# The Effects of Mathematics Instruction Incorporating the TouchMath Program on Addition Computational Fluency in a Third-Grade Classroom

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Abstract

The purpose of this study was to determine the effects of mathematics instruction incorporating the *TouchMath* program on addition computational fluency in a third-grade classroom. The research question that was addressed is, "Does mathematics instruction incorporating the *TouchMath* program improve students' addition computational fluency in one third-grade classroom?" This study took place in a third grade general education classroom consisting of 24 students four days a week for eight weeks. The intervention consisted of teaching students specific touchpoints on numerals one to nine and specific statements to use to increase addition computational fluency. The students were given the *Curriculum- Based Measurement Mathematics Test (M-CBM)* as a pre-test before mathematics instruction incorporating the *TouchMath* program was used, and it was administered again as a post-test at the conclusion of the eight weeks to assess change. Results revealed that after mathematics instruction incorporating the *TouchMath* program, the students' ability to add quickly and accurately improved. Results suggest that teaching students specific touchpoints on numerals, enhances their ability to add fluently, regardless of their gender, native language spoken, or attendance pattern.

Keywords: Addition Computational Fluency, TouchMath, Third Grade

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# Chapter I

## Introduction

According to the National Assessment of Educational Progress (NAEP) (2013), only 35 percent of eighth-grade students tested in the United States scored at or above the proficient level on the mathematics portion of the test. These data suggest that the vast majority of eighth-grade U.S. students fall below desired levels of achievement in mathematics. Experts (Barth, Beckmann, & Spelke, 2008; D. Bryant, B. Bryant, Gersten, Scammacca, Funk, Winter, Shih, & Pool, 2008; & Namkung & Fuchs, 2012) state that within mathematics, specifically addition and subtraction, the United States is behind developing countries. These deficiencies are alarming when experts (Dulgarian, 2000; Bullock, 2011; Green, 2009; Mays, 2008; & Vinson, 2004) remind us that the ability to compute effectively is critical and that all students must acquire these skills before mastering more complex mathematics skills. Other research (Dulgarian, 2000; Henry & Brown, 2008; Mays, 2008; Rudolph, 2008; VanDerHeyden & Burns, 2009; & Vinson, 2005) and literature (Baraoody, 2006; Bullock, 2011 & Vinson, 2004) indicate that single skill interventions, repeated practice, multisensory strategies, and explicit teaching of doubles improve students' addition skills.

*TouchMath,* a multisensory strategy for mathematics learning, was the basis of this study. *TouchMath* founder Janet Bullock (2011) suggests that using touchpoints on numerals bridges the gap between concrete experiences and abstract concepts. Experts (Bullock, 2011 & Green, 2009) found that through the use of touchpoints on numerals, students were able to increase computational fluency. Mathematics deficiencies reported by NAEP indicate the need for a focus on strategies that increase mathematics knowledge in the students in the United States.

**Background of the Problem**

Supporting NAEP (2013) results, Hanueshek, Peterson, and Woessmann (2010) state that the United States as a whole is scoring well below similar and even developing countries in regards to mathematics. According to the Broad Foundation of Education (2012), the United States' student's ranked 25th out of 27 industrialized nations in regards to mathematics. Alarmingly, research by Green (2009) and literature by Korn (2011) reveals that students may be deficient in mathematics because of the way they are taught. It appears that multiple factors have contributed to the reason American students score below other countries on tests of mathematics skills.

**Definitions of Terms**

To facilitate the understanding of this research report, the following terms are defined:

1. Addition computational fluency is the ability to have efficient, flexible, and accurate methods for computing (NCTM, 2000). This term has been operationalized for this study to mean the ability to perform 30 addition computations accurately within four minutes as measured by the practice items released by the *Curriculum-Based Measurement Mathematics Test*.
2. Auditory learning modality is a learning style that is focused on the individual's ability to hear (Bogod, 2013). For this study auditory learning style was measured by individually administering the *What's Your Learning Style* quiz from educationplanner.org
3. *Curriculum- Based Measurement* (M-CBM) Mathematics Test was developed in the early 1970's at the University of Minnesota to measure mathematics, reading, writing, spelling, science, and social studies (Lembke & Stecker, 2007).

4. Fact fluency is the ability to recall basic mathematic facts quickly (Korn, 2011). For this study this term was operationalized to mean the ability to perform addition computations accurately and quickly.
5. Kinesthetic/ Tactile learning modality is a learning style that is focused on the individual's ability to engage in hands-on learning (Bogod, 2013). For this study kinesthetic/ tactile learning style was measured by individually administering the *What's Your Learning Style* quiz from educationplanner.org
6. Mathematics instruction is teaching which guides students through a sequence of learning (Steedly, Dragoo, Arafeh, & Luke, 2008).
7. Multisensory learning is combining auditory, visual, and kinesthetic learning modalities to increase the success rate of students (Bullock, 2011).
8. *TouchMath* is a multisensory mathematics program that requires the student to use specific points on numerals to help add correctly and quickly (Bullock, 2011). This program was used as a part of the mathematics instruction for the study. This term has been operationalized for this study to mean the teaching of addition computing skills with specific touchpoints on numerals and specific statements to follow, 30 minutes per day, four days per week, for eight weeks (see Appendix A1). This instruction is in addition to other mathematics instruction.
9. Visual learning modality is a learning style that is focused on the individual's ability to see (Bogod, 2013). For this study visual learning style was measured by individually administering the *What's Your Learning Style* quiz from educationplanner.org

**Purpose and Significance of the Study**

The purpose of this study was to determine the effects of mathematics instruction incorporating the *TouchMath* program on addition computational fluency in a third-grade classroom. The intent was to determine if teaching students how to touch points on numerals which correspond with that number, improves their ability to add correctly and quickly. Because mathematics instruction incorporating the *TouchMath* program appeared to improve addition computational fluency teachers may use the results of this study to improve addition computational fluency. According to the Measures of Academic Progress (MAP) given at the beginning of the 2013 school year, 21 students in the study classroom scored below grade level expectations on the numbers and operations portion of the test, thus indicating a need for additional instruction to enhance these skills.

Additionally, all students in this classroom demonstrated some preference for visual, auditory, and kinesthetic learning, but a clear majority (52 percent) preferred kinesthetic learning. The *TouchMath* program was designed for all learning style modalities, but its name indicates it appeals to kinesthetic learners. Although the *TouchMath* program was initially designed for students with disabilities, research and experts have found this program is beneficial for all students regardless of learning preference or educational status (Bullock, 2011). The study measured the effects of mathematical instruction incorporating the *TouchMath* program on addition computational fluency in one group of third-grade students. The that was addressed was, "Does mathematics instruction incorporating the *TouchMath* program improve students' addition computational fluency in one third-grade classroom?"

This research report is organized into five chapters. Chapter I offers a statement of introduction for the present study, which was to determine the effects of mathematical instruction

incorporating the *TouchMath* program on addition computational fluency in one third-grade classroom. Chapter II provides a review of literature concerning addition computational fluency and mathematics instruction incorporating the *TouchMath* program. Chapter III explains the methodology for the study. The setting, participants, data collection instrument and analysis procedures, as well as the intervention strategies are described. Chapter IV reports the results of the study. Chapter V draws conclusions and implications, then makes recommendations based on the results of the study.

# Chapter II

## Review of Literature

This chapter provides a comprehensive, yet not exhaustive, review of literature on addition computational fluency and mathematics instruction incorporating the *TouchMath* program. The intent of this chapter is to review research and other literature that supports the argument that mathematics instruction incorporating the *TouchMath* program increases students' ability to add quickly and accurately. Experts (Dulgarian, 2000; Bullock, 2011; Green, 2009; Mays, 2008; & Vinson, 2004) posit that the ability to compute effectively is a critical skill all students must acquire for more complex mathematics. However, Hanueshek, Peterson, and Woessmann (2010) state that the United States as a whole is scoring well below other developing countries in regards to mathematics. Other experts (Barth, Beckmann, & Spelke, 2008; & Bryant et al., 2012) state that for mathematics, specifically addition and subtraction, the United States lags behind developing countries in achievement. Research by Henry and Brown (2008) suggests that students rarely achieve complete addition and subtraction fact fluency in the first few years of school. Other research (Dulgarian, 2000; Henry & Brown, 2008; Mays, 2008; Rudolph, 2008; VanDerHeyden & Burns, 2009; & Vinson, 2004) and literature (Baroody, 2006; Bullock, 2011 & Vinson, 2005) indicate that single skill interventions, repeated practice, multisensory strategies, and explicit teaching of doubles improve students' addition skills.

This chapter is organized so that the literature and research on the importance of addition computational fluency is reviewed first, followed by the deficiencies in students' ability to perform addition computations. Factors that inhibit students' ability to perform addition computations are synthesized. Next, strategies are given on how addition computational fluency

can be improved, and finally support for the argument that mathematics instruction incorporating the *TouchMath* program improves computational fluency is reviewed.

**Importance of Addition Computational Fluency**

Research (Green, 2009; Henry & Brown, 2008; Namkung & Fuchs, 2012; & Vinson, 2005) and literature (Baroody, 2006; Bullock, 2011; Korn, 2011; Russell, 2000; & Vinson, 2004) state that the ability to perform and understand basic addition computations will be required for not only multiplication, but also more complex mathematics computations. The National Council of Teachers of Mathematics (NCTM) (2000) requires all students to be fluent in addition, subtraction, multiplying, and dividing whole numbers. Russell (2000) and Vinson (2005) claim that deep understanding is more important than memorization. Research by Green (2009) and literature by Bullock (2011) opine that basic math skills are building blocks for future mathematic concepts. Green (2009) studied third and fourth grade Special Education students and determined that mathematic instruction incorporating *TouchMath* improves achievement on standardized tests and teacher made tests. Research by Bryant et al. (2008) and Henry and Brown (2008) articulate the notion that some students have an understanding of computational fluency, but still do not understand the concepts in the problem. Henry and Brown (2008) conducted a study of 275 students in multiple school districts' in California to determine students' basic addition facts acquisition. Henry and Brown (2008) conclude that even students at high performing levels lack the conceptual foundation of computational fluency. Literature by Korn (2011) states that in order to move to more complex mathematical subjects, the student must be fluent with addition facts. According to Baroody (2006) and Russell (2000), teaching for skill and understanding is essential, in the current society.

**Deficiencies in Addition Computational Fluency**

Research (Bryant et al., 2012; Green, 2009 & Henry & Brown, 2008) and literature (Baroody, 2006; Barth, Beckmann, & Spelke, 2008; Bullock, 2011; Godfrey & Stone, 2013; Korn, 2011; Namkung & Fuchs, 2012; Russell, 2000) identify several factors that attribute to deficiencies in addition computational fluency. Bryant et al. (2008) state that 5 to 10 percent of students have difficulties in mathematics. Bryant et al. (2008) studied the effects of Tier 2 intervention on the performance of first-grade students who were identified as at risk for mathematics difficulties and found that there was a significant increase in scores on a standardized test. Barth, Beckmann, and Spelke (2008) suggest that learning, physical, and mental disabilities are factors that must be taken into account when teaching computations. Literature by Bullock (2011) claims that mathematic disabilities inhibit a student's learning of number sense, numbers and operations and word problem solving. Additionally, literature by Godfrey and Stone (2013) claims that students gain a strong number sense along with computational fluency when they have had the chance to fully explore number relationships. Furthermore, research by Green (2009) and literature by Korn (2011) suggest that students are also deficient in mathematics because of the way they are taught. Green (2009) investigated the effectiveness of mathematic instruction incorporating the *TouchMath* program on increasing students' with special needs addition computational fluency and found that this program significantly increased student's math achievement. Also, literature by Russell (2000) states that students struggle with addition fluency because they are misaligning the columns in a standard algorithm. According to Henry and Brown (2008), timed tests decrease basic fact retrieval. Henry and Brown (2008) studied 275 students to determine students' basic addition facts acquisition and concluded that even high performing students lack the conceptual foundation of

computational fluency. Research by Henry and Brown (2008) and literature by Namkung and Fuchs (2012) state that when students are required to engage in timed tests, they fail to understand numbers in logical order and solely focus on completing as many computations as possible.

**Factors that Inhibit Students' Ability to Perform Addition Computations Fluently**

Research (Green, 2009; Henry & Brown, 2008 & Vinson, 2005) and literature (Baroody, 2006; Barth, Beckmann, & Spelke, 2008; Bullock, 2011; Russell, 2000; Keiser, 2012) state that home help, outside services, environment, attention difficulties, and different learning styles are all factors that inhibit students' ability to comprehend and perform computations. According to Henry and Brown (2008) many people do not understand mathematics because they see math as only memorizing and do not fully comprehend the problem. Henry and Brown (2008) studied 275 students to determine students' basic addition facts acquisition and concluded that even high performing students lack the conceptual foundation of computational fluency. Other literature by Baroody (2006) affirms that memorization doesn't involve looking for patterns or relational thinking. Research (Green, 2009 & Henry & Brown, 2008) and literature by Korn (2011) suggest that the way in which students are taught addition facts inhibit their ability to obtain computational fluency. Green (2009) investigated the effectiveness of mathematic instruction incorporating the *TouchMath* program on increasing students' with special needs addition computational fluency and found that this program significantly increased student's math achievement. Research by Russell (2000) and literature by Keiser (2012) agree that the teaching of traditional algorithms make conceptual understanding more challenging. Korn (2011) argues that although memorization is an important component of addition computational fluency, that it is not the ultimate goal, complete understanding is the goal. Barth, Beckmann and Spelke (2008)

claim that students also have difficulties in math because they are not receiving sufficient help from home. Literature by Bullock (2011) reports that parents may be reluctant to help due to past mathematics experiences or lack of knowledge. Furthermore, research by Vinson (2005) claims that negative attitudes and anxiety are also factors that inhibit a student's ability to perform. Vinson (2005) studied educators to determine the effectiveness of mathematic instruction incorporating the *TouchMath* program, and found that although some teachers would like to see students getting the correct answer using mental math, these educators reported that students using the *TouchMath* program are getting computation problems correct well into middle and high school.

**Strategies to Improve Addition Computational Fluency**

Research (Bedard, 2002; Bryant et al., 2008; Dulgarian, 2000; Green, 2009; Henry & Brown, 2008; Korn, 2011; Mays, 2008; Rudolph, 2008; & Russell, 2000) and literature (Godfrey & Stone, 2013; & VanDerHeyden & Burns, 2009) offer strategies to improve addition computational fluency. Bryant et al. (2008) and VanDerHeyden and Burns (2009) suggest that small group interventions and explicit procedures increase addition computational fluency in elementary students. Alternatively, Godfrey and Stone (2013) and Baroody (2006) suggest that math games and math talks are needed to increase computational fluency. Godfrey and Stone (2013) and Baroody (2006) claim that such math games can be included in class, or in the students' take home folders to be played at home with parents or siblings. Additionally, they claim that if these games are played purposefully, they can build fact fluency, and confidence in the student. Baroody (2006) and Henry and Brown (2008) recommend that repeated practice of basic addition facts could be beneficial in improving computational fluency. Henry and Brown

(2008) also claim that memorizing doubles facts and fifteen-minute activities will aid in students' acquisition of computational fluency.

Although experts Henry and Brown (2008) claim that timed tests decrease basic fact retrieval, VanDerHeyden and Burns (2009) state that single skill interventions is a specific strategy that teachers can use to increase computational fluency. Russell (2000) proclaims that algorithms be used to increase addition computational fluency only after conceptual understanding has occurred. Other research (Bryant et al, 2008 & Korn, 2011) state that an effective way of teaching addition facts is to make the lessons entertaining. Bryant et al. (2008) declare that entertaining booster lessons and tutor training along with evidence-based interventions promote addition computational fluency. Bryant et al. (2008) opines that the booster lessons help students that are lacking in certain areas; whereas the tutor training allows students to share how they have completed a problem and to help others master the same skill.

Additional research (Bedard, 2002; Dulgarian, 2000; Green, 2009; & Rudolph, 2008) indicate that a multisensory approach to computational fluency has shown significant improvements in students' ability to add fluently. Mays (2008) states that a multisensory approach is effective because auditory, visual, and kinesthetic learning modalities are intertwined.

**TouchMath Improves Addition Computational Fluency**

Research (Dulgarian, 2000; Green, 2009; Mays, 2008; Rudolph, 2008; & Vinson, 2004) and literature (Bullock, 2011 & Vinson, 2005) conclude that mathematics instruction incorporating the *TouchMath* program helps students improve addition computational fluency by providing touchpoints as reference points on the numerals one to nine. Dulgarian (2000) studied 20 students, for ten weeks, who had not mastered addition and subtraction facts. These students

were divided into two groups of ten students. Group I was given instruction incorporating the *TouchMath* program to increase computational fluency whereas Group II received traditional mathematic instruction. Dulgarian (2000) indicated that the *TouchMath* program helped students solve addition and subtraction computations faster and more accurately than the group who received traditional mathematics instruction. Green (2009) investigated the effectiveness of mathematic instruction incorporating the *TouchMath* program on increasing students' with special needs addition computational fluency and found that this program significantly increased student's math achievement. Mays (2008) studied 46 second-grade students, for six weeks, whom did not have mastery of computations. Mays (2008) indicated a functional relationship between *TouchMath* and student performance. Rudolph (2008) studied 17 third-grade students, for one week, who were below basic in mathematics. Rudolph indicated mathematics instruction incorporating the *TouchMath* program increases students' ability to solve computations.

Research (Bedard, 2002; Dulgarian, 2000; Green, 2009; & Rudolph, 2008) reports that students are able to achieve a higher level of computational fluency when using the *TouchMath* system. Additional research (Mays, 2008; Rudolph, 2008; & Vinson, 2004) and literature by Scott (1993) claim this program is a multisensory program that is beneficial to auditory, visual, and kinesthetic learners. Furthermore, Mays (2008) and Rudolph (2008) state that mathematics instruction incorporating the *TouchMath* program will be effective with all students because the program is designed for all learning modalities. Research by Bedard (2002) emphasizes the theory that teachers need to include these three learning styles in every lesson to create a successful mathematical learning environment.

Bullock (2011) states that students learn computations quickly because they are able to see the number, say it, hear it, and touch it. Green (2009), Mays (2008), and Vinson's (2004)

research investigated the links between *TouchMath* and addition computational fluency, and determined that this program not only increases scores on teacher made tests, but also increases scores on standardized tests. Mays (2008) claims that *TouchMath* not only engages the students, but also improves accuracy, fluency, and confidence in mathematics.

*TouchMath* founder Janet Bullock (2011) suggests that using touchpoints on numerals bridges the gap between concrete experiences and abstract concepts. Experts (Bullock, 2011 & Green, 2009) found that through the use of touchpoints on numerals, students were able to increase computational fluency. According to Bullock (2011) and Green (2009), *TouchMath* gives students a strategy to use that can be used well into adulthood. Green (2009) states that this program is not only for students who struggle with mathematics, but also for all students. Vinson (2004) claims that *TouchMath* was initially designed for students will special needs, but because of its high effectiveness, the program has been implemented with all students. Additionally, Green (2009) states that this more creative approach to computational fluency will increase mathematical ability. Research (Bullock, 2011; Dulgarian, 2000; Green, 2009; Mays, 2008; & Vinson, 2004) opines that the ability to compute effectively is a crucial concept that all students must gain for more complex mathematics.

**Summary**

Based on research (Barth, Beckmann, & Spelke, 2008; Bryant et al., 2008; Dulgarian, 2000; Green, 2009, Namkung & Fuchs, 2012; & Mays, 2008) that indicate students' lack of ability to add fluently and the immediate need for mathematic improvement, and other research (Bedard, 2002; Dulgarian, 2000; Green, 2009; Mays, 2008; Rudolph, 2008; & Vinson, 2004) and literature (Bullock, 2011; & Vinson, 2005) that suggest multisensory strategies such as *TouchMath*, improve students' ability to perform addition computations accurately and with full

understanding, it appeared that a study examining the effects of mathematic instruction incorporating the *TouchMath* program on addition computational fluency was appropriate. The next chapter details the methodology of the research report.

# Chapter III

## Methodology

This study was designed to determine the effects of mathematics instruction incorporating *TouchMath* on addition computational fluency in a third-grade classroom. This study was intended to determine if incorporating *TouchMath,* 30 minutes a day, four days a week, for eight weeks improves addition computational fluency, in one third-grade classroom. This chapter describes the setting, the participants, and the confidentiality procedures for this study. How data will be collected and the evaluation instrument is also described. The *TouchMath* intervention is explained and the methods for analyzing data are detailed.

### District Setting

This study took place at an elementary school in Northwest Arkansas. Demographic information for the school district provided in this section is based on published information from the 2013-2014 school year (Arkansas Department of Education [ADE], 2014). The school district serves students in 26 schools. The district in which the school is located has a total number of 20,542 students enrolled in grades K-12. There are 10,115 students enrolled in K-5 in this school district. There were 13,832 (67.3 percent) students in the district who qualified for the Free/Reduced lunch program. The ethnic make up for the school district consisted of 355 Asian students, 465 Black students, 9,150 Hispanic students, 106 Native American/ Native Alaskan students, 2,108 Native Hawaiian/ Pacific Islander students, 8,025 White students, and 333 students with two or more races (see Figure 1). There are 10, 660 males and 9,882 females in this school district. Students enrolled in this district who are also a member of a Gifted and Talented program total 1947 (9.5 percent) students. There are 1863 (9.1 percent) students enrolled in Special Education programs in this school district.

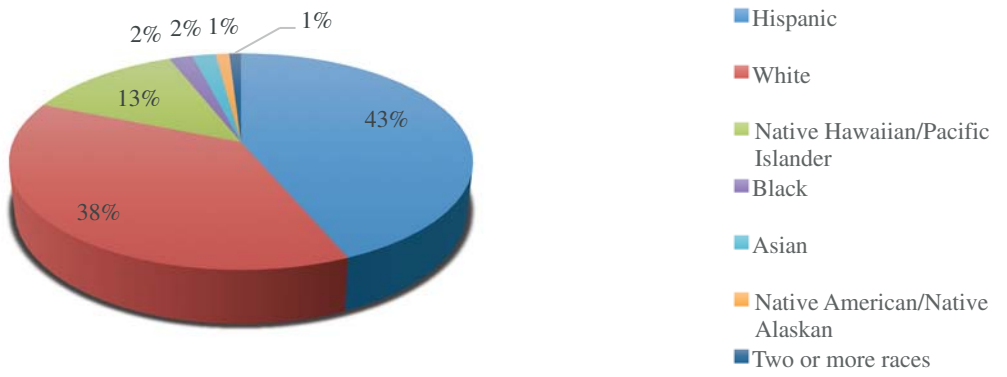


*Figure 1.* Racial demographics for the school district in Northwest Arkansas.

**School Setting**

The elementary school for this study has a total of 617 students (ADE, 2014). The student population consists of 12 Asian students, 12 Black students, 269 Hispanic students, 7 Native American/Native Alaskan students, 79 Native Hawaiian/Pacific Islander students, 232 White students, and 6 students with two or more races (see Figure 2). This elementary school has 322 males and 295 females. There are 456 (73.9 percent) students in this school who qualify for the Free/Reduced lunch program. There are 281 (45.5 percent) students in this school who are English Language Learners (ELL). Students enrolled in this school who are also a member of a Gifted and Talented program totals 38 (6.1 percent) students. There are 55 (8.9 percent) students enrolled in Special Education programs at this school. As of October 1, 2013, there are 5 students enrolled in this school whom are homeless.

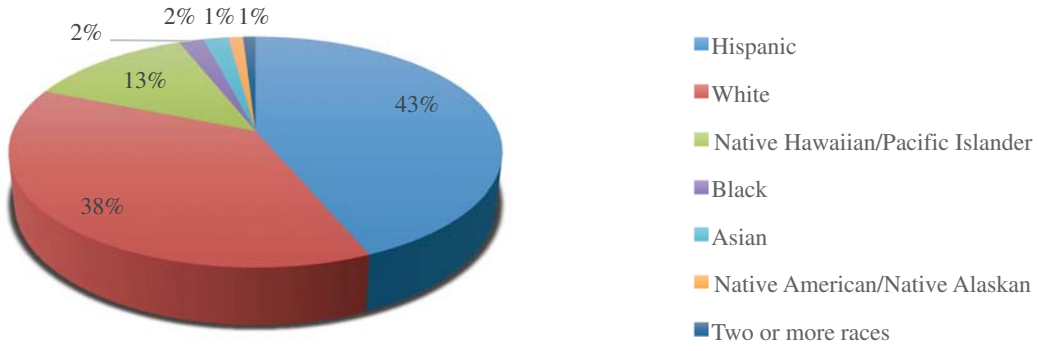


*Figure 2.* Racial demographics for the elementary school in Northwest Arkansas.

