 \\ \hline \end{array}$ $\begin{array}{r} 13 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 14 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ - 4 \\ \hline \end{array}$ $\begin{array}{r} 14 \\ - 7 \\ \hline \end{array}$ $\begin{array}{r} 11 \\ - 2 \\ \hline \end{array}$

f. $\begin{array}{r} 14 \\ - 4 \\ \hline \end{array}$ $\begin{array}{r} 13 \\ - 7 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ - 2 \\ \hline \end{array}$  $\begin{array}{r} 12 \\ - 5 \\ \hline \end{array}$ $\begin{array}{r} 7 \\ - 4 \\ \hline \end{array}$


g. $\begin{array}{r} 16 \\ - 8 \\ \hline \end{array}$ $\begin{array}{r} 11 \\ - 5 \\ \hline \end{array}$ $\begin{array}{r} 17 \\ - 9 \\ \hline \end{array}$ $\begin{array}{r} 10 \\ - 3 \\ \hline \end{array}$ $\begin{array}{r} 4 \\ - 2 \\ \hline \end{array}$

Super Teacher Worksheets - www.superteacherworksheets.com

Addition Basic Facts: First Addend Up to 9
Score: _____ out of 43
Time: _____ minutes

Name: _____

Adding


a. $\begin{array}{r} 5 \\ + 4 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ + 4 \\ \hline \end{array}$ $\begin{array}{r} 4 \\ + 3 \\ \hline \end{array}$ $\begin{array}{r} 3 \\ + 8 \\ \hline \end{array}$ 

b. $\begin{array}{r} 9 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 3 \\ + 2 \\ \hline \end{array}$ $\begin{array}{r} 0 \\ + 6 \\ \hline \end{array}$ $\begin{array}{r} 2 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 8 \\ \hline \end{array}$ $\begin{array}{r} 4 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 8 \\ + 8 \\ \hline \end{array}$

c. $\begin{array}{r} 3 \\ + 3 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 4 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 1 \\ + 0 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ + 8 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 3 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ + 5 \\ \hline \end{array}$

d. $\begin{array}{r} 9 \\ + 3 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ + 1 \\ \hline \end{array}$ $\begin{array}{r} 7 \\ + 6 \\ \hline \end{array}$ $\begin{array}{r} 7 \\ + 8 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 6 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 5 \\ \hline \end{array}$

e. $\begin{array}{r} 7 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 8 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 3 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 8 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 7 \\ + 9 \\ \hline \end{array}$ $\begin{array}{r} 0 \\ + 2 \\ \hline \end{array}$ $\begin{array}{r} 2 \\ + 5 \\ \hline \end{array}$

f. $\begin{array}{r} 1 \\ + 6 \\ \hline \end{array}$  $\begin{array}{r} 9 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 1 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ + 6 \\ \hline \end{array}$ $\begin{array}{r} 6 \\ + 4 \\ \hline \end{array}$

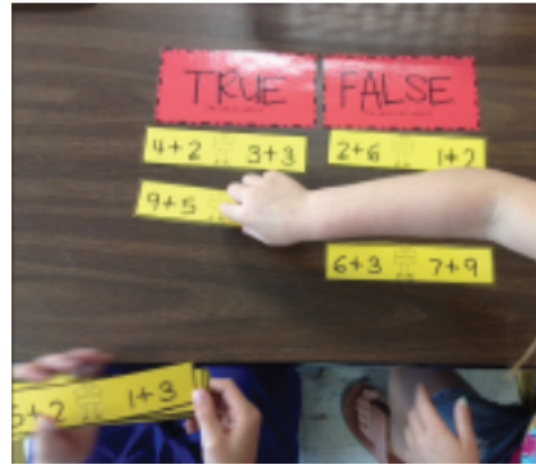
g. $\begin{array}{r} 7 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 8 \\ + 3 \\ \hline \end{array}$ $\begin{array}{r} 4 \\ + 6 \\ \hline \end{array}$ $\begin{array}{r} 5 \\ + 7 \\ \hline \end{array}$ $\begin{array}{r} 9 \\ + 5 \\ \hline \end{array}$

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Appendix B

Math Bag Activities

6		4	
7-1	10-4	9-5	11-7
8-4	4-0	8-2	6-2
			9-3
			6-0



4	5
6	7

6-2 =	4-1 =	8-2 =	5-1 =
2-1 =	3-3 =	4-5 =	5-1 =
3-2 =	5-1 =	6-0 =	0-0 =
2-3 =	3-1 =	4-3 =	5-3 =