**Participants**

This study took place in a third-grade classroom consisting of 24 students. The student population of the classroom consists of 1 Black student, 12 Hispanic students, 10 White students, and 1 Pacific Islander students (see Figure 3). This classroom has 11 females and 13 males. There are 20 (80 percent) students in this classroom who qualify for the Free/Reduced lunch program. ELL Levels are given to students who are learning English. Level 1 indicates very little knowledge of the English language and Level 5 indicates mastery of the English language. There are 11 (44 percent) students in this classroom that are ELL students. There is one student in the class who is considered an ELL level 1. There are three students in the class who are an ELL level 2. There are four students in this class who are an ELL level 3. There are two students in this class who are an ELL level 4. There is also one student in the class who is an ELL level 5. There are 9 students in the class who scored below the 21st percentile in the numbers and operations portion of the Measures of Academic Progress (MAP) test given at the beginning of the school year. There are 6 students in the class who scored between the 21st and 40th percentile in the numbers and operations portion of the MAP test. There are 6 students in the class who scored between the 41st and 60th percentile in the numbers and operations portion of the MAP test. There are 3 students in the class who scored between the 61st and 80th percentile in the numbers and operations portion of the MAP test. There is 1 student in the class who scored above the 80th percentile in the numbers and operations portion of the MAP test. Furthermore, according to the MAP test, 10 students are considered to be one grade level below third grade in mathematics, 8 students are considered below grade level, and 7 students are considered above grade level. While all students demonstrated visual, auditory, and kinesthetic learning styles, a

clear majority of students (13) predominately prefer kinesthetic learning. Additionally, 6 students predominately prefer auditory learning. Also, 6 students predominately prefer visual learning.

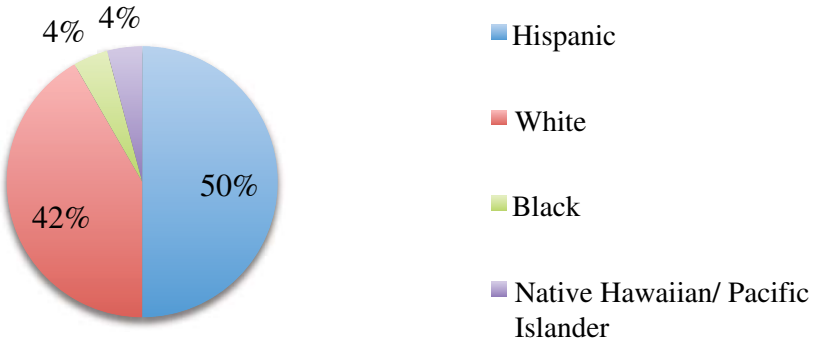


*Figure 3.* Racial demographics for the third-grade classroom in Northwest Arkansas.

**Confidentiality**

Permission to conduct this study was granted by the University of Arkansas Institutional Review Board (see Appendix A), as well as the administration of the elementary school where the study was conducted. Permission to participate in this study was obtained prior to the commencement of this project. A letter along with an Informed Consent was sent home with each student in the appropriate language, and a signature from the parent or guardian was obtained before data for that child was reported. There was a 100 percent return rate of signed Informed Consent letters. The Informed Consent explained the purpose and procedures of the study. It also explained that the child may withdraw from the study at any time without penalty. All information was kept confidential to the extent allowed by applicable State and Federal law and University policy. Confidentiality was maintained and assured by establishing a code through randomly assigned numbers to each participant. All scores and responses for data analysis were recorded using this code. The code and all data were stored in a secure place and were only accessible to the researcher. Once the study is successfully defended, the code will be destroyed.

## Data Collection

This study was designed to determine if mathematics instruction incorporating the *TouchMath* program improves addition computational fluency. Data were collected to determine if teaching addition while using the *TouchMath* program, 30 minutes a day, four days a week, for eight weeks, increased students' addition fluency skills. During the eight-week intervention period, students' ability to add fluently was measured daily as students added single-, double-, and triple-digit numbers between 0-1000. Eight weekly timed tests were also given and scored on the fourth day of the instruction cycle. Daily and weekly scores as well as detailed anecdotes, in addition to a score earned before and after the intervention, were recorded.

**Evaluation instrument.** The *Curriculum-Based Measurement (M-CBM) Mathematics* measures addition computational fluency. It was developed in the early 1970's at the University of Minnesota. This assessment has been researched in multiple academic areas that include: mathematics, reading, writing, spelling, science, and social studies. The CBM is valid, efficient to administer, and reliable. This study consists of five individual subtests of the *M-CBM* that measure addition of one, two, and three digit numbers with and without regrouping in single, double, and triple columns. There were 30 addition problems on each assessment that were timed for four minutes each. The students' scores were derived by giving a score of one for each correct answer then dividing the total number of addition computations correct by the total number of addition computations. The subtest scores were combined to create a percentage of accuracy score for each participant.

According to the Common Core State Standards (CCSS), by the end of third grade, students should be able to fluently add within 1000. The scores were organized into categories of

achievement: advanced 90-100% correct answers, proficient 70-89% correct answers, basic 51-69% correct answers, and below basic 0-50% correct answers.

**Baseline data.** In order to establish a baseline for addition computational fluency, the *M-CBM* was administered during the week of December 12, 2013 (see Appendices C1, C2, C3, C4, & C5 for *M-CBM* pre-assessment). The scores from this test established the students' ability to add quickly and accurately prior to mathematic instruction incorporating the *TouchMath* program in the classroom. As a pre-assessment, the *M-CBM* was administered.

**Other data collection methods.** Daily scores were recorded as students computed one single-, double-, and triple digit addition computation problem each day (see Appendix D for individual examples of daily assessment). The students were given 15 seconds to answers all three problems. Daily scores were averaged at the end of each week to get a weekly average of daily scores. In addition to daily timed computations, students were also given a score on their daily independent practice. The scores were converted to percentage of accuracy each in order to compare results. Daily independent practice scores were averaged at the end of each week to get a weekly average of daily independent practice scores.

Additionally, a weekly test was given on the fourth day of the instruction cycle (see Appendices E1, E2, & E3 for individual examples of weekly assessments). Five single-, five double-, and five triple digit addition computation problems were given to the students to complete**.** Computations were timed for two minutes and then scored for accuracy. The students' scores were derived by giving a score of one for each correct answer then dividing the total number of addition computations correct by the total number of addition computations

In addition to daily and weekly scores on computational fluency, observed anecdotes related to computational fluency performance throughout the study were recorded. Data that

were recorded throughout the eight weeks were then organized and analyzed to determine if mathematic instruction incorporating the *TouchMath* program impacted computational fluency in this third-grade classroom.

**Post data analysis.** In order to determine the effectiveness of mathematic instruction incorporating the *TouchMath* program on addition computational fluency, the *M-CBM* assessment was administered again to each student following the same protocol used for the pre-assessment (see Appendices F1- F5 for *M-CBM* post-assessment). The post-assessment results were examined and compared to the baseline data. A paired-samples *t*-test was conducted to determine if a significant difference exists between the pre-assessment and post-assessment scores. Anecdotal records were coded and analyzed to determine patterns and themes that appeared (see Appendices G1 & G2 for observed anecdotes). A weekly average of daily scores was calculated at the end of each week. Weekly scores were also given.

All daily scores, weekly scores, pre- and post-assessments and anecdotal records were carefully examined and analyzed to determine changes and trends. Then conclusions were drawn.

## Intervention Strategies

During the course of this study, students learned to gain speed in computing addition facts using the *TouchMath* program. The students were taught the touchpoints on the numerals and taught to use these touchpoints when adding to help them calculate more quickly. Students participated in focused instruction on specific addition facts and how to increase speed and accuracy when adding. The scope and sequence (see Appendices B1, B2, B3, & B4) of addition included addition of 1 – 3 digit numbers with place value through 1000. The order was basic addition, addition with counting on, addition without regrouping, and addition with regrouping.

Student groups were based on the addition skills demonstrated by the pre-assessment scores. Students in Group 1 consisted of 12 students who scored between 0-75 points on the pre-assessment. However, Group 2 consisted of 13 students who scored between 76-104 points on the pre-assessment.

The achievement categories were formulated based on generally accepted percentage achievement levels. Students were grouped according to their achievement level in order to differentiate their instruction to meet their individual needs. The scope and sequence of this study was determined using the Common Core State Standards, the *TouchMath* program, and research based sequence. This study took place in one third grade classroom, 30 minutes a day, four days a week, for eight-weeks. This mathematic instruction was in addition to regular mathematic instruction.

**Weekly routine.** A week consisted of four consecutive days of instruction. The addition content chosen for this study was based on the scope and sequence of Common Core State Standards and MAP testing conducted at the beginning of the 2013 school year (see Appendices B1, B2, B3, & B4) along with the scope and sequence of the *TouchMath* program. The first week of instruction focused on identifying the touchpoints on the numerals and learning the Beginning Addition Statement. The second week of instruction focused on identifying numbers that sum to 10 and 100. The students were also taught the four remaining *TouchMath* statements that were used throughout the remainder of the study. The third and forth weeks of instruction focused on +1, +2, and +0 of 1 – 3 digit numbers with place value through 1000 using the *TouchMath* strategy. The fifth and sixth weeks of instruction focused on doubles of 1 – 3 digit numbers with place value through 1000 using the *TouchMath* strategy. The seventh and eighth weeks of instruction focused on near doubles of 1 – 3 digit numbers with place value through 1000 using

the *TouchMath* strategy. The final week of instruction focused on reviewing all addition facts and *TouchMath* statements and administering the post-assessment.

***Week one.*** The first week of instruction focused on beginning addition computation skills. Students participated in planned instruction and activities to increase addition computational fluency (see Appendices H1, H2, & H3 for lesson plan and independent practice). The students learned the Beginning Addition Statement: "I touch and count all the TouchPoints on the number." The students were required to touch the TouchPoints with a pencil point and count aloud in the correct order. The students reinforced the facts by repeating the computation and the answer aloud.

***Week two.*** The second week of instruction focused on addition of single digit numbers to the sum of 10 and addition of double-digit numbers to the sum of 100 (see Appendices I1, I2, & I3 for lesson plan and independent practice). The students were taught the remaining *TouchMath* statements: Addition with counting on, addition without regrouping, and addition with regrouping. The students learned the Addition Counting on Statement: "I touch the greater(est) number, say its name, and continue counting on the TouchPoints of the other number(s)." The students were taught to start with the greatest number, cross it out, and count on from the top most number. The students reinforced the facts by repeating the computation and the answer aloud. The students learned the Addition without Regrouping Statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." The students learned the Addition with Regrouping Statement: "I must regroup in my answer is greater than 9." The students were taught to begin with the Addition Counting on Statement, move to the Addition without Regrouping Statement, and when necessary use the Addition with Regrouping Statement. When a computation required regrouping, the students were taught to record the number of tens

regrouped to the tens column, then to record the number of ones or to record the number of hundreds regrouped to the hundreds columns, then to record the number of tens.

***Weeks three and four.*** Instruction during these weeks focused on +1, +2, and +0 of 1 – 3 digit numbers with place value through 1000 using the *TouchMath* strategy. Students participated in planned instruction and activities to increase addition computational fluency (see Appendices J1-J6 & K1-K6 for lesson plans and independent practice). The students were taught to use *TouchMath* statements: Addition with counting on, addition without regrouping, and addition with regrouping as a strategy to increase addition computational fluency. Week three instruction focused on the addition of two addends; whereas week four instruction focused on the addition of three or more addends.

***Weeks five and six.*** Instruction during these weeks focused on doubles of 1 – 3 digit numbers with place value through 1000 using the *TouchMath* strategy. Students participated in planned instruction and activities to increase addition computational fluency (see Appendices L1-L3 & M1-M3 for lesson plans and independent practice). The students were taught to use *TouchMath* statements: Addition with counting on, addition without regrouping, and addition with regrouping as a strategy to increase addition computational fluency. Week five instruction focused on the addition of two addends; whereas week six instruction focused on the addition of three or more addends.

***Weeks seven and eight.*** Instruction during these weeks focused on near doubles of 1 – 3 digit numbers with place value through 1000 using the *TouchMath* strategy. Students participated in planned instruction and activities to increase addition computational fluency (see Appendices N1-N3 & O1-O3 for lesson plans and independent practice). The students were taught to use *TouchMath* statements: Addition with counting on, addition without regrouping,

and addition with regrouping as a strategy to increase addition computational fluency. Week seven instruction focused on the addition of two addends; whereas week eight instruction focused on the addition of three or more addends.

**Daily routine.** A similar pattern and sequence of instruction was followed days 1-4 each week of the study. The week began by learning the addition facts in the ones place value column and progressed to the thousands place value column. The new addition facts were introduced on the first day of instruction and then practiced with double-digit numbers on the second day, triple-digit numbers on the third day, and four-digit numbers on the fourth day. On the first day of the instruction cycle, the students were instructed to use the *TouchMath* "Addition with counting on statement." On the second day of the instruction cycle, the students were encouraged to use the *TouchMath* "Addition without regrouping statement." On the third and fourth days of the instruction cycle, the students were encouraged to use the *TouchMath* "Addition with regrouping statement."

***Day one.*** On Day one, students were introduced to the addition fact in the ones place value column. The students were taught to use the "Addition with counting on statement." Students practiced addition computations at the conclusion of the lesson (see Appendices XXX for lesson plan and independent practice).

***Day two.*** On Day two, students were introduced to the addition fact in the tens place value column. The students were taught to use the "Addition without regrouping statement." Students practiced addition computations at the conclusion of the lesson.

***Day three.*** On Day three, students were introduced to the addition fact in the hundreds place value column. The students were taught to use the "Addition with regrouping statement." Students practiced addition computations at the conclusion of the lesson.

***Day four.*** On Day four, students were introduced to the addition fact in the thousands place value column. The students were taught to use the "Addition with regrouping statement." Students practiced addition computations at the conclusion of the lesson.

**Summary**

Data suggested that the vast majority of eighth-grade U.S. students fall below desired levels of achievement in mathematics. Experts (Barth, Beckmann, & Spelke, 2008; D. Bryant, B. Bryant, Gersten, Scammacca, Funk, Winter, Shih, & Pool, 2008; & Namkung & Fuchs, 2012) state that within mathematics, specifically addition and subtraction, the United States is behind developing countries. These deficiencies are alarming when experts (Dulgarian, 2000; Bullock, 2011; Green, 2009; Mays, 2008; & Vinson, 2004) remind us that the ability to compute effectively is critical and that all students must acquire these skills before mastering more complex mathematics skills. Research (Bedard, 2002; Dulgarian, 2000; Green, 2009; Mays, 2008; Rudolph, 2008; & Vinson, 2004) and literature (Bullock, 2011; & Vinson, 2005) suggests that multisensory strategies such as *TouchMath*, improves students' ability to perform addition computations accurately and with full understanding, Therefore, this research study was conducted in a third-grade classroom for a eight-week period.

# Chapter IV

## Results

The purpose of this chapter is to provide analyses of data collected for the study designed to address the research question, "Does mathematics instruction incorporating the *TouchMath* program improve students' addition computational fluency in one third-grade classroom?" Data are presented through narrative text that is supported with tables and figures. The purpose of this study was to determine if mathematics instruction incorporating touchpoints on numerals and specific addition statements enhances students' ability to add quickly and accurately in a narrative format.

Twenty-four students from a local elementary school participated in the study. Over the course of eight weeks, students participated in planned classroom mathematical instruction including +1, +2, +0, doubles, and near doubles involving four *TouchMath* strategies: touching points on the numerals, finding the greater addend and counting on, starting in the ones column when using the standard algorithm, and regrouping when the answer is greater than nine. The ability to fluently solve addition computations was determined by scoring students' timed addition quizzes. Scores for addition computations were recorded daily on the ability to correctly and fluently add single-, double-, and triple-digit computations. Daily scores were averaged at the end of each week to get a weekly average of daily scores. In addition to a daily score, a weekly timed addition computation quiz was given on the fourth day of the instruction cycle.

### Baseline Data

Baseline data were established by measuring the students' ability to add using the *Curriculum-Based Measurement (M-CBM) Mathematics Test.* The pre-assessment scores were obtained during the week of December 9, 2013. Only the addition section of the *M-CBM* was

used for this study. The scores from the *M-CBM* represent the number of correct responses that were collected before the commencement of the study to establish baseline ability to add prior to the implementation of mathematical instruction using the *TouchMath* program.

Five subtests of the *M-CBM* were administered to each student. These subtests included: single-, double-, and triple-digit addition computations, as well as computations with more than two addends. Each subtest consisted of 30 addition computations. The individual subtest scores were combined to get a total score representing correct responses for each student (see Appendix P for individual subtest pre-assessment scores). Students' ability to correctly add was measured using a 1-point rubric. The highest possible total points a student could receive on the *M-CBM* was 150, and the minimum score was 0. The maximum score recorded was 104 and the minimum score was 42. Thus, the range was 62. The mean score was 75. The median score was 73. The mode was 70 (see Appendix Q for individual student scores). There was no score identified as an outlier.

The baseline scores were classified into four achievement categories: below basic, basic, proficient, and advanced. In order to compare end results with the baseline data, each of these categories were given a specific range of scores that did not change when the end results were analyzed. Theses ranges were formulated based on generally accepted percentage achievement levels and then categorized into achievement categories as follows: 0-75 points means below basic, 76-104 points means basic, 105-134 points mean proficient, and 135-150 points means advanced. There was 12 scores classified as below basic, 12 scores classified as basic, and zero scores classified as proficient, and zero scores classified as advanced. Figure 4 illustrates the percentage of score in each achievement category.

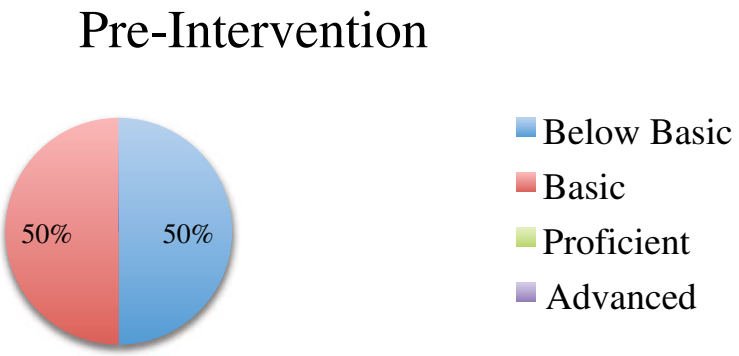


*Figure 4.* Percentage of students in each baseline addition computation achievement category.

**During Intervention**

In order to measure students' ability to fluently add during the present study, a daily and weekly addition computation score was recorded for each student throughout the eight-week intervention. In order to obtain daily scores, students computed three addition equations within 15 seconds each day before mathematical instruction incorporating the *TouchMath* program. These computations were scored on a 3-point scale. Daily scores were averaged at the end of each week to get a class mean score for daily addition fluency ability for that week (see Appendices R1-R8 for individual students daily scores and weekly averages). The highest possible addition fluency average was 3 and the lowest possible was 0.

Weekly averages of daily scores of addition ability varied slightly throughout the study. There was a slight increase in scores between the first and second weeks of the intervention, after the introduction of the *TouchMath* program. There was an additional slight increase in scores between the second and third weeks of the intervention. Throughout the remainder of the study weekly averages of daily scores remained somewhat constant with only a sharp increase during week seven when near doubles with two addends was taught. The class means of daily averages are shown in Figure 5.

In addition to a daily score, a weekly single-, double-, and triple-digit addition computation score was recorded for each student throughout the eight-week intervention to measure students' addition computational fluency. In order to obtain these scores, students computed 15 addition equations within two minutes. This was at the conclusion of a four-day mathematical instruction cycle incorporating the *TouchMath* program. These weekly scores were averaged to get a class mean score for weekly addition fluency ability for that week (see Appendices R1-R8 for individual student weekly scores). The highest possible addition fluency average was 20 and the lowest possible was 0. Because the new mathematical concepts taught each week build on one another, each weekly average is dependent from the previous weekly score.

Weekly averages of addition ability varied throughout the study. There was a slight decrease in scores between the first and second weeks of the intervention, after the introduction of the *TouchMath* program. There was a sharp increase in scores between the second and third weeks of the intervention when plus 1, plus 2, and plus 0 with two addends was taught. There was a sharp decrease in scores between the third and fourth week when plus 1, plus 2, and plus 0 with more than two addends were taught. There was an increase in scores between the fourth and fifth week when doubles with two addends were taught. There was a decrease in scores between the fifth and sixth weeks with doubles with more than two addends were taught. There was an increase in scores for the remaining weeks of the intervention when near doubles with two and more than two addends were taught. The class means of weekly averages are shown in Figure 5.

Weekly averages of daily scores and weekly scores followed similar trends throughout the eight-week study. Weekly averages of daily scores and weekly averages both had a slight decrease between the first and second week when adding sums to 10, 100, and 1000, along with

a sharp increase between the second and third weeks when adding plus one, two, and zero. Throughout the remainder of the intervention, scores increased slightly except for the final week of instruction when the scores decreased somewhat. The means of weekly averages of daily scores and averages of weekly scores for addition ability scores are shown in Figure 5.

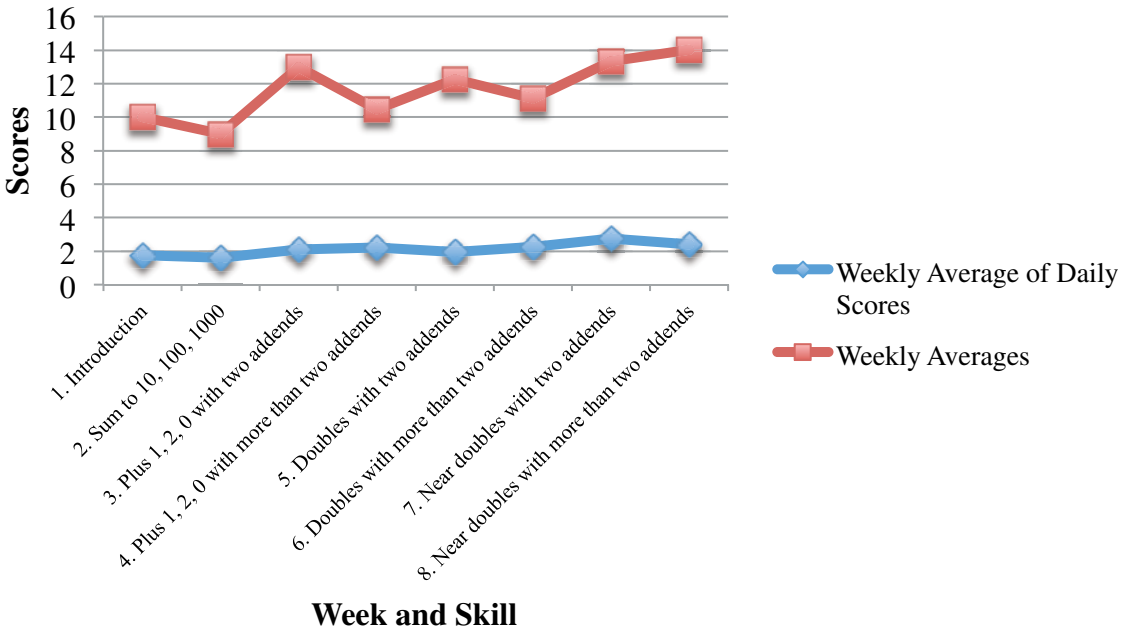


*Figure 5.* The class mean of daily (out of 3) and weekly (out of 15) averages for efficiency in adding computations.

**Post Intervention**

To determine the effectiveness of mathematical instruction incorporating the *TouchMath* program on addition computational fluency, the *M-CBM* was administered at the conclusion of the intervention (see Appendices F1-F5 for *M-CBM* post-assessment examples). The same computations were given in the same manner as before the intervention. The students' individual ability to add quickly and accurately was measured and analyzed to determine if mathematical instruction incorporating the *TouchMath* program improved their ability to solve addition computations. The test was given during the week of March 17, 2014.

Students computed various equations from the *M-CBM* to determine their ability to add quickly and accurately. The individual subtest scores were combined to get a total score representing correct responses for each student (see Appendix S for individual subtest post-assessment scores). The highest possible total points a student could receive on the *M-CBM* was 150, and the minimum score was 0. The maximum score recorded was 125 and the minimum score was 75. Thus, the range was 50. The mean score was 101. The median score was 102. The modes were 83, 98, 100, and 105 (see Appendix Q for individual student scores). There was no score identified as an outlier. Figure 6 illustrates the individual student pre- and post-intervention addition computation ability scores as measured by the *M-CBM*.

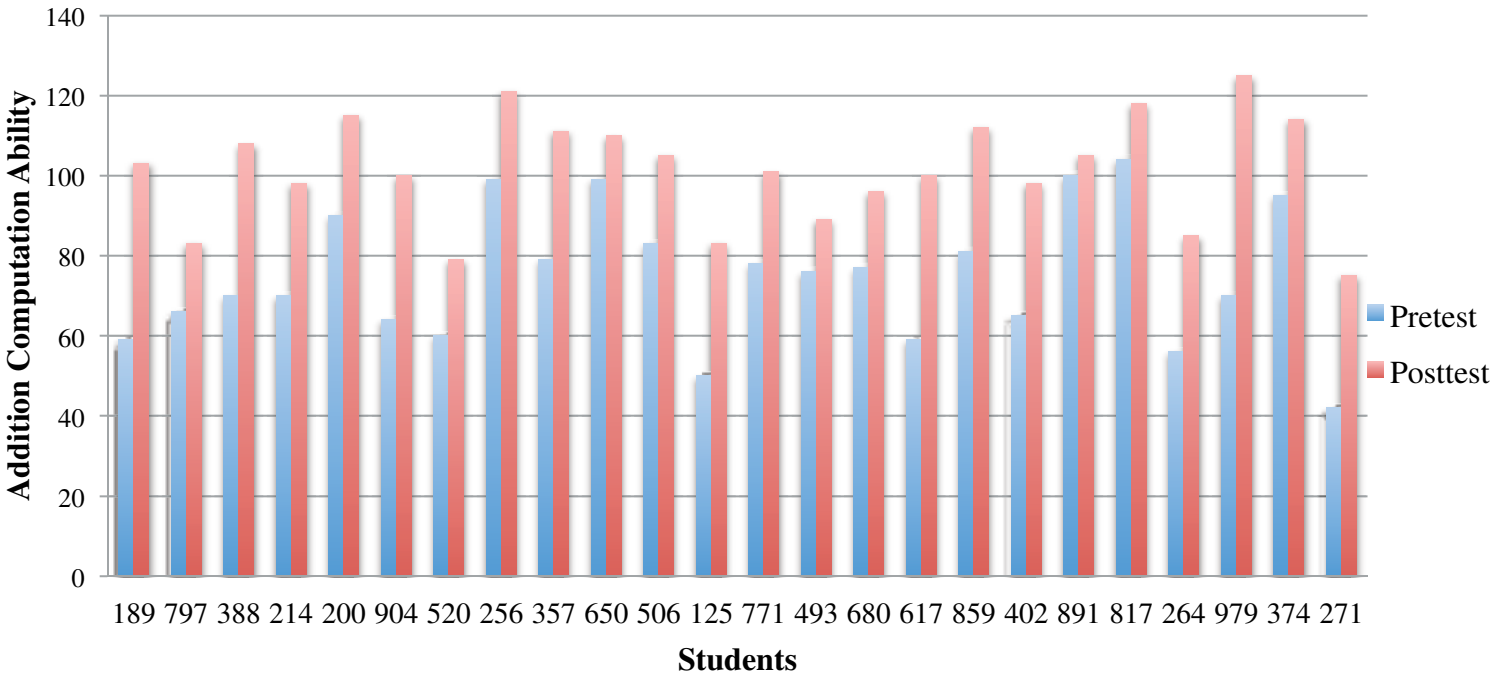


*Figure 6.* Individual pre- and post-intervention addition computation scores.

Post- intervention data were then organized into four achievement categories: advanced, proficient, basic, and below basic. There were 0 scores in the advanced category, 11 scores in the proficient category, 12 scores in the basic category, and 1 score in the below basic category (see

Appendix T for individual student achievement scores). The number of scores at proficient increased by 11 scores, the number of scores at basic remained constant at 12 scores. The number of scores at below basic decreased by 10. Figure 7 illustrates the percentages of students in each category for both pre- and post-intervention data.

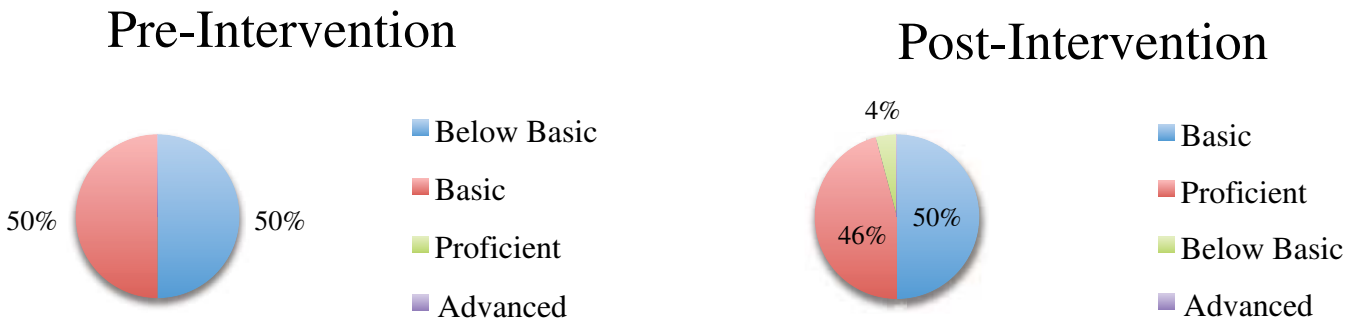


*Figure 7.* Percentage of scores in each addition computational fluency achievement category.

**Data Analysis**

In order to measure the ability to add quickly and accurately, the *M-CBM* was administered before and after the implementation of the intervention. Before mathematical instruction incorporating the *TouchMath* program was used, the mean addition computational fluency score of participants measured by the *M-CBM* was 75. After the intervention, the mean score according to the *M-CBM* was 101. These results were analyzed using a paired- samples *t*-test with an alpha level set at .001. This analysis revealed a significant difference between the pre- and post-intervention addition computational fluency scores, $t(24)=3.77$; *t Stat*=11.31; $p<.001$. The mean increased 26 points on the posttest scores, which was a significant increase (see Appendix U for complete results). The *t*-test results are presented in Table 1.

*Table 1*
Results Obtained from *t*-test for Addition Computational Fluency Scores

| Pre-test | | Post-test | | | | |
|---|---|---|---|---|---|---|
| N | Mean | N | Mean | *t* | *tStat* | *p* |
| 24 | 75 | 24 | 101 | 3.77 | 11.31 | .0000000000719 |
| | | | | | | *p*=<.001 |

**Subpopulations**

The *M-CBM* addition computational fluency scores of subpopulations were also analyzed to determine if there were any relationships in the findings in terms of gender, first language spoken, and attendance. Pre-test and post-test scores were compared in each subpopulation to determine if there were significant differences in growth.

**Male and female.** Scores were noted with regards to gender. The difference in the pre- and post-intervention mean scores of male students was 30 while the difference in mean scores of female students was 24. Addition computational fluency scores for males increased 6 points more than addition computational fluency scores for females (see Appendix V for male and female pre- and post-test scores). These results were analyzed using a paired-samples *t*-test assuming unequal variances with an alpha level of .05, and this analysis did not reveal a significant difference between the growth in male and female addition computational fluency scores (see Appendix V for complete results). Figure 8 illustrates the pre- and post-intervention means of male and female students for addition computational fluency scores.

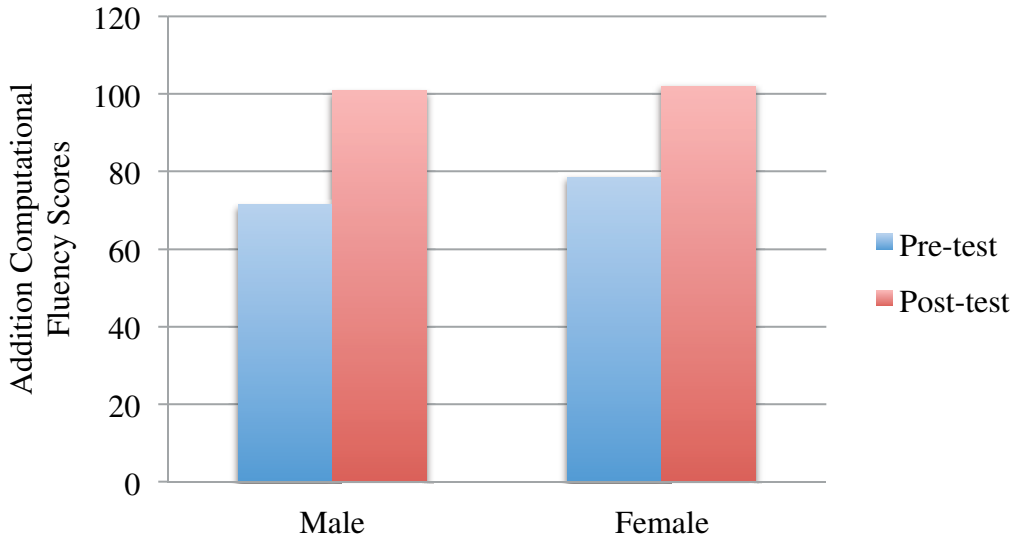


*Figure 8.* Pre- and post-intervention scores by gender.

**English language learners and non-English language learners.** Scores were also noted with regards to first language spoken. The difference in the pre- and post-intervention mean scores of English language learners was 25, and the difference in mean scores for non-English language learners was 28. Addition computational fluency scores for non-English language learners increased by 3 points more than English language learners (see Appendix W for individual English language learners and non-English language learners pre- and post-test scores). These results were analyzed using a paired-samples *t*-test assuming unequal variances with an alpha level of .05, and this analysis did not reveal a significant difference between the growth in English language learners and non-English language learner's addition computational fluency scores (see Appendix W for complete results). Figure 9 illustrates the pre- and post-intervention means of English language learners and non-English language learners for addition computational fluency scores.

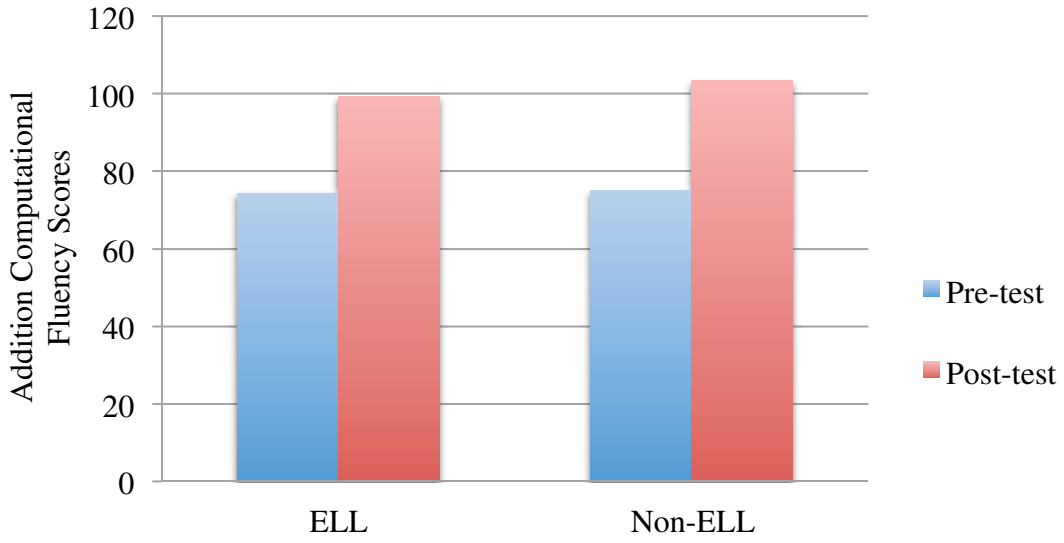


*Figure 9.* Pre- and post-intervention scores by first language spoken.

**Regular attendance and irregular attendance.** Scores were also noted with regards to attendance. Irregular attendance is defined as being absent for more than 20 percent or seven

days of the eight-week intervention. Regular attendance is defined as being present for more than 80 percent or 25 days of the eight-week intervention. The difference in the pre- and post-intervention mean scores of students with regular attendance was 27, and the difference in mean scores for students with non-regular attendance was 24. Addition computational fluency scores for students with regular attendance increased by 3 points more than students with non-regular attendance (see Appendix X for individual students with regular attendance and students with non-regular attendance pre- and post-test scores). These results were analyzed using a paired-samples *t*-test assuming unequal variances with an alpha level of .05, and this analysis did not reveal a significant difference between the growth in students with regular attendance and students with non-regular attendance addition computational fluency scores (see Appendix X for complete results). Figure 10 illustrates the pre- and post-intervention means of students with regular attendance and students with non-regular attendance for addition computational fluency scores.

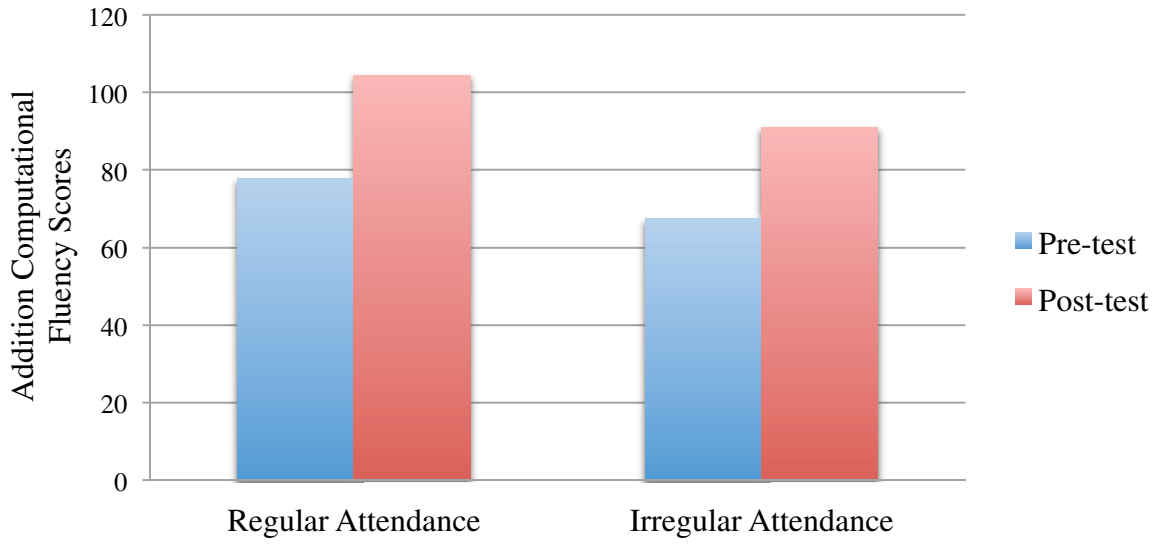


*Figure 10.* Pre- and post-intervention score by attendance.

**Anecdotal Records**

Anecdotes were recorded during the eight-week intervention addressing the research question, "Does mathematics instruction incorporating the *TouchMath* program improve students' addition computational fluency in one third-grade classroom?" Anecdotal records were based on observations related to students' transfer of acquired skills and attitude toward computation. Records were analyzed and then organized into two categories according to patterns and themes that emerged. These categories were transfer of *TouchMath* knowledge to other mathematic instruction and improved attitude towards math (see Appendices G1 & G2 for observed anecdotes).

Throughout the course of the intervention, students made connections and transferred their knowledge gained from mathematical instruction incorporating the *TouchMath* program. On January 30, 2014 during a Cognitively Guided Instruction (CGI) Math Lesson, Student 357 transferred the use of the touchpoints in an addition equation to a subtraction equation. Without being told, the student knew that you could say the largest number and count back using the touchpoints to find the correct answer. During other mathematics instruction, on February 17, 2014, student 506 drew the touchpoints on the numerals to help find the perimeter of a quadrilateral. Additionally, Students 189, 200, and 506 were observed using touchpoints during Benchmark preparation practice on February 25, 2014 and March 8, 2014. Also, Students 402, 125, 506, and 402 were observed using touchpoints during after school tutoring on multiple dates which included: February 17, 2014 and February 25, 2014. Students 200, 374, and 402 stated that they used *TouchMath* during SuccessMaker, a computer based learning tool, on February 12, 2014, February 25, 2014, and March 12, 2014. Additionally, when students turned in their

weekly math homework, multiple students drew the touchpoints on the numbers to find the correct answer.

In addition to transfer of knowledge, students' overall attitude towards math improved. Student 271 stated on February 12, 2014 that, "I am starting to understand addition better." Multiple other students stated that they are feeling more comfortable with math, specifically addition. Student 817 stated on February 13, 2014 that, "*TouchMath* is my favorite thing to do at school." On February 25, 2014 Student 214 stated, "*TouchMath* is pure magic! It's helping me get really fast at adding." Another Student, 506, on March 5, 2014 stated "I feel like *TouchMath* is helping me because I am not failing math anymore." Throughout the intervention, the student' attitudes about math increased. After initially not enjoying more math instruction, multiple students began to ask at the beginning of every day, "When are we going to do *TouchMath?"*

Overall, *TouchMath* has increases most of the students attitude towards math and has provided a strategy that students have transferred to other mathematical situations.

**Summary**

This chapter has presented an analysis of all data collected for the purpose of measuring the effects of mathematical instruction incorporating the *TouchMath* program on addition computational fluency in one third grade classroom. The next chapter provides conclusions and implications that can be drawn from the study. Recommendation for future instruction and further research are made. Possible limitations imposed on the research are also noted.

# Chapter V

## Discussion

The ability to add fluently and efficiently is an important skill that students need to be successful throughout schooling. Numerous experts (Dulgarian, 2000; Bullock, 2011; Green, 2009; Mays, 2008; & Vinson, 2004) posit that the ability to compute effectively is a critical skill all students must acquire for more complex mathematics. However, Hanueshek, Peterson, and Woessmann (2010) state that the United States as a whole is scoring well below other developing countries in regards to mathematics. Other experts (Barth, Beckmann, & Spelke, 2008; & Bryant et al., 2012) state that for mathematics, specifically addition and subtraction, the United States lags behind developing countries in achievement. Research by Henry and Brown (2008) suggests that students rarely achieve complete addition and subtraction fact fluency in the first few years of school. Research (Dulgarian, 2000; Green, 2009; Mays, 2008; Rudolph, 2008; & Vinson, 2004) and literature (Bullock, 2011 & Vinson, 2005) conclude that mathematics instruction incorporating the *TouchMath* program helps students improve addition computational fluency by providing touchpoints as reference points on the numerals one to nine. The purpose of this study was to determine the effects of mathematics instruction incorporating the *TouchMath* program on addition computational fluency in a third-grade classroom.

This study addressed the question, “Does mathematics instruction incorporating the *TouchMath* program improve students’ addition computational fluency in one third-grade classroom?” The results of the present study suggest that mathematic instruction incorporating the *TouchMath* program significantly improved this groups’ ability to add quickly and accurately. Results obtained by analyzing daily addition computation quizzes revealed that students scored lowest on sums to 10, 100, and 1000, and highest on near doubles with two

addends. Results obtained by analyzing weekly addition computation quizzes revealed that students scored lowest on sums to 10, 100, and 100, and highest on near doubles with more than two addends. Overall, addition with two addends appeared to be more successful than addition with more than two addends (see Appendix Y for table of results, conclusions, implications, and recommendations).

The *M-CBM* pre- and post-test revealed a significant increase of the class' mean for addition computational fluency. One hundred percent of students' addition computational fluency scores improved after mathematic instruction incorporating the *TouchMath* program was implemented. Scores for subpopulations within the classroom revealed that addition computational fluency scores for both male and female students improved from pre-test to post-test after mathematic instruction incorporating the *TouchMath* program. Increases in mean scores from the pre-test to the post-test for males and females differed only 6 points. Similarly, all students' mean scores improved regardless of first language spoken. Addition computational fluency mean scores for those who speak English as a first language increased slightly more than those students who speak English as a second language. Furthermore, all students' scores improved regardless of attendance patterns.

Analysis of achievement category scores indicate that students in the basic or below basic categories grew the most. Students moved from the below basic category to the basic or proficient category. Students moved from the basic category to the proficient category. There were 18 students who improved one achievement category. There were two students who advanced two categories. There were no students who regressed a category. Although every student's addition computational fluency score increased, there were four students who did not improve enough to change achievement categories.

Results obtained by reviewing anecdotal records to find common themes, revealed that attitude toward math improved and students transfer the *TouchMath* program to other mathematics practice. At the beginning of the study students were noticeably upset engaging in additional mathematic instruction. At the conclusion of the study, students excitedly asked all throughout the day, "When is it time for *TouchMath*?" It was also noted that students transferred the use of touchpoints learned during the intervention outside of the specific intervention to Benchmark practice, after school tutoring, morning math practice, additional math instruction, and SuccessMaker.

**Conclusions**

Based on the results of this study, it appears that students' ability to add quickly and accurately improved. Results of the present study revealed that these students were able to add with more accuracy and speed after participating in mathematics instruction incorporating the *TouchMath* program activities. All students in this third-grade classroom, regardless of gender, native language spoken, or attendance pattern, improved. Males and female students' scores improved about the same after the implementation of mathematical instruction incorporating the *TouchMath* program. Non-English language learners improved slightly more than English language learners. Additionally, students with regular attendance scores increased slightly more than students' with irregular attendance.

Addition computational fluency scores improved for all students, which impacted each achievement category. Below grade level students' scores improved more than other categories, but the majority (83 percent) of all students moved up at least one category in terms of grade-level performance.

Daily averages recorded throughout the study showed little improvement from week 1 to week 8. The students scored lowest on sums to 10, 100, and 1000, and highest on near doubles with two addends. Weekly averages recorded throughout the study showed a notable improvement from week 1 to week 8. The students scored lowest on sums to 10, 100, and 1000, and highest on near doubles with more than two addends. Knowledge increased with practice and promoted fluency from beginning to end.

The results indicate an overall improvement in the students' ability to add fluently, from the beginning of the intervention to the end of the intervention. The overall improvement of all scores and anecdotal records suggest that students became faster and more accurate and became more positive towards mathematics. These findings are similar to those of Dulgarian (2000), Green (2009), Mays (2008), and Rudolph (2008) who found that mathematics instruction incorporating the *TouchMath* program is effective with all students regardless of achievement ability. Anecdotal records of daily observations in this study indicated that the students' attitude towards math increased which supports the findings of Mays (2008) who found that mathematic instruction incorporating the *TouchMath* program improved mathematics confidence. Additionally, anecdotal records in this study indicated that the students were able to transfer the use of touchpoints to homework, Benchmark practice, additional math instruction, and SuccessMaker.

**Implications**

The results of this study imply that mathematics instruction incorporating the *TouchMath* program may improve students' ability to add quickly and accurately. Results suggest that teaching students specific touchpoints on numerals, enhances their ability to add fluently, regardless of their gender, native language spoken, or attendance pattern. Mathematics

instruction incorporating the *TouchMath* system may be equally effective for males, females, English language learners, non-English language learners, students with regular attendance, and students with irregular attendance.

In addition, the results of this study imply that mathematics instruction incorporating the *TouchMath* program may be cumulative and may impact addition computational fluency more over time.

Additionally, the results of this study imply that mathematics instruction incorporating the *TouchMath* program is effective for a wide range of achievement levels, but particularly for those who are below grade level. Scores taken during the intervention suggest that mathematics instruction incorporating the *TouchMath* program may be more effective for addition computations with two addends as compared to addition computations with more than two addends. Anecdotal records taken during this study imply that the *TouchMath* program is transferrable to other mathematical skills. In addition, anecdotes imply that the *TouchMath* program may improve students' attitude toward math.

**Limitations**

As with any study, there were factors over which the researcher had no control that may have affected the results of this study, and it is important to interpret the findings of this study with full knowledge of the limitations. Some factors may have positively impacted the results, other may have negatively impacted the results, and others may have had an unknown impact. Factors that may have boosted additional computational fluency are preparation for Benchmark exams, SuccessMaker, FastMath, after school tutoring, additional math instruction, and natural maturation. At least once a week, students received extra mathematical instruction to improve students' computation ability as part of preparations for the Benchmark exams. At least once a

week, most students participated in the online learning tools SuccessMaker and FastMath to improve mathematical ability. At least twice a week, most students participated in after school tutoring as part of preparations for the Benchmark exams. Students also received extra math practice during Math Wall and throughout regular mathematical instruction during the day. Teachers taught basic and advanced math skills and concepts, which may have boosted their post-test scores. Finally, this study was conducted over an eight-week period, so it is possible that some of the students' growth could be attributed to natural maturation.

A factor that may have negatively impacted the addition computational fluency scores was the time of day when instruction occurred. The researcher was given the last 30-40 minutes of the day to implement mathematics instruction incorporating the *TouchMath* program and to conduct a daily assessment. Students were exhausted by the end of the day, which may have negatively impacted the students' ability to obtain more knowledge and practice their addition skills. Additionally, winter weather was a dominant factor at the beginning of the study. Snow and ice caused twelve days of interruption to the intervention, which may have negatively impacted the students' ability obtain more knowledge about addition.

## Recommendations

Based on the results of the present study, recommendations are made. Recommendations are made regarding future instruction and future research.

**For the classroom.** It is recommended that mathematics instruction incorporating the *TouchMath* program be taught to all students to improve their ability to add fluently. Since all students' addition computational fluency ability improved, it is recommended that teachers use mathematics instruction incorporating the *TouchMath* program to improve all groups of students' addition computational fluency ability, regardless of gender, native language spoke, or

attendance pattern. It is further recommended that mathematics instruction incorporating the *TouchMath* program be implemented for all ranges of achievement levels, but particularly for those who are below grade level. Additionally, it is recommended for teachers to use the *TouchMath* program throughout the school year in combination with subtraction, multiplication, and division to develop deep mathematical skills and fluency.

It is recommended that mathematics instruction incorporating the *TouchMath* program be implemented in a lower-elementary class because using touchpoints on numerals bridges the gap between concrete experiences and abstract concepts. It is also recommended that mathematics instruction incorporating the *TouchMath* program be taught in combination with direct instruction in the classroom.

**For future research.** Recommendations for future research include the length of the study, research setting, research design, and the correlation between addition computational fluency and attitude towards math. Since the students' scores fluctuated slightly each week, but notably from pre-test to post-test, it is recommended that mathematics instruction incorporating the *TouchMath* program be implemented over a shorter period of time. Since the students in this particular third-grade classroom were all lower-achieving math students, it is recommended that mathematics instruction incorporating the *TouchMath* program be tested in a lower grade elementary classroom to determine effectiveness. Only addition computational fluency was tested during this study, but anecdotal records showed the appearance of an increase in attitude towards math. Therefore, it is recommended that mathematics instruction incorporating the *TouchMath* program be tested for other variables such as ability to increase attitude and confidence towards mathematics.

It is also recommended that the research design be changed to allow a comparison of a similar third-grade classroom that only gets direct mathematics instruction to a group that gets only mathematics instruction incorporating the *TouchMath* program.

**Summary**

Research (Bullock, 2011; Dulgarian, 2000; Green, 2009; Mays, 2008; & Vinson, 2004) opines that the ability to compute effectively is a crucial concept that all students must gain for more complex mathematics. This chapter has offered conclusions for the study, along with what those conclusions imply. Recommendations for future instruction and for further research were made. Additionally, factors other than the intervention that may have impacted the results of the study were identified. Overall, conclusions and implications from the present study suggest that mathematics instruction incorporating the *TouchMath* program improves students' addition computational fluency. These results may be useful for other elementary teachers. Mathematics instruction incorporating the *TouchMath* program appears to have improved the ability to add quickly and accurately for the students in this study.

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# Appendix A

UNIVERSITY OF ARKANSAS

*Office of Research Compliance*
*Institutional Review Board*

December 2, 2013

MEMORANDUM

| | |
|---|---|
| TO: | Chelsea Ullrich<br>Linda Eilers |
| FROM: | Ro Windwalker<br>IRB Coordinator |
| RE: | New Protocol Approval |
| IRB Protocol #: | 13-11-247 |
| Protocol Title: | *The Effects of Mathematics Instruction Incorporating the TouchMath Program on Addition Computational Fluency in a Third-Grade Classroom* |
| Review Type: | ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB |
| Approved Project Period: | Start Date: 12/2/2013 Expiration Date: 12/1/2014 |

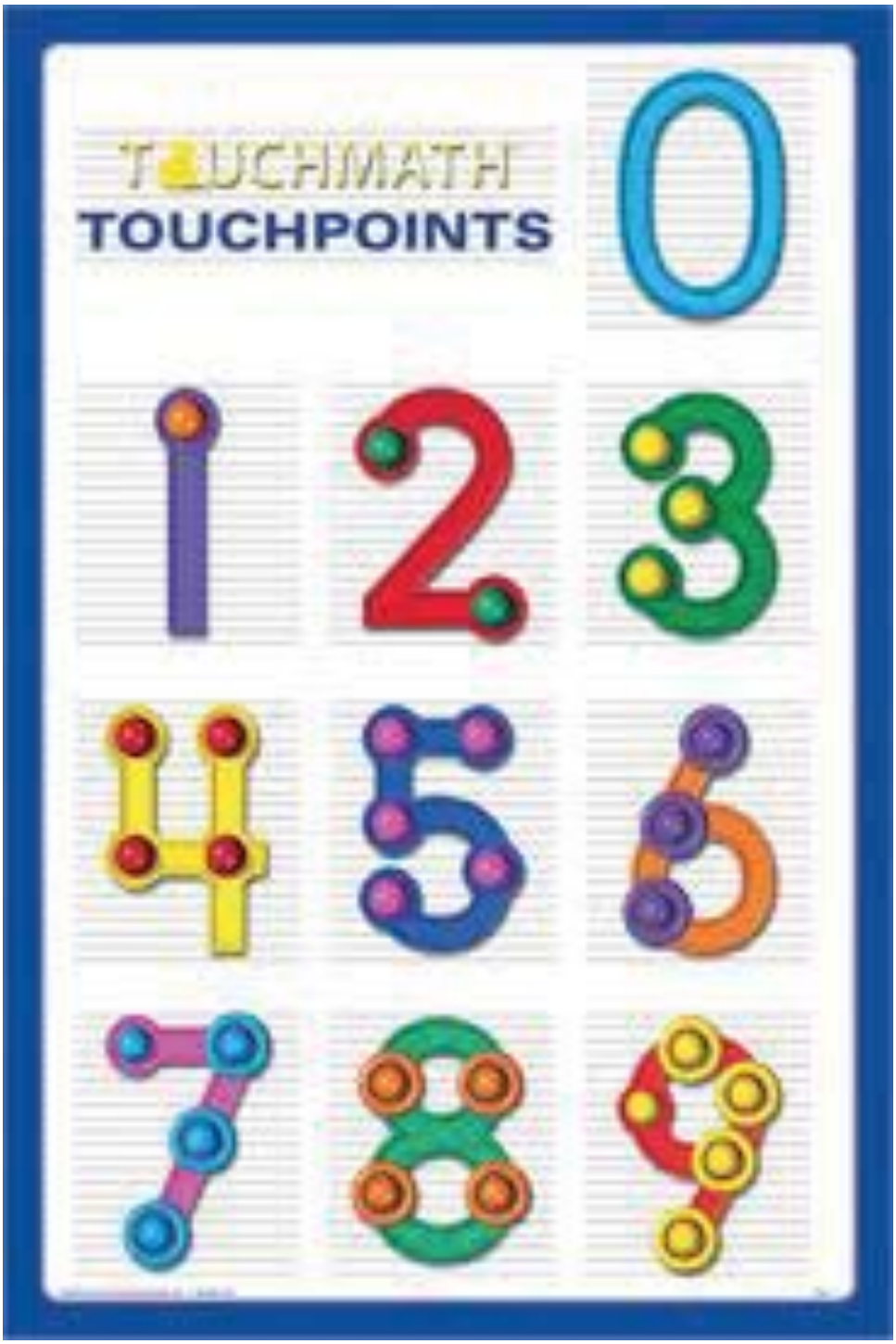
Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (http://vpred.uark.edu/210.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

**This protocol has been approved for 25 participants.** If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.

210 Administration Building • 1 University of Arkansas • Fayetteville, AR 72701
Voice (479) 575-2208 • Fax (479) 575-3846 • Email irb@uark.edu

**Appendix A1**



## Appendix B1

| Week.Day | Addition Skill | Strategy |
|---|---|---|
| 1.1 | Beginning math practice | Introduce and explain TouchMath with peach ring candy and Dots. Explain and model the addition skill using physical representation. |
| 1.2 | Beginning math practice | Review addition skill. Use randomly generated numbers to create computations and be able to answer the computations within three minutes. |
| 1.3 | Beginning math practice | Use grocery fliers to gather numbers to add; focusing on single-digit numbers. The students will be given three minutes to complete the addition computations. |
| 1.4 | Beginning math practice | The students will create and answer addition computation word problems. The students will be given five minutes to complete the computations. The students will also be given a weekly summative test to determine knowledge gained. |
| 2.1 | Single digit numbers that sum to ten | Addition with counting on statement. |
| 2.2 | Single digit numbers that sum to ten | Addition with counting on statement. |
| 2.3 | Double digit numbers that sum to 100 | Addition without regrouping statement. |
| 2.4 | Double digit numbers that sum to 1000 | Addition with regrouping statement. |
| 3.1 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with counting on statement. |
| 3.2 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>Two addends | Addition without regrouping statement. |
| 3.3 | +1, +2, +0 in ones, tens, hundreds, and thousands place value | Addition with regrouping statement. |
| 3.4 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with regrouping statement. |
| 4.1 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with counting on statement. |

(table continues)

## Appendix B2

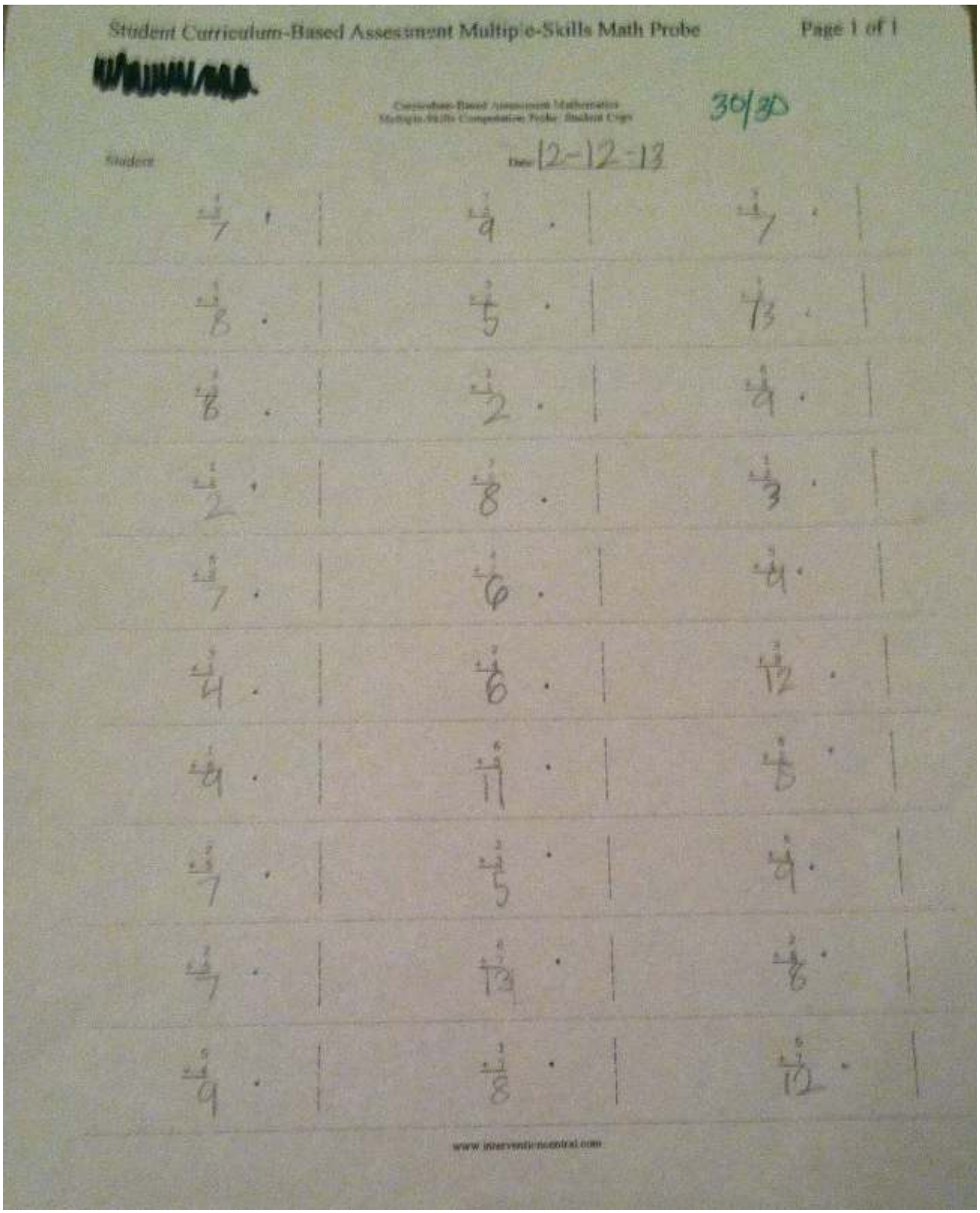
| | | |
|---|---|---|
| 4.2 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition without regrouping statement. |
| 4.3 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |
| 4.4 | +1, +2, +0 in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |
| 5.1 | Doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with counting on statement. |
| 5.2 | Doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition without regrouping statement. |
| 5.3 | Doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with regrouping statement. |
| 5.4 | Doubles in ones, tens, hundreds, and thousands place value | Addition with regrouping statement. |
| 6.1 | Doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with counting on statement. |
| 6.2 | Doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition without regrouping statement. |
| 6.3 | Doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |
| 6.4 | Doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |

(table continues)

## Appendix B3

| | | |
|---|---|---|
| 7.1 | Near doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with counting on statement. |
| 7.2 | Near doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition without regrouping statement. |
| 7.3 | Near doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with regrouping statement. |
| 7.4 | Near doubles in ones, tens, hundreds, and thousands place value<br>Two addends | Addition with regrouping statement. |
| 8.1 | Near doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with counting on statement. |
| 8.2 | Near doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition without regrouping statement. |
| 8.3 | Near doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |
| 8.4 | Near doubles in ones, tens, hundreds, and thousands place value<br>More than two addends | Addition with regrouping statement. |
| 9.1 | Review | The teacher will review the addition strategies that were learned. The teacher will remind the students of the *TouchMath* system.. |
| 9.2 | Review | The teacher will review the addition strategies that were learned. The teacher will remind the students of the *TouchMath* system. |
| 9.3 | Post Assessment | The teacher will administer the *Curriculum Based Measurement Test* as a post assessment of knowledge gained throughout the study. |
| 9.4 | Post Assessment | The teacher will administer the *Curriculum Based Measurement Test* as a post assessment of knowledge gained throughout the study. |

**Appendix C1**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Page 1 of 1
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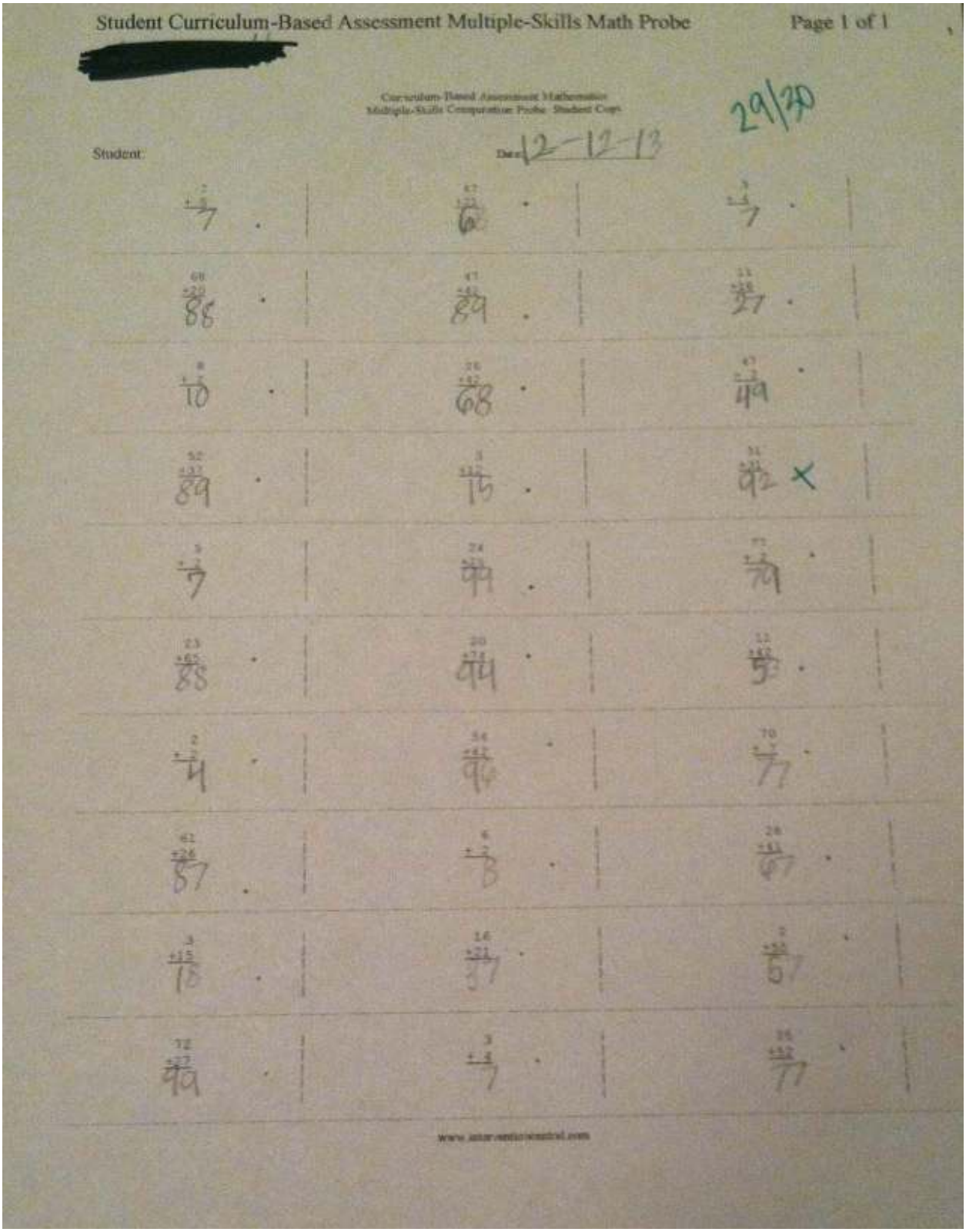
Date 12-12-13
www.interventioncentral.com

**Appendix C2**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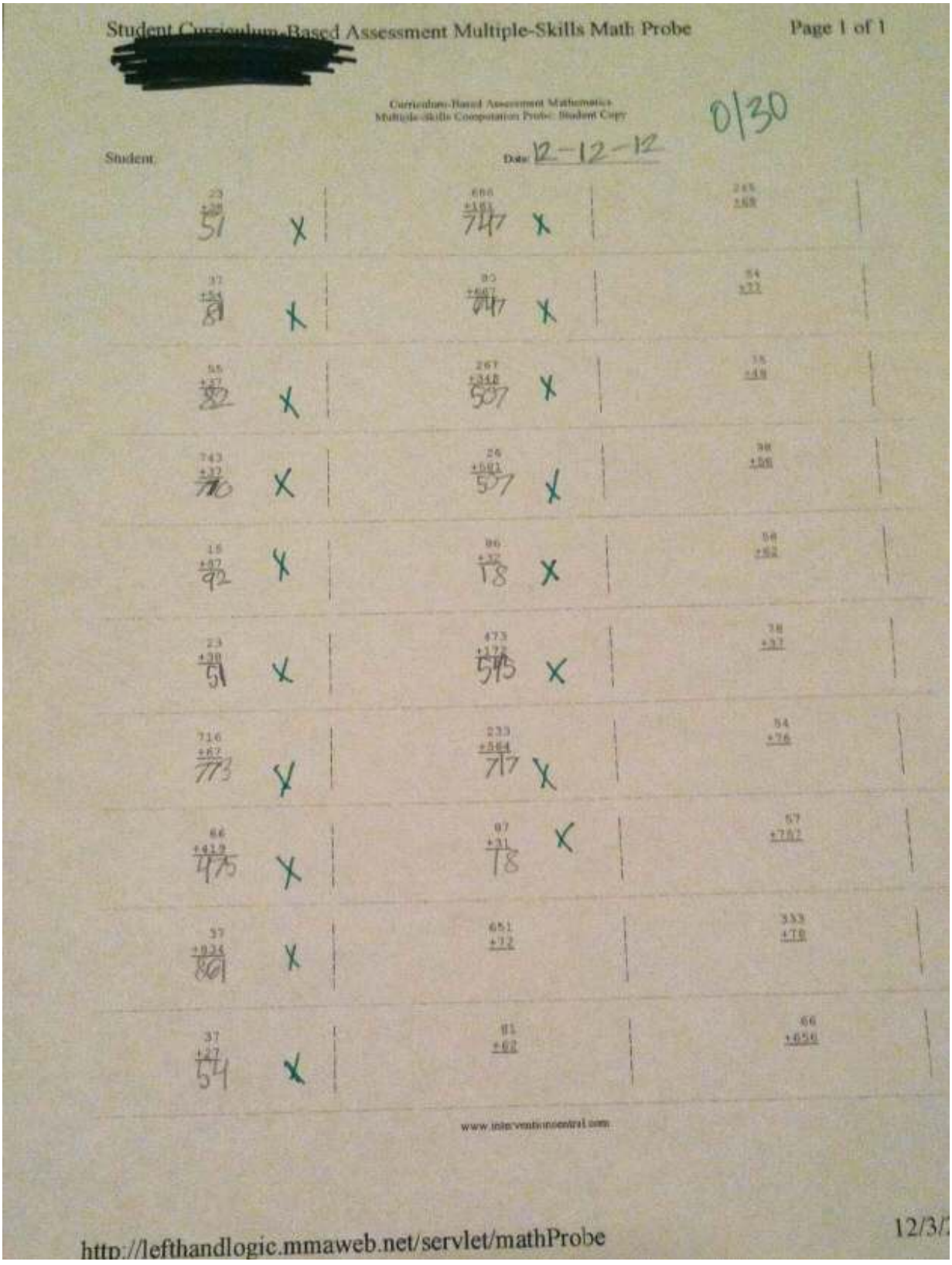
**Appendix C3**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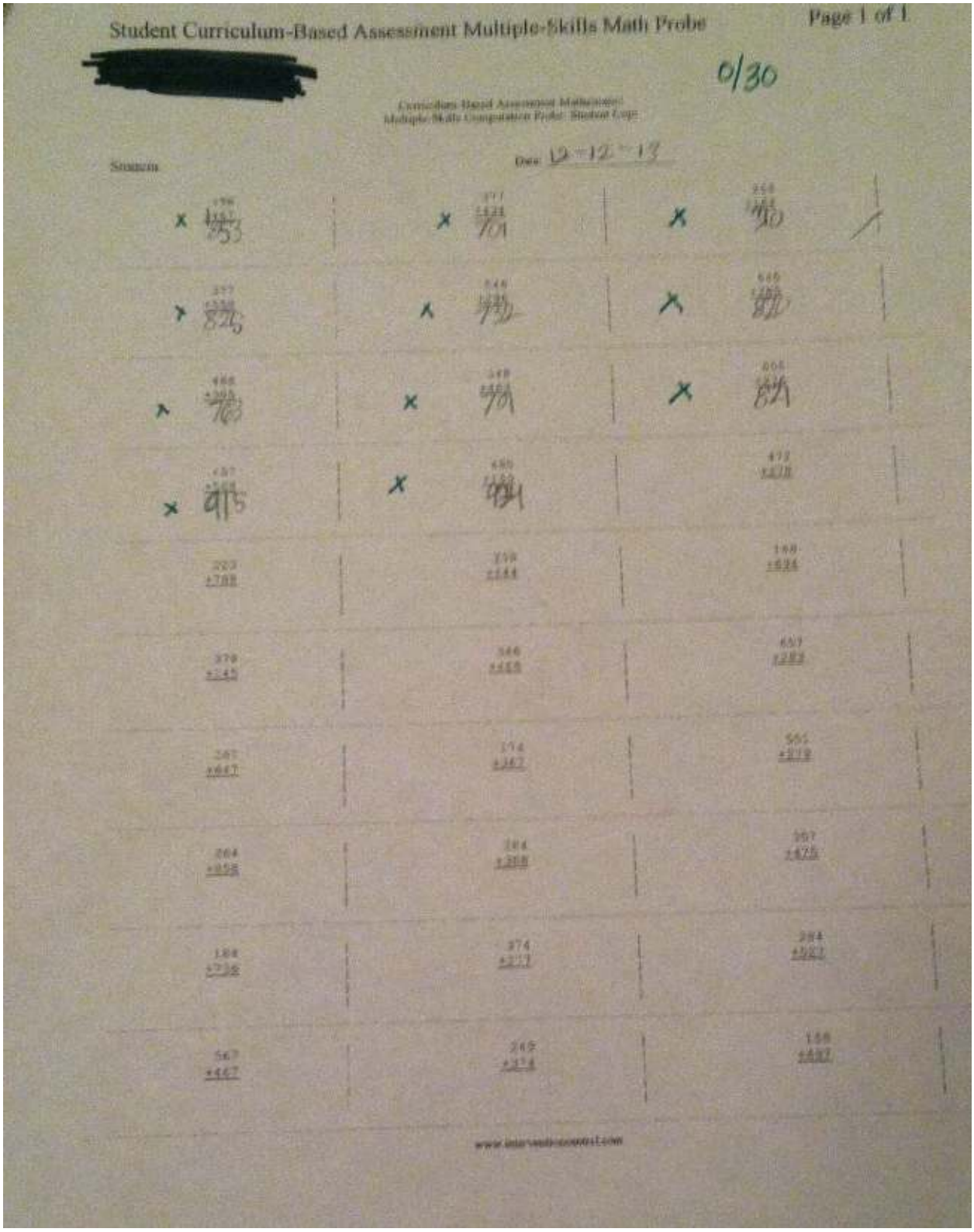
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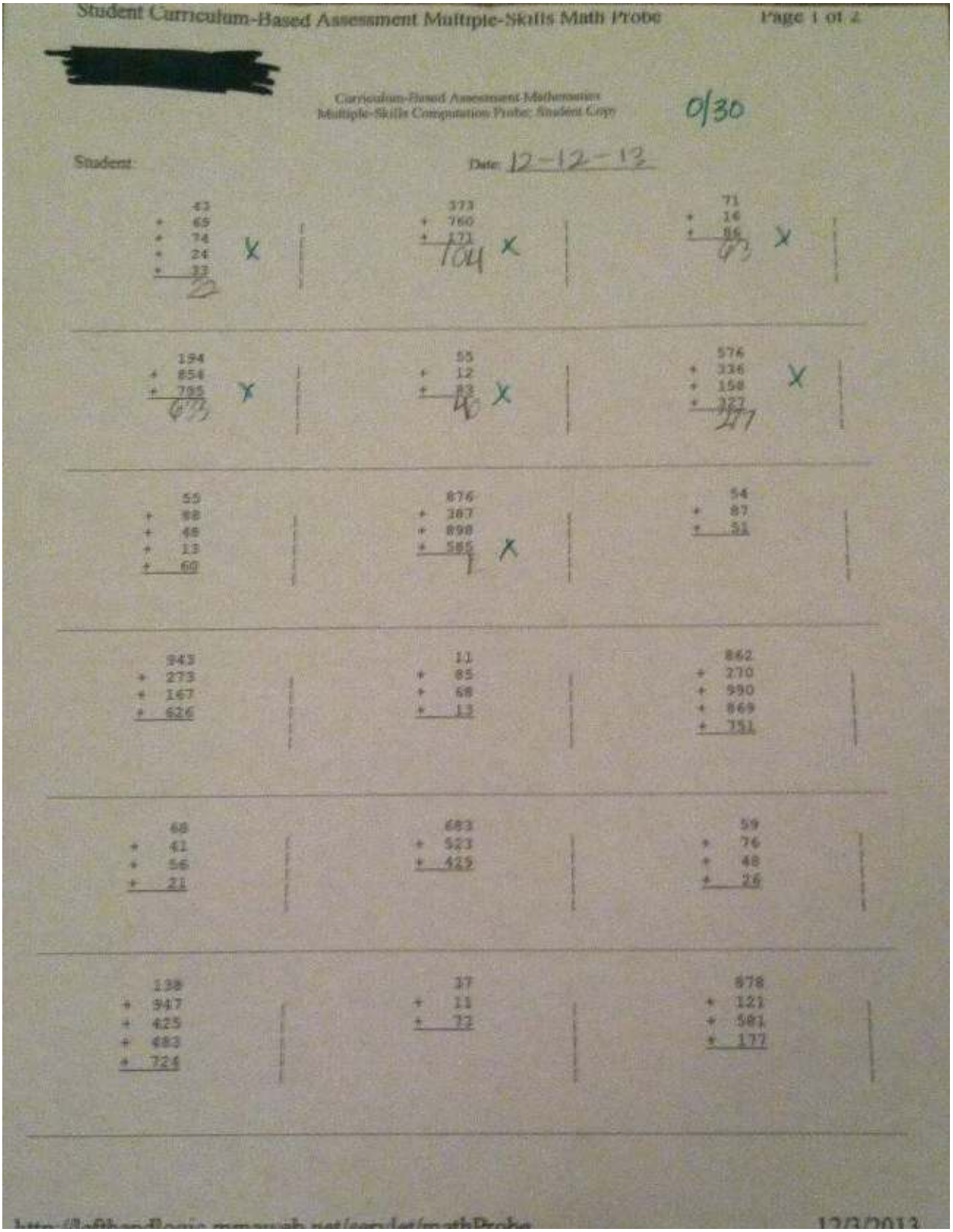

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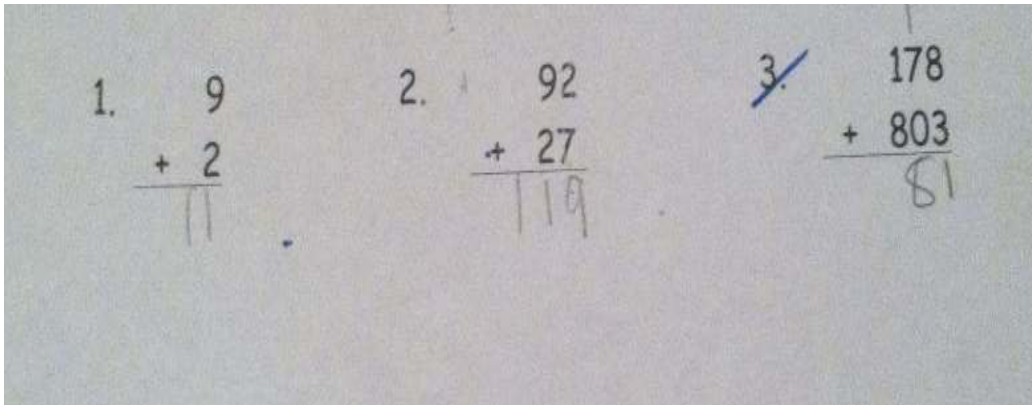
| | | |
|---|---|---|
| 43 + 65 + 74 + 24 + 33 = 22 X | 373 + 760 + 171 = 104 X | 71 + 16 + 86 = 63 X |
| 194 + 854 + 785 = 673 X | 55 + 12 + 83 = 46 X | 576 + 336 + 158 + 327 = 277 X |
| 55 + 88 + 46 + 13 + 60 | 876 + 387 + 898 + 585 = 7 X | 54 + 87 + 51 |
| 943 + 273 + 167 + 626 | 11 + 85 + 68 + 13 | 862 + 270 + 990 + 869 + 751 |
| 68 + 41 + 56 + 21 | 683 + 523 + 429 | 59 + 76 + 48 + 26 |
| 138 + 947 + 425 + 683 + 724 | 37 + 11 + 72 | 878 + 121 + 581 + 177 |

http://softhandbasic.mrmath.net/cgi-bin/mathProbe 12/3/2013

**Appendix D**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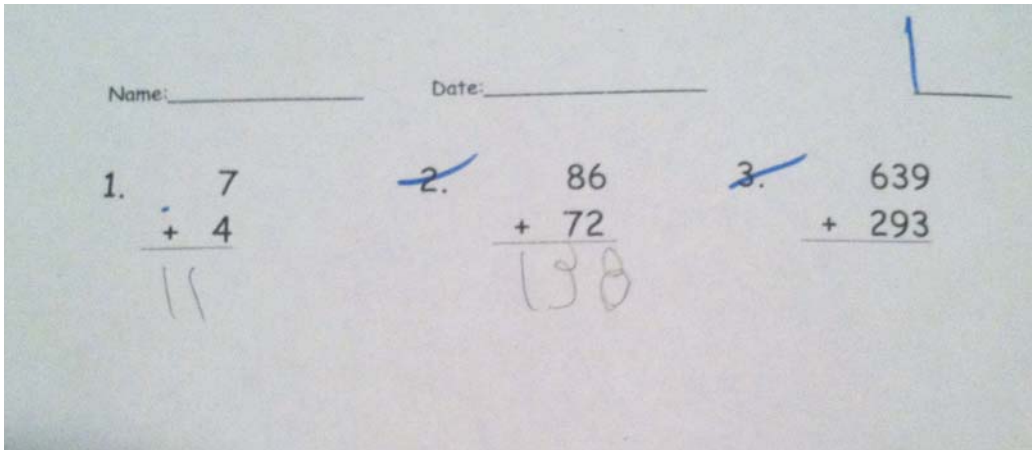
2. 92 + 27 = 119
3. 178 + 803 = 81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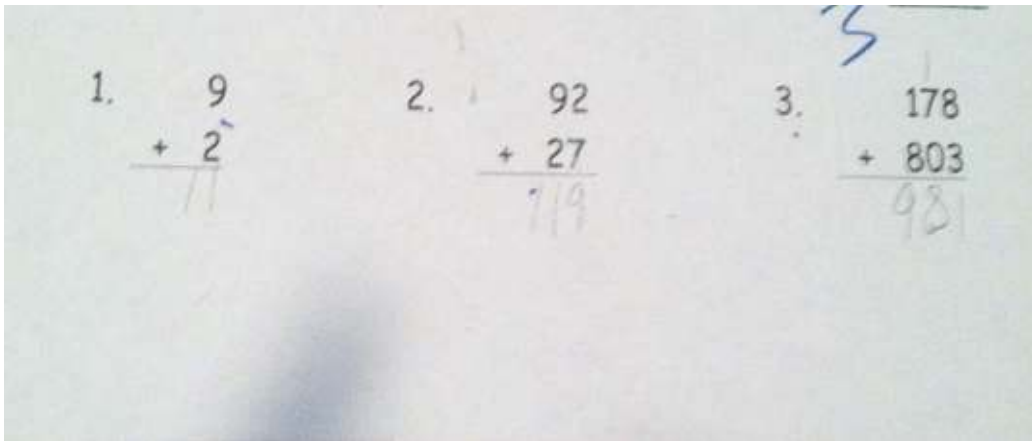
3. 639 + 293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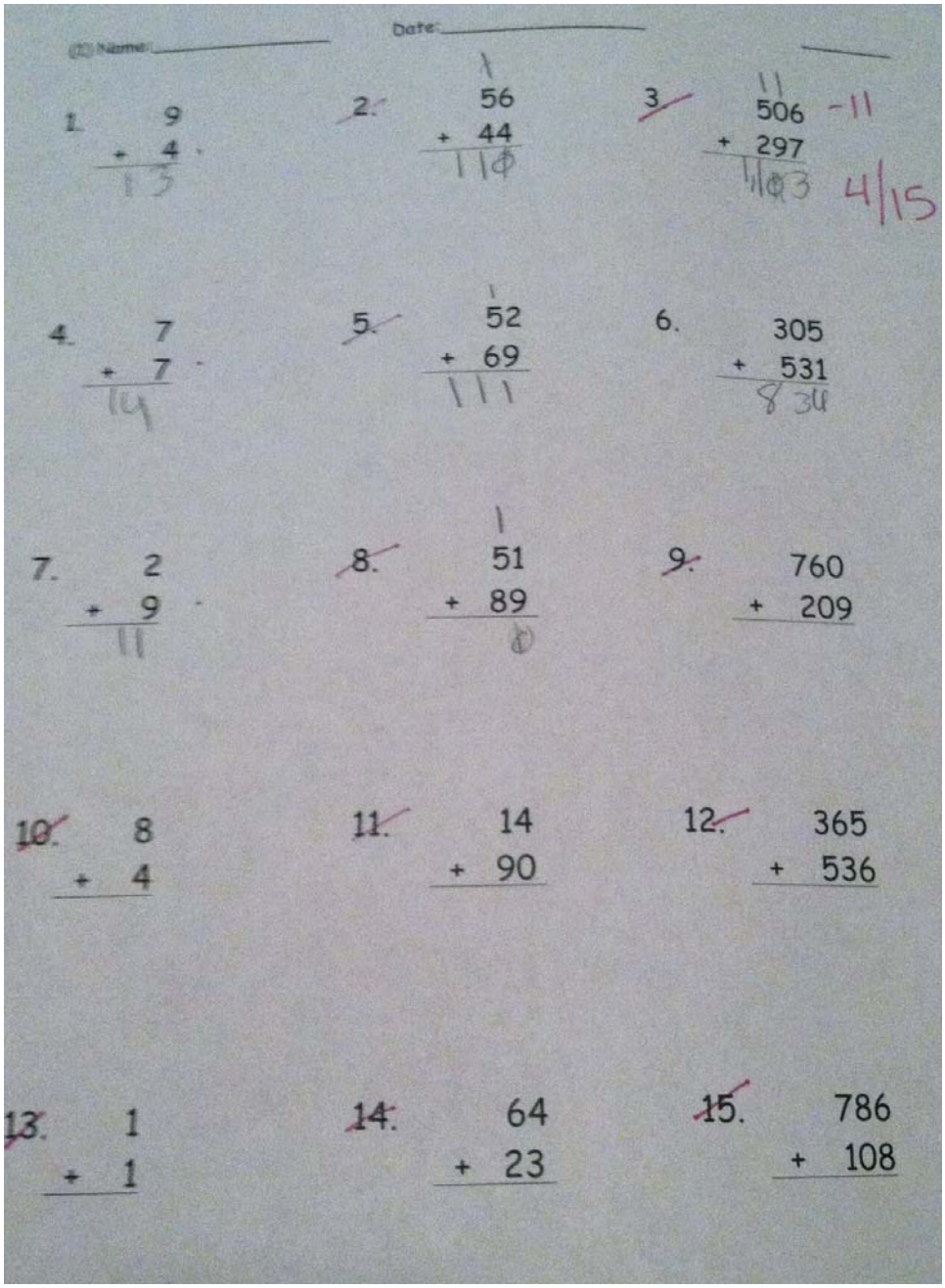
2. 92 + 27 = 119
3. 178 + 803 = 981

**Appendix E1**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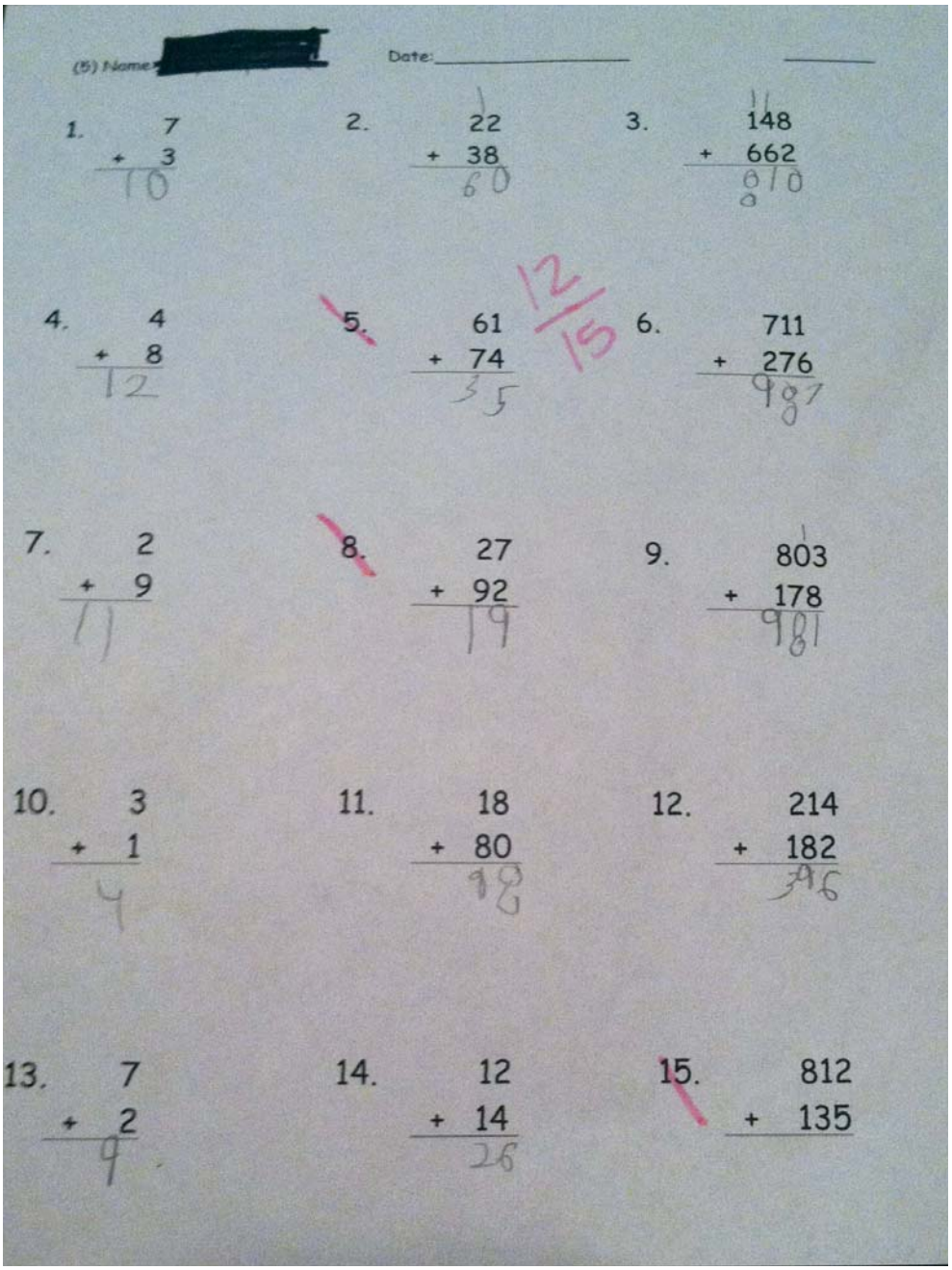
3. 506 + 297 = 803
4. 7 + 7 = 14
5. 52 + 69 = 111
6. 305 + 531 = 836
7. 2 + 9 = 11
8. 51 + 89 = 140
9. 760 + 209
10. 8 + 4
11. 14 + 90
12. 365 + 536
13. 1 + 1
14. 64 + 23
15. 786 + 108

**Appendix E2**


(5) Name [redacted] Date:_____ _____

1. 7 + 3 = 10

2. 22 + 38 = 60

3. 148 + 662 = 810

4. 4 + 8 = 12

5. 61 + 74 = 135 12/15

6. 711 + 276 = 987

7. 2 + 9 = 11

8. 27 + 92 = 119

9. 803 + 178 = 981

10. 3 + 1 = 4

11. 18 + 80 = 98

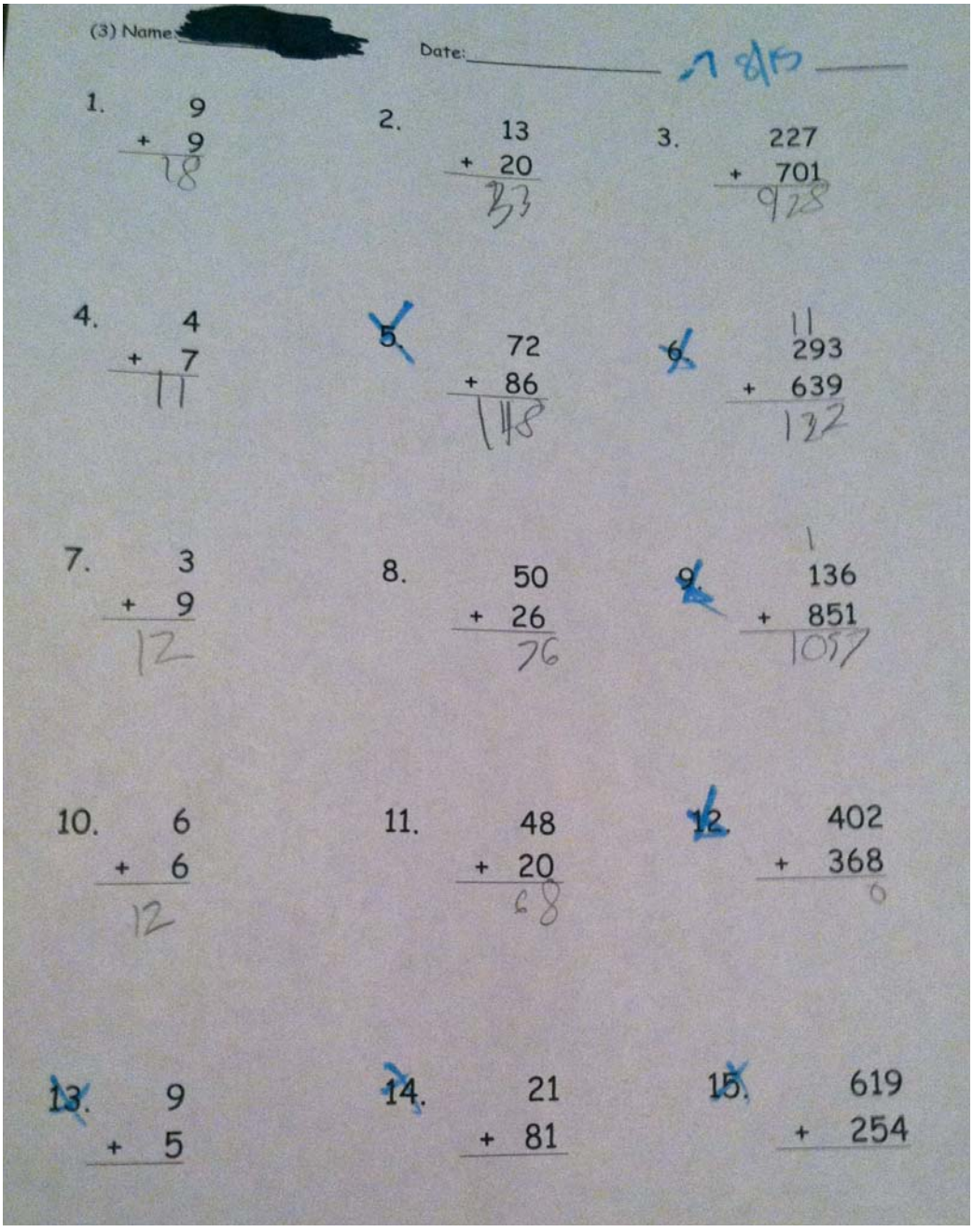
12. 214 + 182 = 396

13. 7 + 2 = 9

14. 12 + 14 = 26

15. 812 + 135

**Appendix E3**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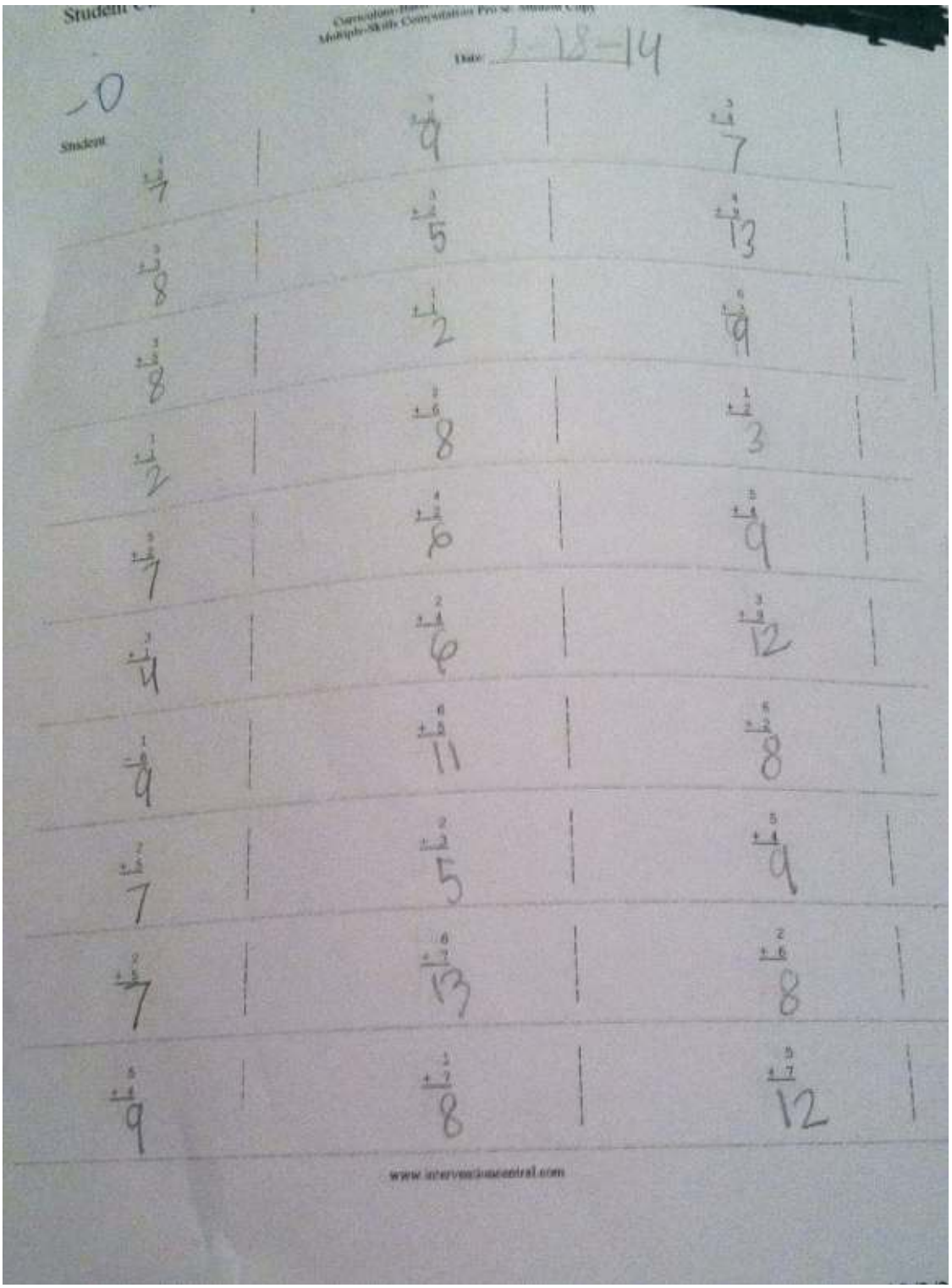
3. 227 + 701 = 928
4. 4 + 7 = 11
5. 72 + 86 = 118
6. 11 / 293 + 639 = 132
7. 3 + 9 = 12
8. 50 + 26 = 76
9. 1 / 136 + 851 = 1057
10. 6 + 6 = 12
11. 48 + 20 = 68
12. 402 + 368 = 0
13. 9 + 5
14. 21 + 81
15. 619 + 254

**Appendix F1**



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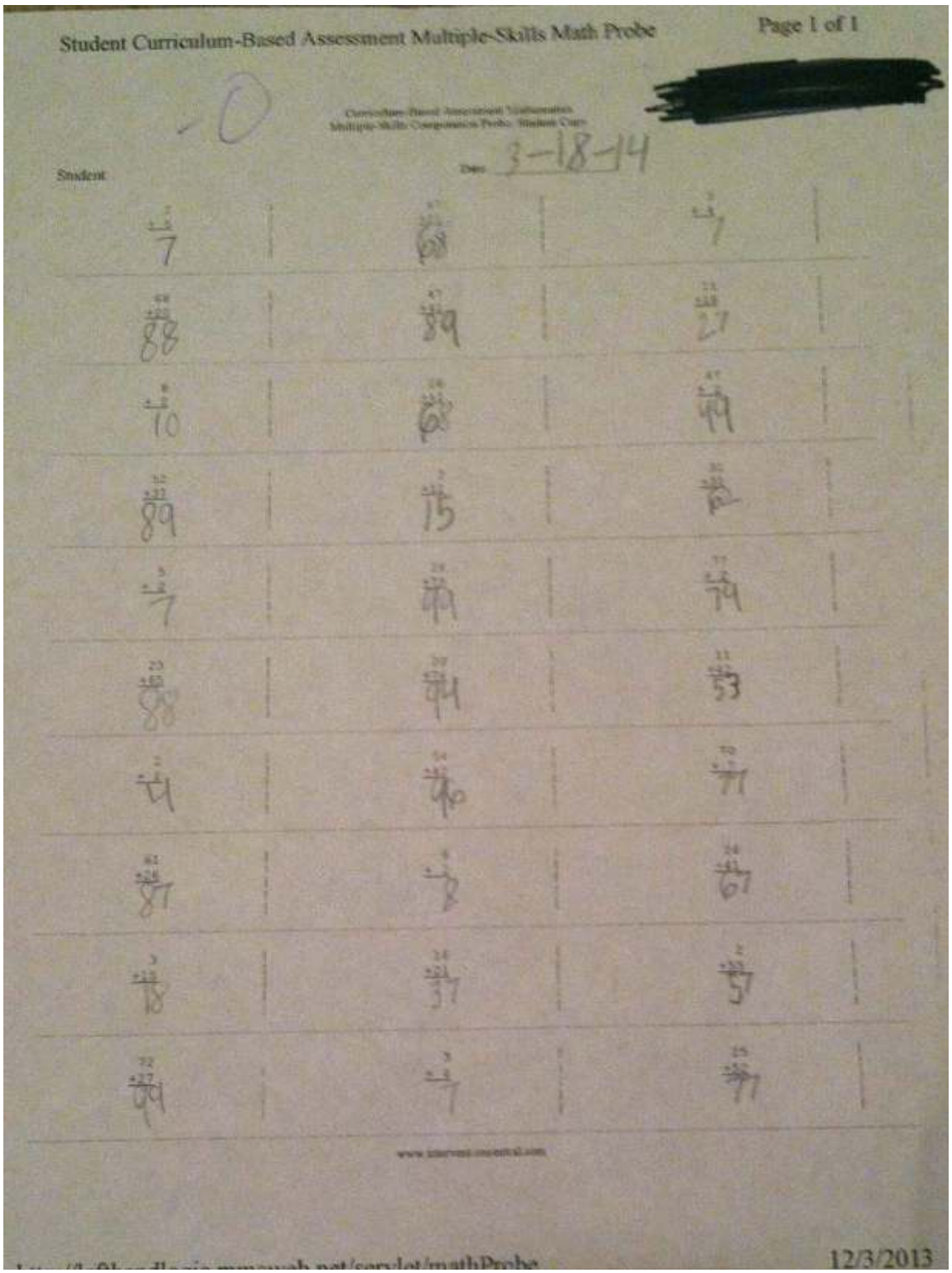
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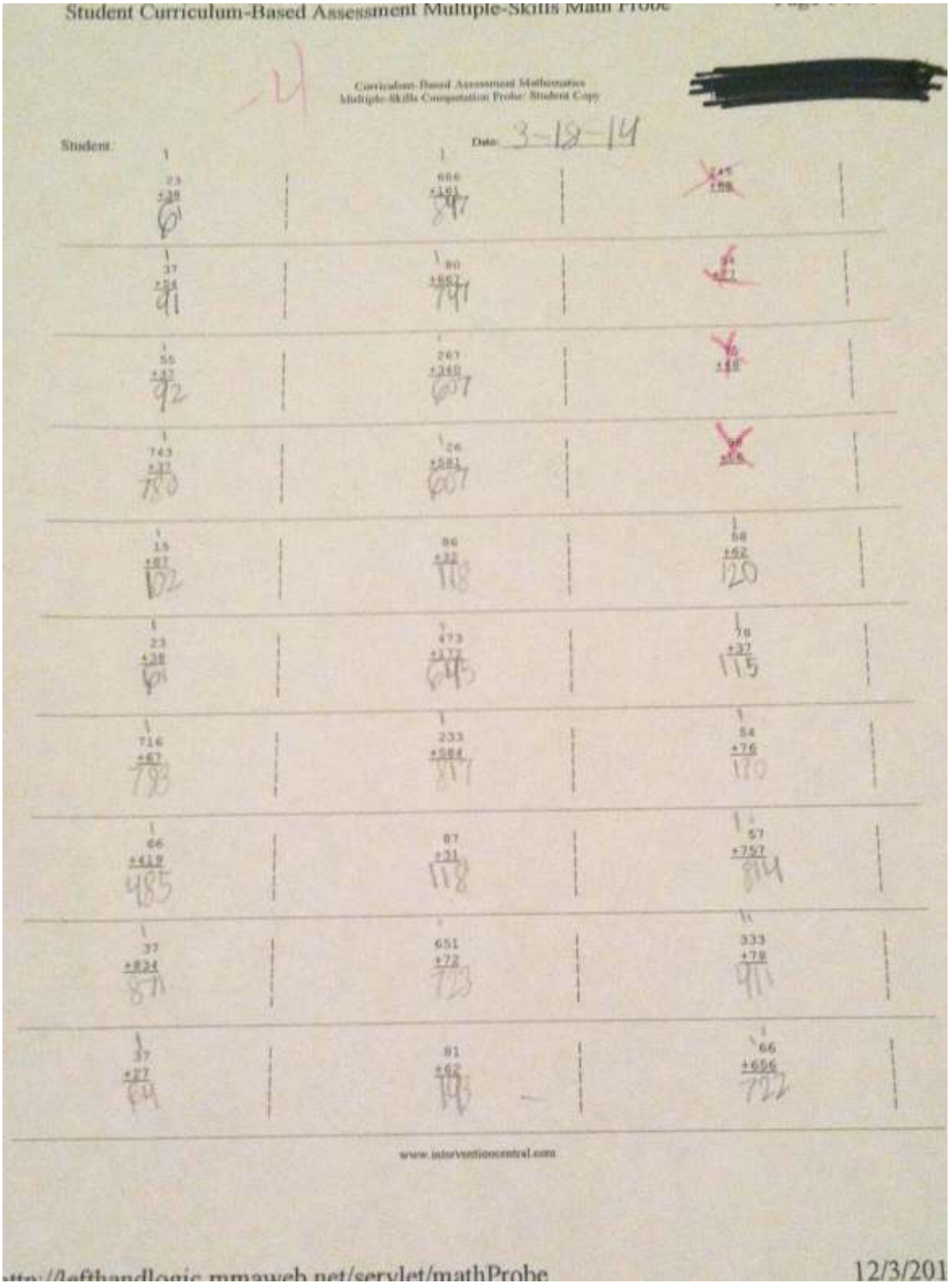
Date 3-18-14
12/3/2013

**Appendix F3**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www.interventioncentral.com
12/3/201

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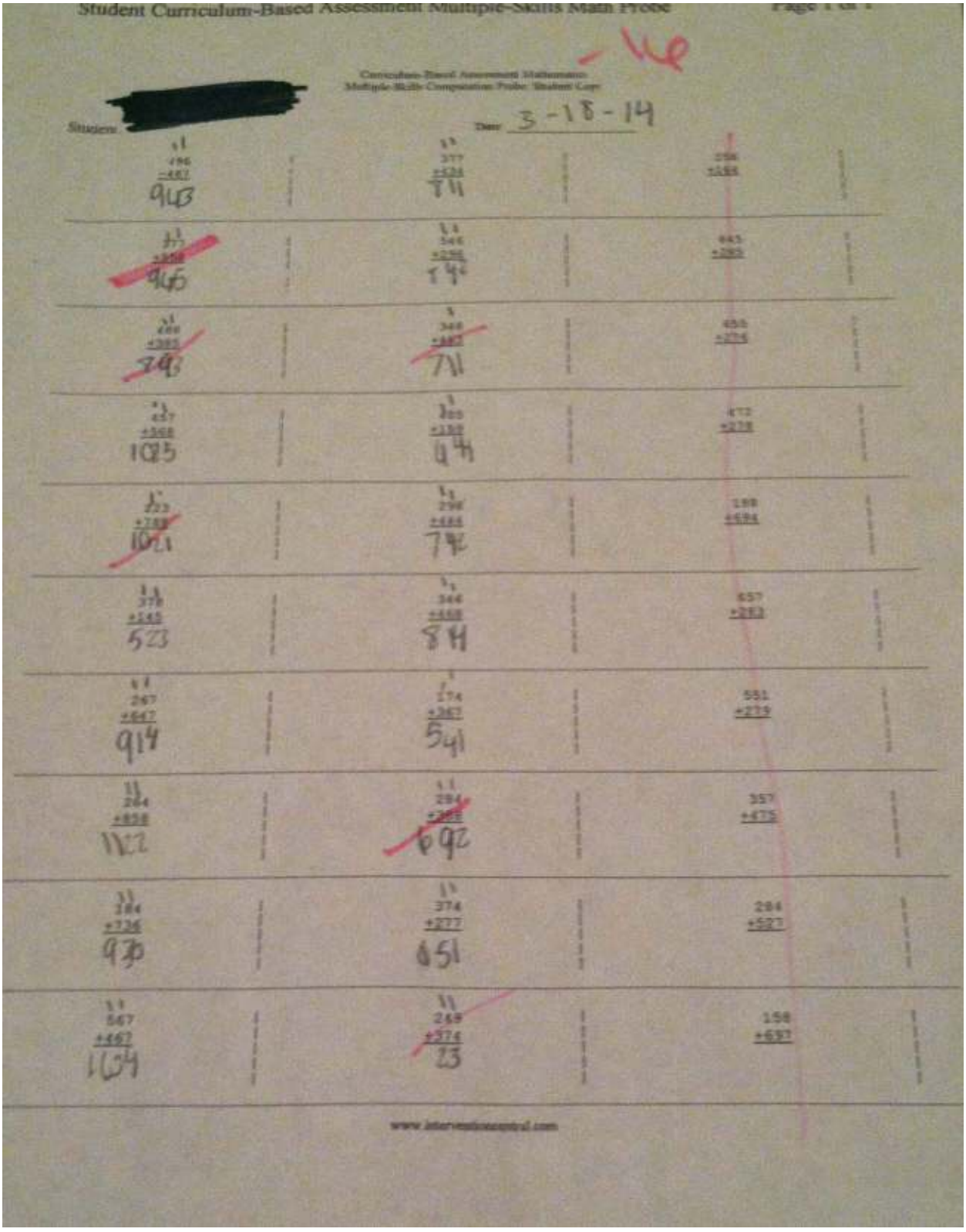
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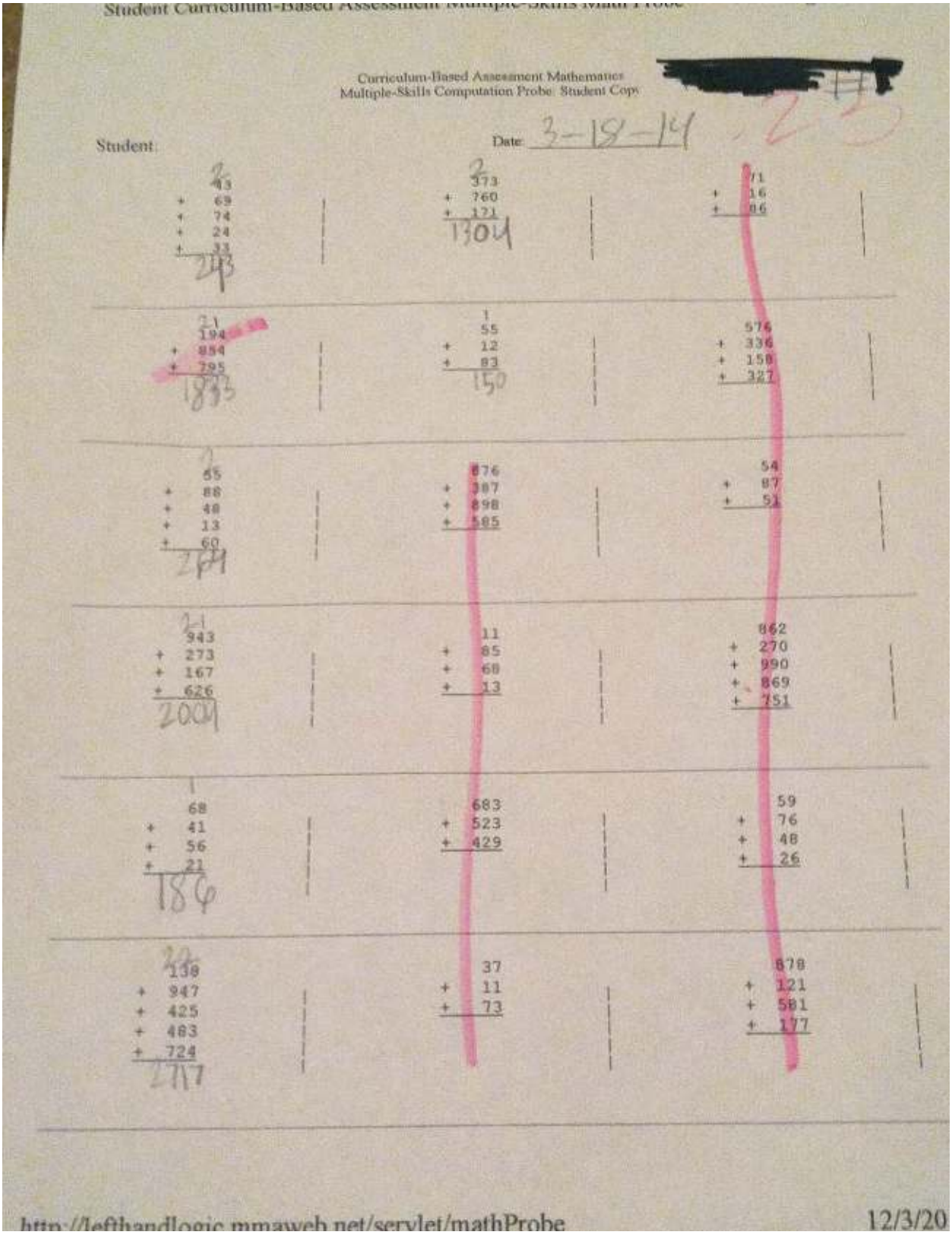
www.interventioncentral.com

**Appendix F5**


Curriculum-Based Assessment Mathematics
Multiple-Skills Computation Probe: Student Copy
[redacted]
Student:
Date: 3-18-14
http://lefthandlogic.mmaweb.net/servlet/mathProbe
12/3/20

## Appendix G1

## Anecdotal Records

| Date | Transfer of Knowledge | Attitude Towards Mathematics |
|---|---|---|
| 1/30/2014 | Student 357: When answering a CGI subtraction problem, this student made the connection of using the touchpoints to count backwards. | |
| 2/10/2014 | | Student 402: "Math is getting easier." |
| 2/12/2014 | Student 402: Told me he has been using the touchpoints when he is working on math at Brain Camp. | |
| 2/13/2014 | Student 200: Taught mom at p/t conferences | |
| 2/17/2014 | Student 506 Started to use at Brain Camp and on area w/s. | Student 256 said “TM is helping me get faster at adding.” |
| 2/19/2014 | | Student 388: “I feel better about math.”<br><br>Student 520: “Touchpoints are so much easier because you wont lose track.” |
| 2/20/2014 | | Student 817: “TouchMath is my favorite thing to do at school.” |
| 2/25/2014 | Student 374: Use TouchMath on homework, Benchmark practice, Brain Camp, and SuccessMaker. | Student 271: “TouchMath has inspired me to teach it to my daughter some day.”<br><br>Student 214: “*TouchMath* is pure magic! It’s helping me get really fast at adding.” |

## Appendix G2

## Anecdotal Records

| | | |
|---|---|---|
| 2/28/2014 | Student 493: Said he uses on homework. | Student 859: “I feel better about math.” |
| 3/5/2014 | | Student 904: “Math is now my favorite subject.”<br><br>Student 506: “I feel like *TouchMath* is helping me because I am not failing math anymore.” |
| 3/6/2014 | Student 256: "When grocery shopping, my dad makes me keep record of everything we buy, and I have to add up the total using my touchpoints before we check out."<br>“Today’s lesson was fun.” | Student 189: “TouchMath is making me go faster.”<br><br>Student 200: “I feel confident when I use touchpoints because I know I am getting the answer right.” |
| 3/7/2014 | Student 797: Used touchpoints on morning math work.<br><br>Student 402: Used on morning math work. | Student 125: “Are we doing TouchMath today?”<br><br>Student 617: “I like this math-it is fun.” |
| 3/8/2014 | Student 200: Uses on Benchmark Practice.<br><br>Student 189: Uses on Benchmark Practice.<br><br>Student 264: Uses on Benchmark Practice. | Student 357: “I love math, it is just my thing.”<br><br>Student 904: “TouchMath helps you learn and get really fast, like 7 & 8, you don’t have to use your fingers.” |
| 3/12/2014 | Student 200: Uses on SuccessMaker.<br><br>Student 125: Taught TouchMath to his brother. | Student 493: “TouchMath makes adding easier and faster.” |

# Appendix H1

**1.1----- 1/8/2014**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

**Student Learning Goals**
**-The students will know how to use TouchMath and algorithms based on place value to add two single-digit computations.**
**-The students will understand that place value algorithms and TouchMath increase two single-digit addition computational fluency.**
**-The students will be able to create a personal reference sheet to use throughout the intervention and correctly use TouchMath and algorithms based on place value to add two single-digit computations.**

**Materials**

- Paper, pencil, beans, clipboard, Lifesavers, Round mini sweet tarts, TouchMath poster, Daily assessment, paper with numerals

**Procedures:**
***Schema Activation:** TTW share a personal story about how she learned to add quickly in elementary school.
***Review:** TTW review the terms: addend, set, and sum.
***Direct Instruction (ME):** TTW explain the TouchMath system. TTW place a TouchMath poster in the room that is easily visible to each student. TTW introduce the TouchMath statement: "I touch and count all the TouchPoints on the numbers." TTW model how to use the addition skill (single-digit addition with two addends) and statement using physical representation (beans) and demonstrating how to use the touchpoints. TTW focus instruction on two single-digit addition computations such as: 5+4, 8+2, 4+6, 9+6, etc. TTW have the students reinforce the facts by repeating the problem and the answer aloud. TTW explain how TouchMath is similar to how she learned to add quickly.

***Guided Practice (WE):** TT and TLW create touch points on numerals using candy lifesavers and round mini sweet tarts. TT and TLW say the number before and after counting the touch points. TT and TLW practice adding numbers using the statement: "I touch and count all the TouchPoints on the numbers." TT and TLW practice simple addition such as: 3+2, 7+2, 6+5+4+2, etc.

***Independent Practice (THEY):** TTW have the students clear off their lifesavers and round mini sweet tarts. TTW give the students one minute to correctly place the lifesavers and round mini sweet tarts on all the numerals. TLW create a personal reference sheet for the statement and skill. This reference sheet will include numerals 1-9 with TouchPoints in the correct place, the statement for the week, and examples of addition computation problems.

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problems.

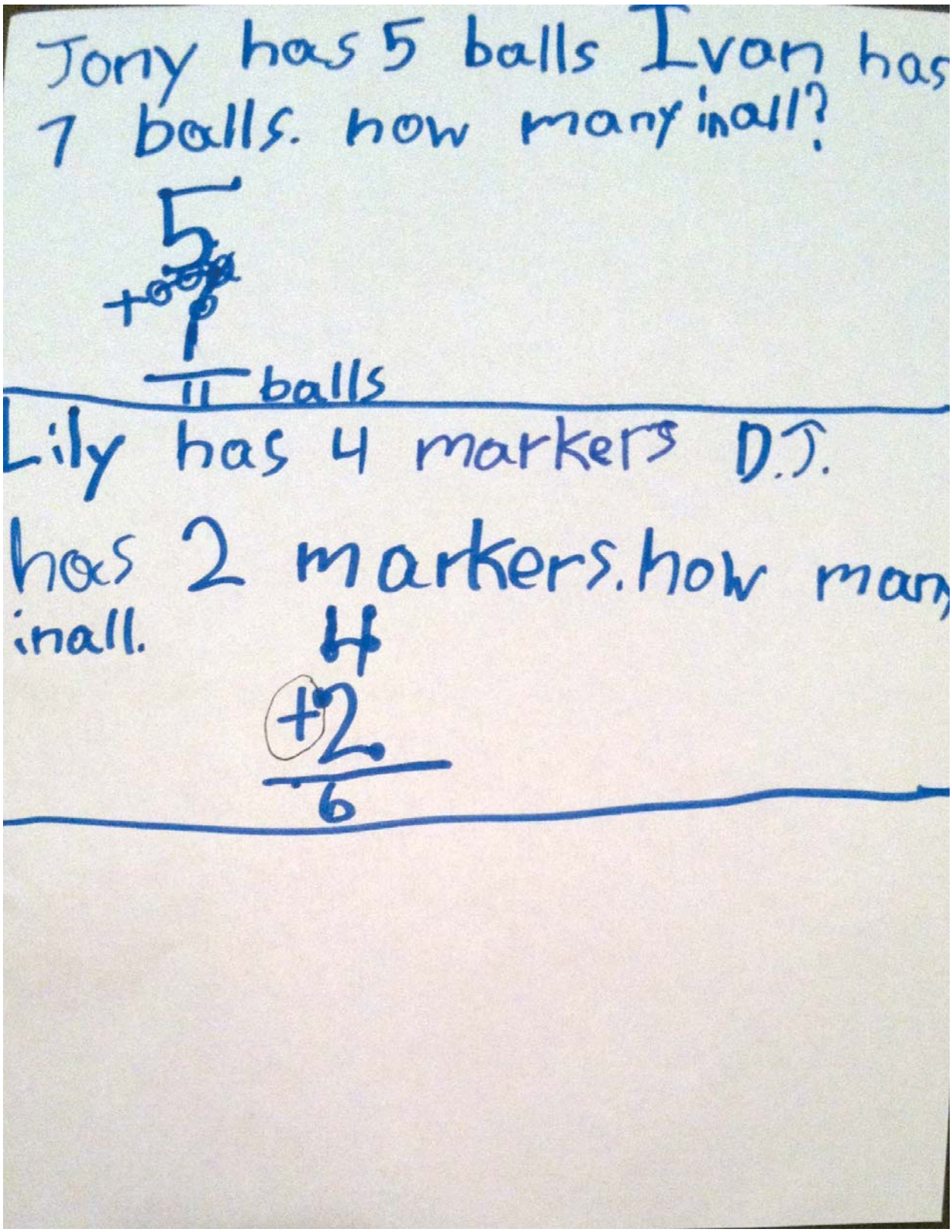
***Differentiation:** The lesson will be differentiated for auditory, visual, and kinesthetic learners. TLW see the number, say the number, and touch the number.

***Closure:** TTW will facilitate a conversation about what TLs learned during the lesson. TTW have multiple students come to the board to draw the touch points on the numerals. TTW have TLs share their personal reference sheet.

***Evaluation of Student Learning:** TTW determine the student's understanding based on accurate completion of the reference sheet. TTW check every student's reference sheet for accuracy and place a symbol indicating accurate completion. TTW determine the student's understanding based on accurate placing of lifesavers and round mini sweet tarts on all the numerals.

***Reflection:**
This lesson went well today. The students really enjoyed the candy I brought to teach the touchpoints. My initial plan was to have the students place the candy in the correct spots as an evaluation of learning. After watching the students struggle to make the sweet tarts sit still, I told them to put all the candy away and we were going to just draw the touchpoints. All students were able to draw the touchpoints in the correct spots. I had five students absent today. From my perspective, the students understand the touchpoints and are still learning the statement in which to use. The students were also able to correctly create a reference sheet that they will be able to use throughout the intervention. If I were to do this lesson over, I would not include the candy, this seemed to be more distracting then beneficial.

**Appendix H2**


Jony has 5 balls Ivan has 7 balls. how many in all?
5
+7
11 balls
Lily has 4 markers D.J. has 2 markers. how many in all.
4
+2
6

# Appendix H3

**1.2----- 1/13/14**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.

**Student Learning Goals**
**- The students will know how to use TouchMath and algorithms based on place value to add two single-digit computations.**
**-The students will understand that place value algorithms and TouchMath increase two single-digit addition computational fluency.**
**-The students will be able to create and answer 15 single-digit addition computations while using TouchMath and algorithms based on place value to add two single-digit computations.**

**Materials**

- Daily assessment, beans, promethean board, dry erase board and markers

**Procedures:**
***Schema Activation:** TTW share a personal story about watching her nephew learn to count.
***Review:** TT and TLW review the touch points and the statement: "I touch and count all the TouchPoints on the numbers."
***Direct Instruction (ME):** TTW teach the addition skill (single-digit addition of two addends) and statement using physical representations (beans). TTW model how the touch points represent numbers. TTW model how to use the addition skill and statement using physical representation (beans) and demonstrating how to use the touchpoints. TTW focus instruction on two single-digit addition computations such as: 3+4, 4+6, 5+2, 8+7, etc. TTW have the students reinforce the facts by repeating the problem and the answer aloud. TTW explain that you must know how to correctly count before you can use the TouchMath system.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I touch and count all the TouchPoints on the number." TT and TLW practice simple addition such as: 3+4, 4+6, 5+2, 8+7, etc. TT and TLW say the number before and after counting the touch points. TLW assist TT in creating single digit addition computations for the class to be modeled for the class. TLW find the answers using touchpoints (beans).

***Independent Practice (THEY):** TLW make addition computation problems. Group 1 will be required to create 15 single-digit addition computations on the dry erase board using only numerals 1-4. Group 2 will be required to create 15 single-digit addition computations on the dry erase board using only numerals 3-7. Group 3 will be required to create 15 single-digit addition computations on the Promethean Board using only numerals 5-9. Once the computations are created, the students will have two minutes to solve each set of their computations.

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problems.

***Differentiation:** The lesson will be differentiated for auditory, visual, and kinesthetic learners. TLW see the number, say the number, and touch the number. The lesson will also be differentiated for readiness; different grouping.

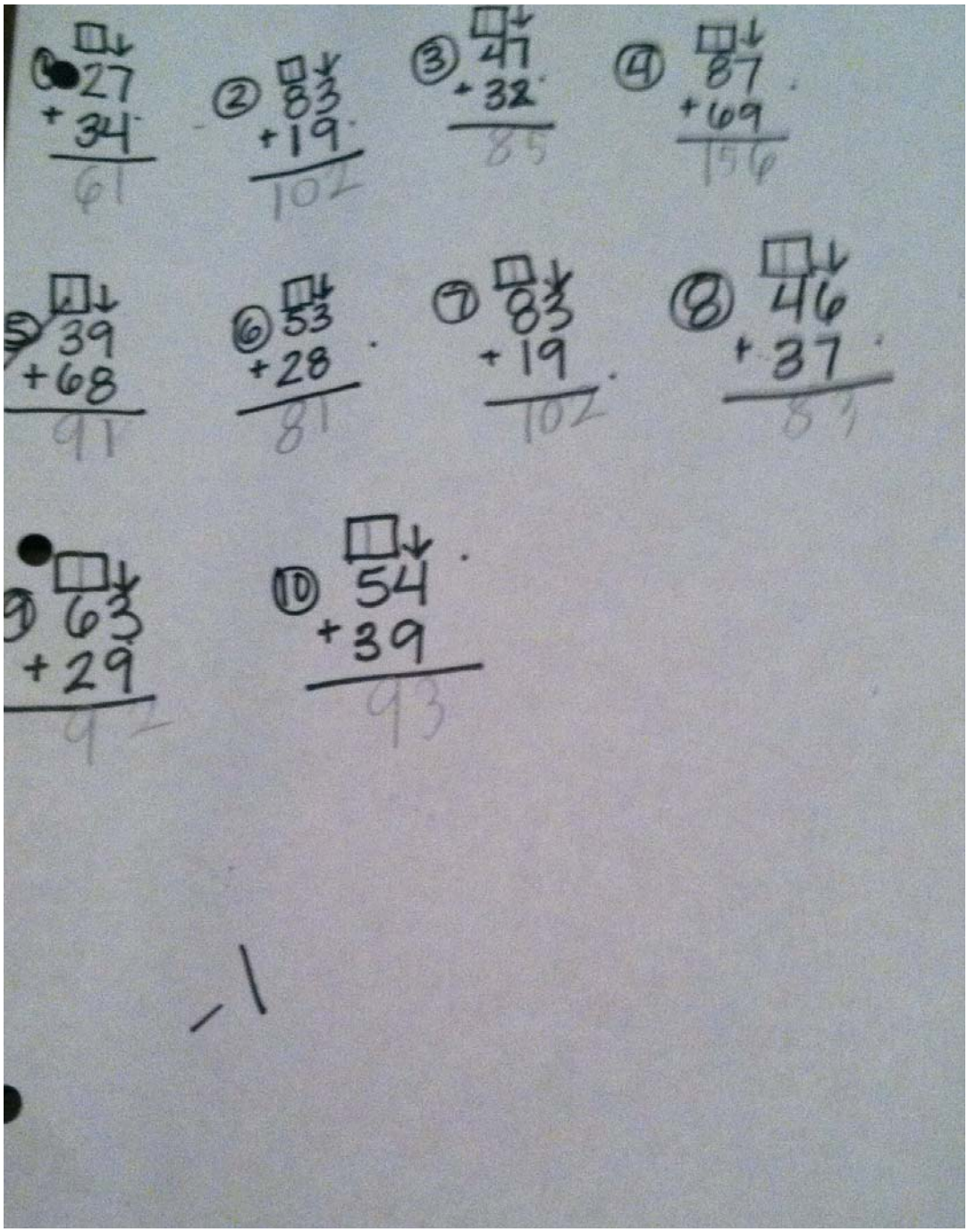
***Closure:** TTW will model for the students how to answer all the computations that were made. TLW help the teacher determine the correct answers and grade their paper.

***Evaluation of Student Learning:** TTW determine the student's understanding based the accurate creation and answering of 15 single digit addition computations.

***Reflection:**

This lesson went better than the initial lesson. The students were more focused during the lesson and were able to answer the questions I asked. I heard multiple students say, "This is easy." I told the students that it is going to start out easy and get harder. Although, I repeated this multiple times, the students still said, "This is easy." Upon re-reading my lesson before my intervention, I decided to change the independent practice. Instead of having the students write on the Promethean board or the dry erase board, I gave the students a piece of paper and had them write their computations on that. One out of three groups struggled picking someone to be a writer for the group; I had to help this group a lot. I should have explained the answering process better to the students; I will do this next week. I think this lesson was an overall success. When I teach this similar lesson again, I will be sure to provide a better way of testing the students once they complete the independent practice.

**Appendix H4**


1 27 + 34 = 61
2 83 + 19 = 102
3 47 + 32 = 85
4 87 + 69 = 156
5 39 + 68 = 91
6 53 + 28 = 81
7 83 + 19 = 102
8 46 + 37 = 83
9 63 + 29 = 92
10 54 + 39 = 93

# Appendix I1

**2.3-----1-22-14**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**-The students will know the addition facts i.e. 80 + 20 and other double-digit numbers that sum to 100 and the adding without regrouping strategy.**
**-The students will understand that "addition without regrouping" means starting at the ones column, adding those numbers, then moving to the tens column. They will understand that this strategy increases ability to add quickly without using manipulative materials, fingers, or increases accuracy.**
**-The students will be able to use the addition without regrouping statement strategy to quickly and accurately add 2-digit numbers with partial sums that equal 100.**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets

**Procedures:**
***Schema Activation:** TTW tell a personal story about going to the grocery and the register being broken. TTW explain that the cashier had to quickly add the total in her head and make sure it was accurate so she did not cheat me or the store.

***Review:** TTW review the difference between a number and a numeral – number is how many and numeral is the symbol for that number. TTW review the rules of the base ten numeration system. TTW review the addends that equal 10 from the week before.

***Direct Instruction (ME):** TTW teach the addition without regrouping statement, "I start on the side with the arrow. The arrow is in the ones column on the right side." The students will follow a step-by step process to complete the computation. This process is (example 42+36): 1. Say the greater number in the ones column: "6," and continue counting on the TouchPoints of the 2: "7, 8" 2. Record the answer: 8, 3. Repeat step 1 in the tens column: "4", and continue counting on the TouchPoints of the 3: "5, 6, 7" 4. Record the answer: 7, 5. Repeat the problem and answer aloud.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 10 or 20 double-digit addition computations without regrouping with multiple addends.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW reiterate the adding without regrouping strategy by showing one last example. TTW remind students that the purpose of today's lesson was to learn to add larger numbers quickly and accurately without a calculator.

***Evaluation of Student Learning:** TTW determine the students' ability to use the addition without regrouping statement strategy to quickly and accurately add 2-digit numbers with partial sums that equal 100.

***Reflection:**

Today's lesson went better. The students were more focused on the lesson. I hung an anchor chart in the room with all four TouchMath statements. This will replace the students creating their own reference sheet. I will need to make another one to put on the other side of the room for the students who are struggling to see it. After grading the independent practice of the day, I had 10 students get 100%. For these students, I will need to increase the complexity of the numbers. I had 8 students miss one or two questions. For these students I will need to explain +1 and +2. I had two students miss 4 or more. For these students I will need to give smaller numbers and provide manipulative for the students to use. I try to incorporate the touchpoints into any lesson during the day where it would fit. I had students say: "this is easy," "can we do more?," and "I like touchmath."

# Appendix I2

**2.4-----1-23-14**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**
- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**-The students will know the TouchMath "Addition with regrouping practice statement" and the traditional algorithms based on place value to add double-digit computations that requires regrouping.**
**-The students will understand that place value algorithms and the TouchMath "Addition with regrouping practice statement" depends on understanding the value of the same numerals in different places in 2 and 3 digit numbers and using this knowledge increases double-digit addition computational fluency.**
**-The students will be able to add double-digit computations that require regrouping using the TouchMath "Addition with regrouping practice."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problems.

**Materials**
- Paper, pencil, Daily assessment, Worksheets, Weekly assessment

**Procedures:**
***Schema Activation:** TTW show the words mat and mate. TTW ask students to pronounce. TTW point out that the same letter "a" has a different sound in these words because of the rules of our language – the silent e makes it a long a.
***Review:** TTW quickly review touchpoints and the statements "I touch and count all the touchpoints on the numbers," "I touch the greater (est) number, say its name, and continue counting on the TouchPoints of the other number(s)," and "I start on the side with the arrow. The arrow is in the ones column on the right side." by referring to the anchor charts on the wall.

***Direct Instruction (ME):** TTW explain that just like the rules of our language – the language of mathematics has rules as well. The same symbol – a numeral -- can have a different value in a different context. TTW demonstrate by showing 2 and 3 digit numbers with different values. TTW teach by demonstrating the addition with regrouping statement, "I must regroup if my answer is greater than 9." The students will follow a step-by step process to complete the computation. This process is (example 27+38):
1. Introduce the regrouping box. Students will write the regrouped number of tens in the box.
2. For the example, begin in the ones column below the arrow. Say the name of the greater number "8," and continue counting on the 7: "9-10, 11-12, 13-14, 15."
3. Use the box to record the number of tens regrouped to the tens column. Record the number of tens, 1 in the box FIRST. Then record the number of ones, 5.
4. Add the tens column. Start with the greatest number, cross it out, and continue counting from the top: 1, 2, 3, 4, 5, 6.
5. Record the answer: 6.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I must regroup if my answer is greater than 9." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 10 or 20 double-digit addition computations with multiple addends. TLW take a two-minute quiz that has five single, five double- and five triple-digit addition computation problems.

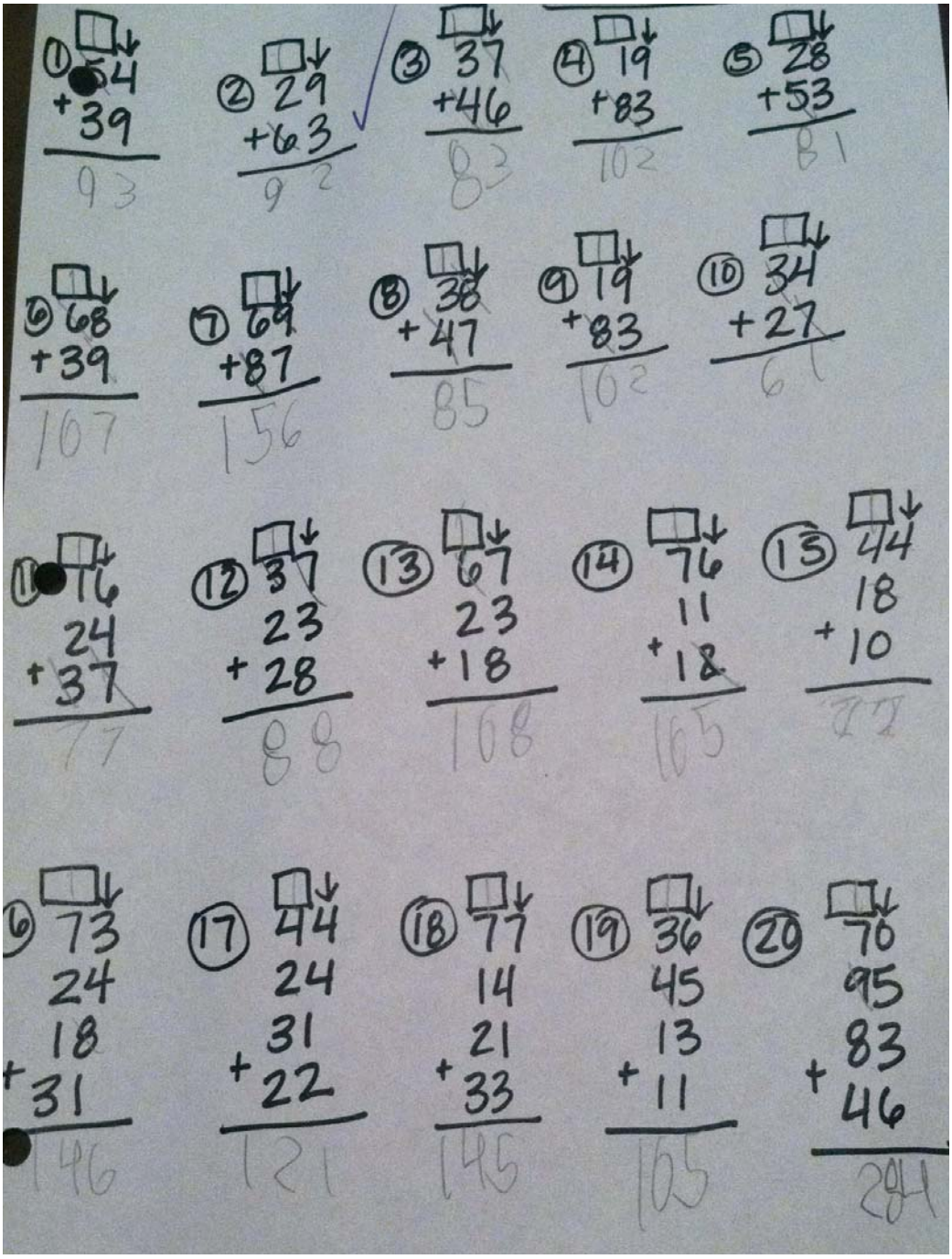
***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW will quickly reiterate the rules of place value learned today and the addition with regrouping statement, "I must regroup if my answer is greater than 9" as she quickly demonstrates the concept.

***Evaluation of Student Learning:** TTW determine the students' to add double-digit numbers that require regrouping using the TouchMath "Addition with regrouping practice" by checking the worksheet for accuracy.

***Reflection:**
Today's lesson was challenging. The students were very hyper this afternoon. Implementing Action Research in the afternoon has been a struggle. The students are less attentive in the afternoon. After grading the independent practice for the day, I can tell that addition with regrouping is going to be where I need to spend more instruction time. I only had 6 students get all questions correct. I will need to increase the difficulty in addition computations for these students. I was very impressed with one student who has not been here for the entire instruction of TouchMath. I let him use manipulatives to help with solving the problems, and he answers all questions correct on the independent practice. I had 6 students only miss one problem. I will need to continue to teach the addition with regrouping strategy to these students. Beyond that, most of the students missed over half of his/her assignment. I will need to spend more time teaching this strategy and will need to give these students easier numbers to work with to build the computational fluency slower. Many of the students told me today that they like TouchMath and that they think it is fun. I put touchpoint reference sheets on each students' desk. I had one students come to me and tell me that, "We can say the largest number, then count the touchpoints on our reference sheet for the other number." I also watched one student not regroup his numbers, but before I could show him his error, he fixed it himself. I still have students using theirs fingers to count up. I also had one students tell me, "We always write numbers from left to right, so when regrouping always put the first number above the next place value column." I was very impressed with the higher level thinking from this student.

**Appendix I3**


1 54 +39 93
2 29 +63 92
3 37 +46 83
4 19 +83 102
5 28 +53 81
6 68 +39 107
7 69 +87 156
8 38 +47 85
9 19 +83 102
10 34 +27 61
11 16 24 +37 77
12 37 23 +28 88
13 67 23 +18 108
14 76 11 +18 105
15 44 18 +10 72
16 73 24 18 +31 146
17 44 24 31 +22 121
18 77 14 21 +33 145
19 36 45 13 +11 105
20 70 95 83 +46 294

# Appendix J1

**3.1----- 1/29/14**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**-The students will know the TouchMath "Addition with counting on" and the traditional algorithms based on place value to add single-digit computations that requires +1, +2, +0 in the ones place value column.**
**-The students will understand that place value algorithms and the TouchMath "Addition with counting on statement" depends on understanding that +1, +2, +0 is the same as counting on and using this knowledge increases single-digit addition computational fluency.**
**-The students will be able to add single-digit computations that require +1, +2, +0 in the ones place value column using the TouchMath "Addition with counting on statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problems.

**Materials**

- Paper, pencil, Daily assessment, Worksheets,
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW share a personal story about going to Chuck E Cheese when she was a young girl. TTW explain that she was always able to get tokens. TTW explain that she can remember her dad giving her tokens one or two at a time. TTW explain that she needed to fully understand +1, +2, +0, so that when her father gave her more tokens, she wouldn't have to count all of the tokens again.

***Review:** TTW quickly review touchpoints and the statements "I touch and count all the touchpoints on the numbers."

***Direct Instruction (ME):** TTW teach by demonstrating the addition with counting on statement, "I touch the greater (est) number, say its name, and continue counting on the TouchPoints of the other number(s)." The students will follow a step-by step process to complete the computation using addends that equal 10: 9 + 1, 8 + 2, 7 + 3, 6 + 4; 5 + 5. Reinforce the addition facts by repeating the problem and answer aloud. For longer columns of numbers, cross out the greatest number as you say its name, and continue counting from the top downward, then write the answer. TTW will focus instruction on +1, +2, +0 in the ones place value column. TTW focus instruction on the addition of two addends. TTW explain to the students that +1, +2, +0 is just like counting on. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I touch the greater (est) number, say its name, and continue counting on the TouchPoints of the other number(s)." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 32 single- or double-digit addition computations using +1, +2, +0.

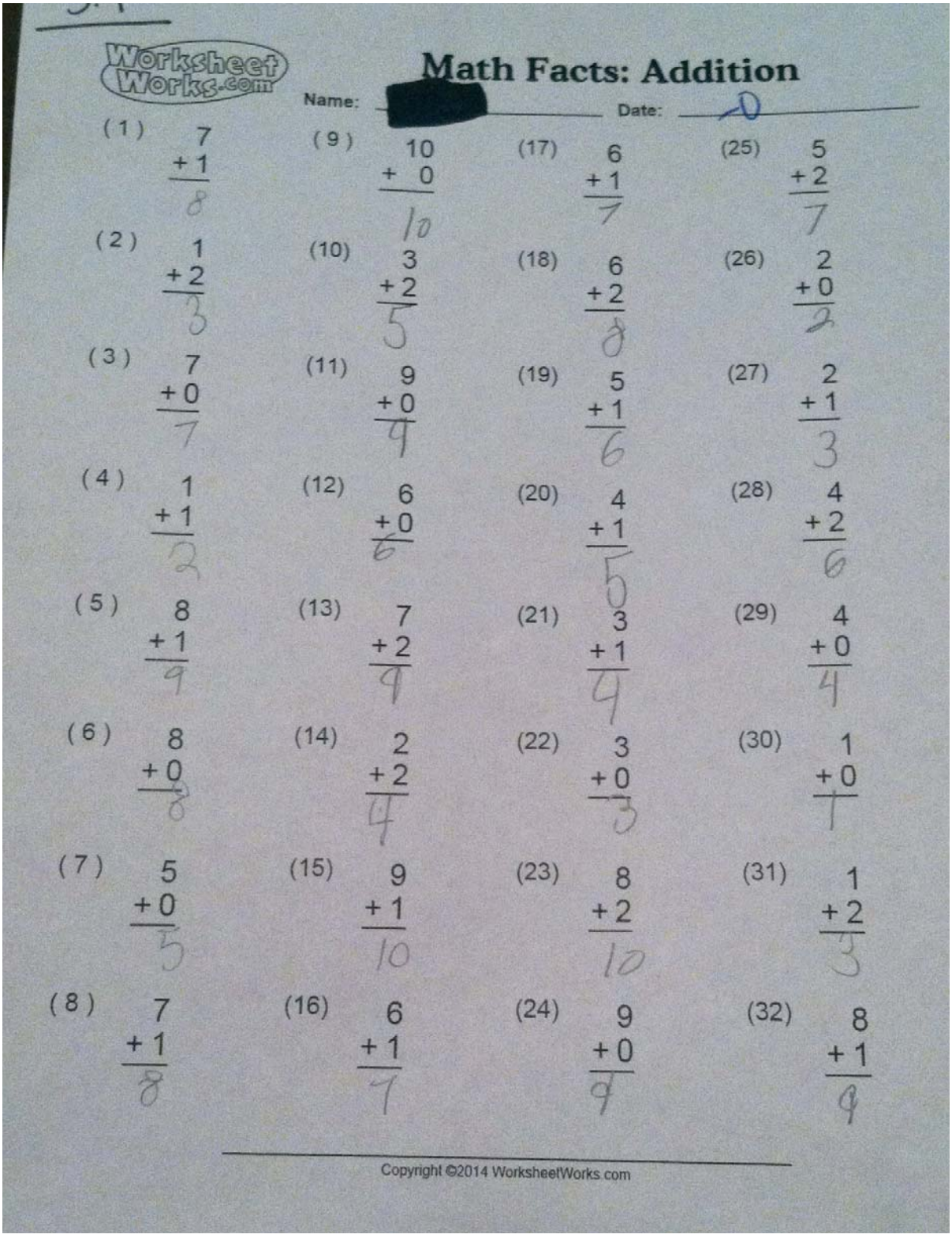
***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW reiterate the importance of being able to quickly compute +1, +2, +0 in their head quickly and accurately.

***Evaluation of Student Learning:** TTW determine the students' ability to add single-digit computations that require +1, +2, +0 in the ones place value column using the TouchMath "Addition with counting on statement" by checking the worksheet for accuracy.

***Reflection:**
Overall the lesson today went well except for behavior issues. The students seem to not listen to me as well as they listen to my mentor. Since today was +1, +2, +0 of single digit numbers, I had a lot of students who said this is easy because it's just like counting up. I was very impressed with the independent practice today. All but two students received a 100% on the independent practice. This tells me I need to increase the difficulty in the independent practice next week. The students are constantly asking me, "when are we doing TouchMath?" This makes me feel good because the students are eager to learn. I noticed during a CGI lesson my mentor was teaching, the students transferred their knowledge of touchpoints to subtraction. One student was able to completely explain how he would use touchpoints to subtract, even when my mentor was questioning him. I am happy to see that the students are able to use TouchMath throughout all mathematic instruction, not just during my action research time. Next week when I teach a similar lesson, I will need to time the students instead of giving any amount of time.

**Appendix J2**

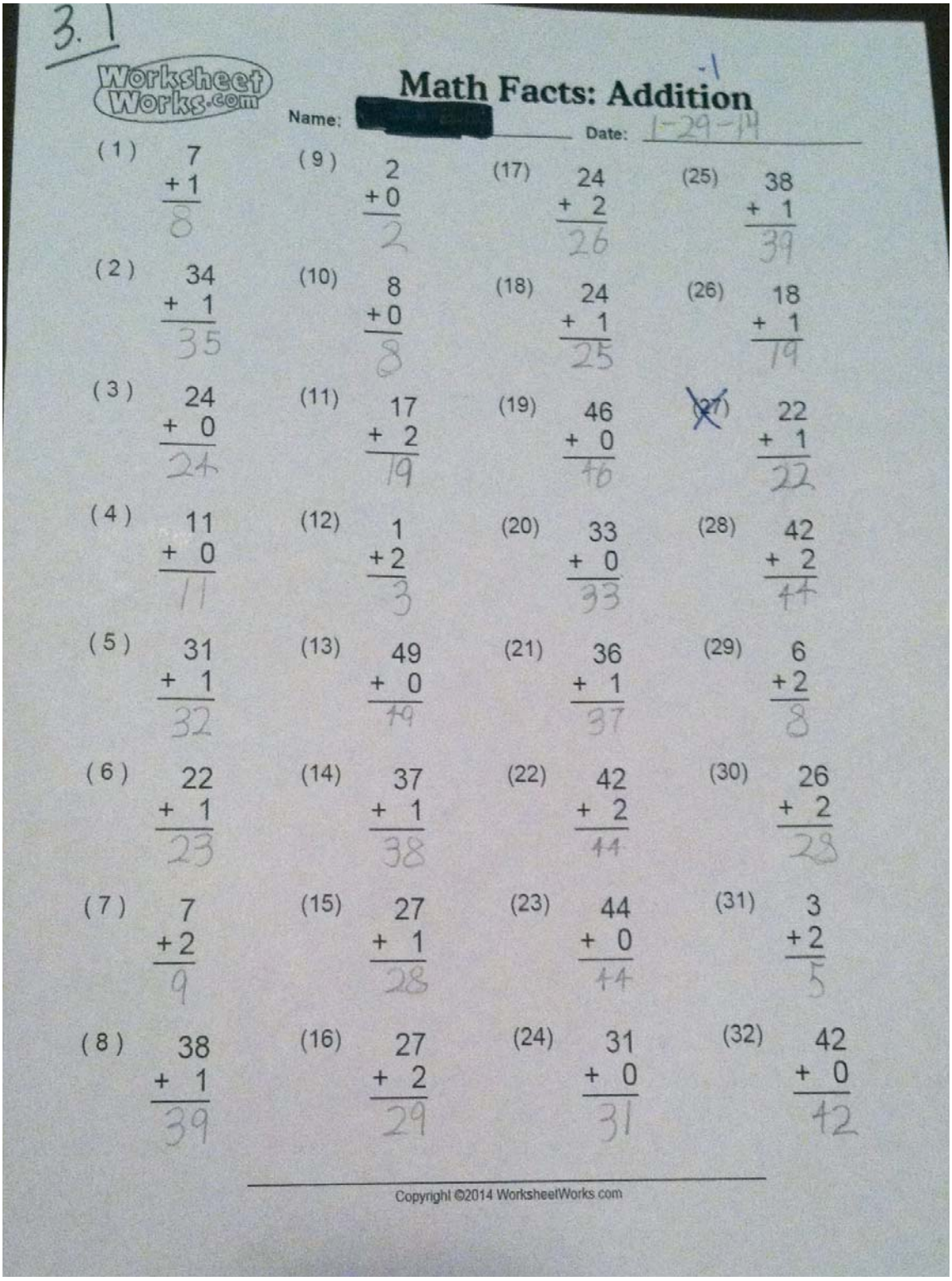


Math Facts: Addition

Name: [redacted] Date: 10

| | | | |
|---|---|---|---|
| (1) 7 + 1 = 8 | (9) 10 + 0 = 10 | (17) 6 + 1 = 7 | (25) 5 + 2 = 7 |
| (2) 1 + 2 = 3 | (10) 3 + 2 = 5 | (18) 6 + 2 = 8 | (26) 2 + 0 = 2 |
| (3) 7 + 0 = 7 | (11) 9 + 0 = 9 | (19) 5 + 1 = 6 | (27) 2 + 1 = 3 |
| (4) 1 + 1 = 2 | (12) 6 + 0 = 6 | (20) 4 + 1 = 5 | (28) 4 + 2 = 6 |
| (5) 8 + 1 = 9 | (13) 7 + 2 = 9 | (21) 3 + 1 = 4 | (29) 4 + 0 = 4 |
| (6) 8 + 0 = 8 | (14) 2 + 2 = 4 | (22) 3 + 0 = 3 | (30) 1 + 0 = 1 |
| (7) 5 + 0 = 5 | (15) 9 + 1 = 10 | (23) 8 + 2 = 10 | (31) 1 + 2 = 3 |
| (8) 7 + 1 = 8 | (16) 6 + 1 = 7 | (24) 9 + 0 = 9 | (32) 8 + 1 = 9 |

**Appendix J3**



3.1

Worksheet Works.com

**Math Facts: Addition** -1

Name: [redacted] Date: 1-29-14

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (1) | 7 + 1 = 8 | (9) | 2 + 0 = 2 | (17) | 24 + 2 = 26 | (25) | 38 + 1 = 39 |
| (2) | 34 + 1 = 35 | (10) | 8 + 0 = 8 | (18) | 24 + 1 = 25 | (26) | 18 + 1 = 19 |
| (3) | 24 + 0 = 24 | (11) | 17 + 2 = 19 | (19) | 46 + 0 = 46 | (27) | 22 + 1 = 22 |
| (4) | 11 + 0 = 11 | (12) | 1 + 2 = 3 | (20) | 33 + 0 = 33 | (28) | 42 + 2 = 44 |
| (5) | 31 + 1 = 32 | (13) | 49 + 0 = 49 | (21) | 36 + 1 = 37 | (29) | 6 + 2 = 8 |
| (6) | 22 + 1 = 23 | (14) | 37 + 1 = 38 | (22) | 42 + 2 = 44 | (30) | 26 + 2 = 28 |
| (7) | 7 + 2 = 9 | (15) | 27 + 1 = 28 | (23) | 44 + 0 = 44 | (31) | 3 + 2 = 5 |
| (8) | 38 + 1 = 39 | (16) | 27 + 2 = 29 | (24) | 31 + 0 = 31 | (32) | 42 + 0 = 42 |

# Appendix J4

**3.2----- 1/29/14**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- The students will know the TouchMath "Addition without regrouping statement" and the traditional algorithms based on place value to add double-digit computations that requires +10, +20, +11, +12, etc in the ones and tens place value columns.**
**-The students will understand that place value algorithms and the TouchMath "Addition without regrouping statement" depends on understanding that +10, +20, +11, +12 is the same as counting on and using this knowledge increases single- and double-digit addition computational fluency.**
**-The students will be able to add single- and double-digit computations that require +10, +20, +11, +12, etc in the ones and tens place value columns using the TouchMath "Addition without regrouping statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW tell a personal story about her grandfather giving her twenty ones for her birthday, and then her grandma giving her a ten dollar bill. TTW explain that she need to be able to add the two amounts of money quickly so that she would know how much money she had.

***Review:** TTW review the difference between a number and a numeral – number is how many and numeral is the symbol for that number.

***Direct Instruction (ME):** TTW teach the addition without regrouping statement, "I start on the side with the arrow. The arrow is in the ones column on the right side." The students will follow a step-by step process to complete the computation. This process is (example 42+36): 1. Say the greater number in the ones column: "6," and continue counting on the TouchPoints of the 2: "7, 8" 2. Record the answer: 8, 3. Repeat step 1 in the tens column: "4", and continue counting on the TouchPoints of the 3: "5, 6, 7" 4. Record the answer: 7, 5. Repeat the problem and answer aloud. TTW will focus instruction on +10, +20, +11, +12, etc in the ones and tens place value column. TTW focus instruction on the addition of two addends. TTW explain to the students that +10, +20, +11, +12, etc is just like counting on. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 single- and double-digit addition computations without regrouping using +10, +20, +11, +12, etc.

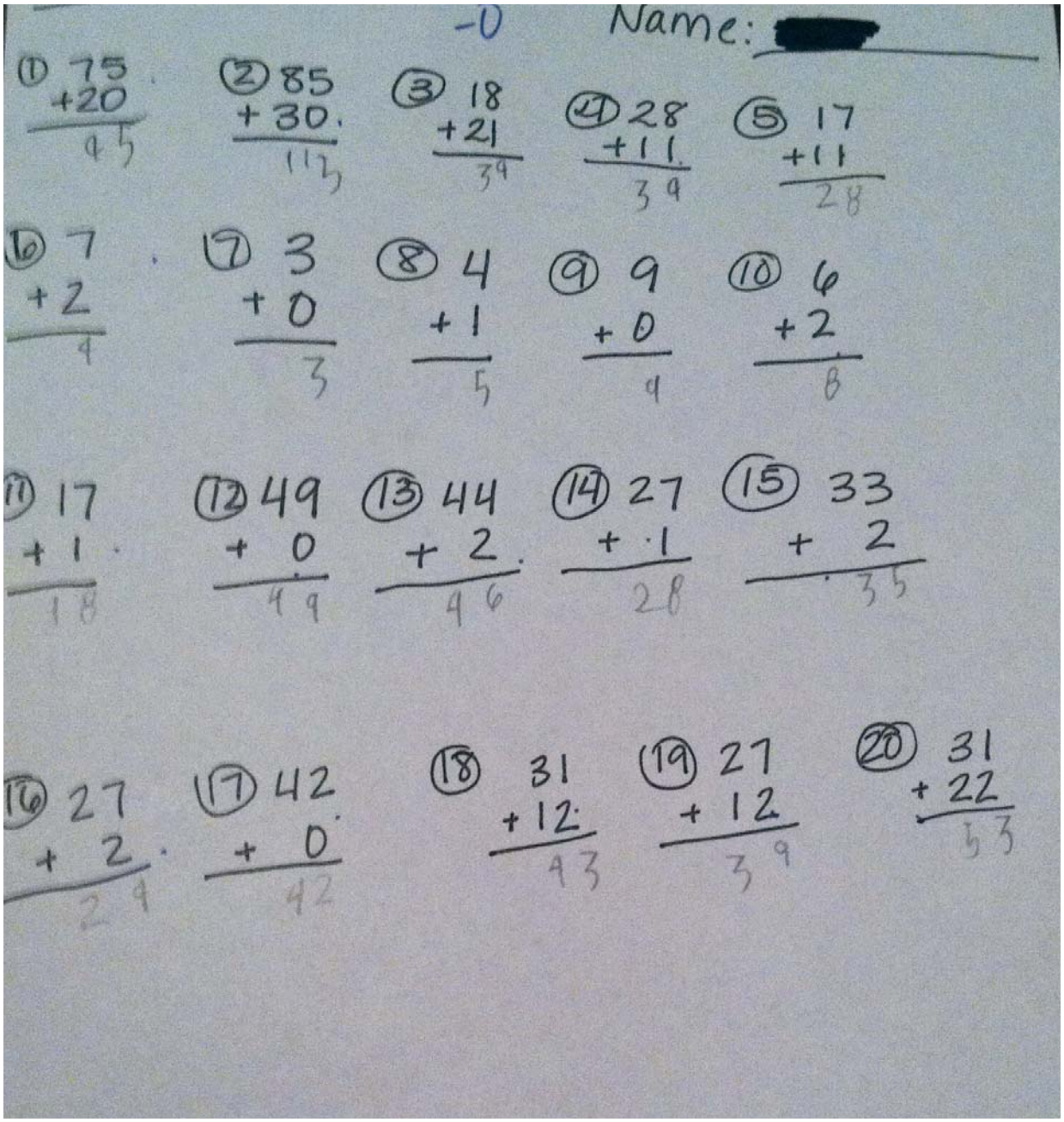
***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW reiterate the adding without regrouping strategy by showing one last example. TTW remind students that the purpose of today's lesson was to learn to add larger numbers quickly and accurately without a calculator.

***Evaluation of Student Learning:** TTW determine the students' ability to add single- and double-digit computations that require +10, +20, +11, +12, etc in the ones and tens place value columns using the TouchMath "Addition without regrouping statement" by checking the worksheet for accuracy.

***Reflection:**
Overall, the students were very engaged in the lesson. We are still working on raising hands when they have an answer. The classroom layout is not as perfect as I would like, so at times it is hard for me to see that every student in paying attention. I still see students using their fingers when completing addition computations. I need to remind the students that the touchpoints are to replace finger counting. I had one boy come up to me today and tell me that he loves touchmath, and that it is really helping him. The highest student in my class also came up to me and told me he is happy we are doing touchmath because it helps him too. At the conclusion of the lesson, the students were required to complete 20 addition computations. I had 5 students not receive a 100%. I contribute this to the student trying to rush to finish. When I teach this lesson again next week, I will require the students to be timed so that I can get a better understanding of the students addition computation fluency.

**Appendix J5**


-0
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② 85 +30 115
③ 18 +21 39
④ 28 +11 39
⑤ 17 +11 28
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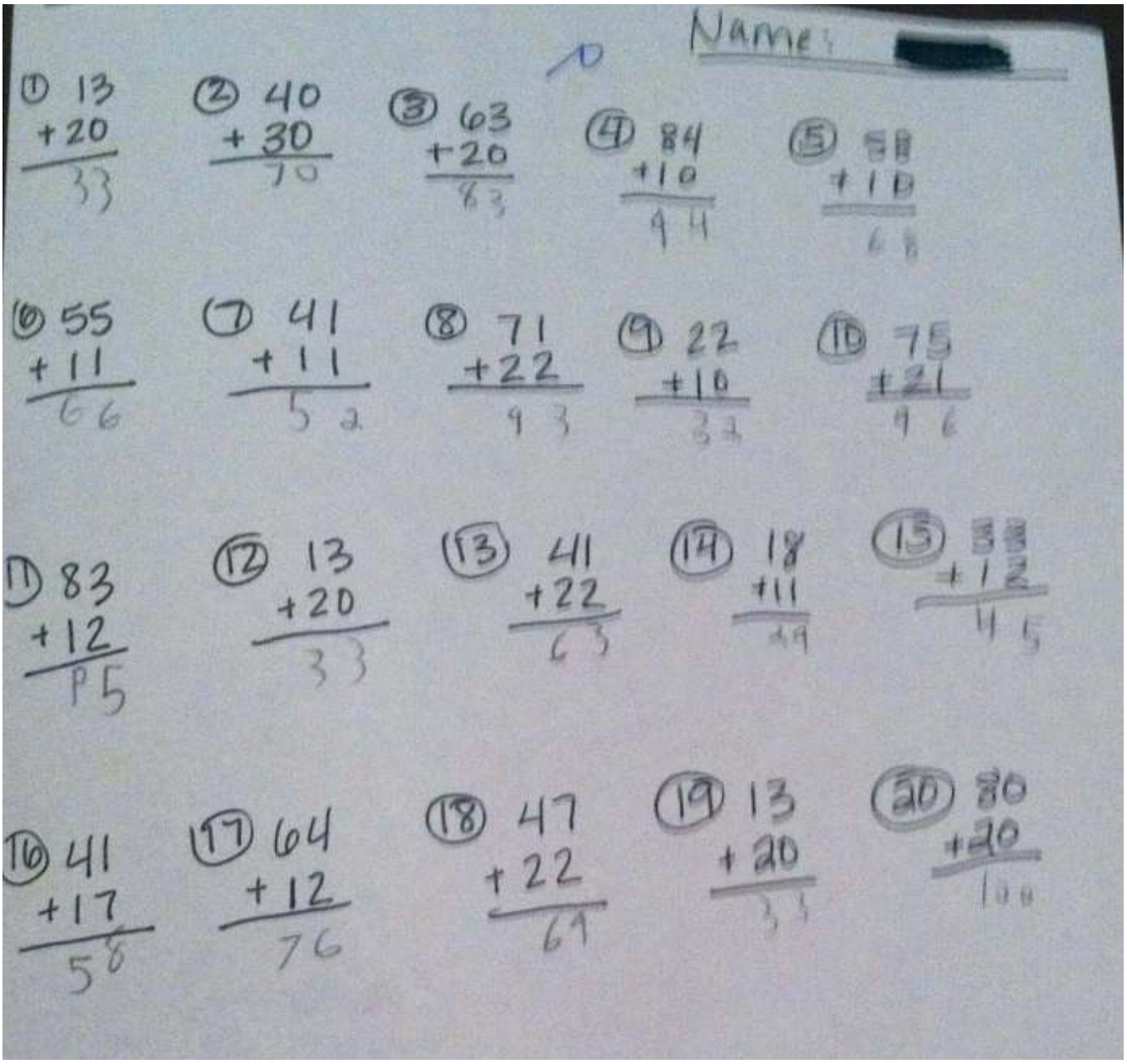
⑦ 3 +0 3
⑧ 4 +1 5
⑨ 9 +0 9
⑩ 6 +2 8
⑪ 17 +1 18
⑫ 49 +0 49
⑬ 44 +2 46
⑭ 27 +1 28
⑮ 33 +2 35
⑯ 27 +2 29
⑰ 42 +0 42
⑱ 31 +12 43
⑲ 27 +12 39
⑳ 31 +22 53

**Appendix J6**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10
1) 13 +20 33
2) 40 +30 70
3) 63 +20 83
4) 84 +10 94
5) [redacted] +10 68
6) 55 +11 66
7) 41 +11 52
8) 71 +22 93
9) 22 +10 32
10) 75 +21 96
11) 83 +12 95
12) 13 +20 33
13) 41 +22 63
14) 18 +11 29
15) [redacted] +12 45
16) 41 +17 58
17) 64 +12 76
18) 47 +22 69
19) 13 +20 33
20) 80 +20 100

# Appendix K1

**4.3-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- The students will know the TouchMath "Addition with regrouping statement" and the traditional algorithms based on place value to add double and triple-digit computations with more than two addends that requires +100, +200, +110, +120, etc in the ones, tens, and hundreds place value columns.**
**-The students will understand that place value algorithms and the TouchMath "Addition with regrouping statement" depends on understanding that +100, +200, +110, +120 is the same as counting on and using this knowledge increases double- and triple-digit addition computational fluency.**
**-The students will be able to add double- and triple- digit computations with more than two addends that require +100, +200, +110, +120, etc in the ones, tens, and hundreds place value columns using the TouchMath "Addition with regrouping statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW share a personal story about her nephew learning to count. TTW explain that he doesn't have counting down yet, so he would not be able to add as fluently as her class.

***Review:** TTW review the "Addition with counting on statement." TTW review +1, +2, +0, +10, +11, +20, +12, etc from the previous days' learning.

***Direct Instruction (ME):** TTW teach by demonstrating the addition with regrouping statement, "I must regroup if my answer is greater than 9." The students will follow a step-by step process to complete the computation. This process is (example 27+38): 1. Introduce the regrouping box. Students will write the regrouped number of tens in the box.
2. For the example, begin in the ones column below the arrow. Say the name of the greater number "8," and continue counting on the 7: "9-10, 11-12, 13-14, 15." 3. Use the box to record the number of tens regrouped to the tens column. Record the number of tens, 1 in the box FIRST. Then record the number of ones, 5.4. Add the tens column. Start with the greatest number, cross it out, and continue counting from the top: 1, 2, 3, 4, 5, 6.5. Record the answer: 6. TTW will focus instruction on +100, +200, +110, +120, etc in the ones, tens, and hundreds place value column. TTW focus instruction on the addition of more than two addends. TTW explain to the students that +100, +200, +110, +120, etc is just like counting on. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 single-, double-, and triple-digit addition computations with more than two addends with regrouping using +100, +200, +110, +120, etc.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW reiterate the adding with regrouping strategy by showing one last example. TTW remind students that the purpose of today's lesson was to learn to add numbers with multiple addends quickly and accurately.

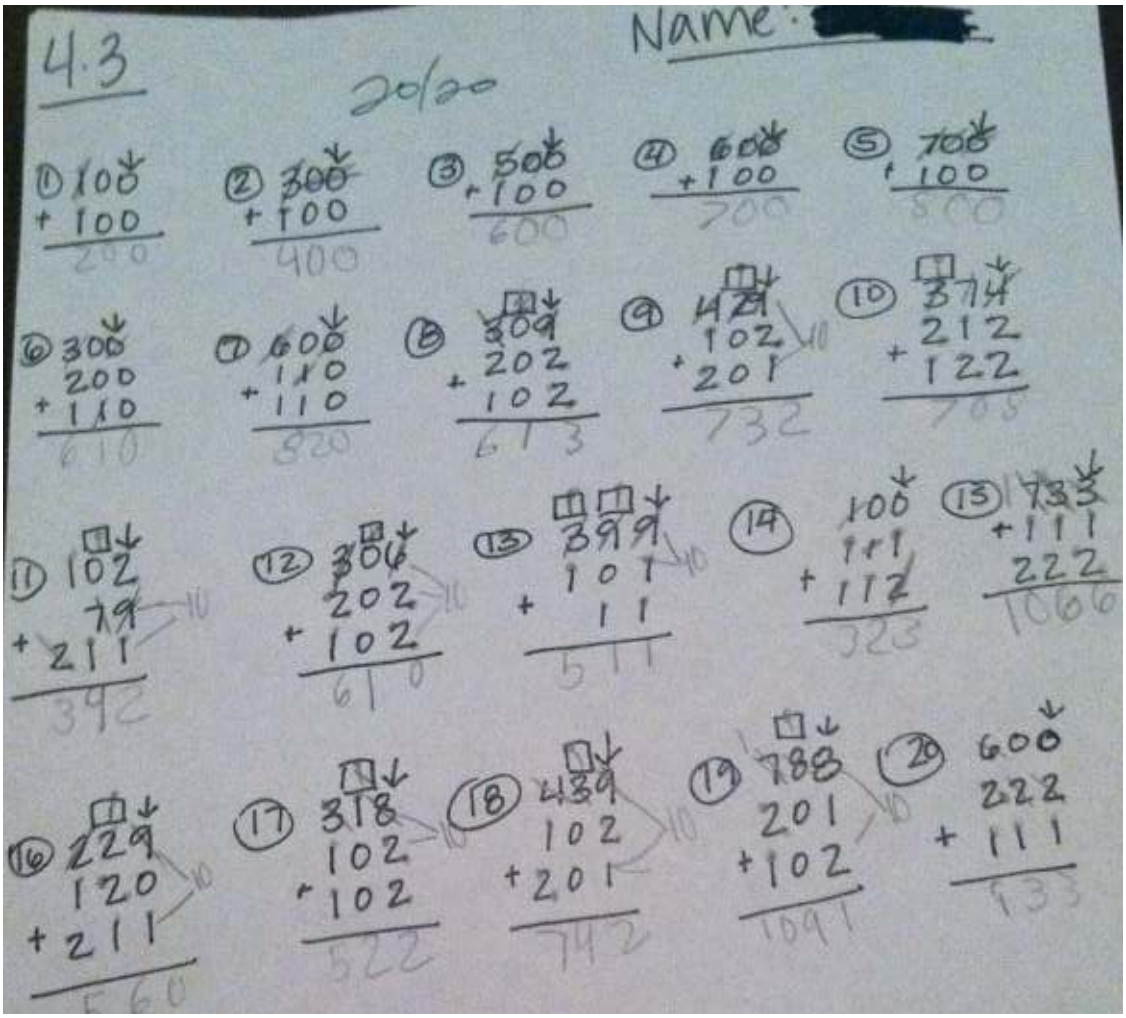
***Evaluation of Student Learning:** TTW determine the students' ability to add double- and triple- digit computations with more than two addends that require +100, +200, +110, +120, etc in the ones, tens, and hundred place value columns using the TouchMath "Addition with regrouping statement" by checking the worksheet for accuracy.

***Reflection:**

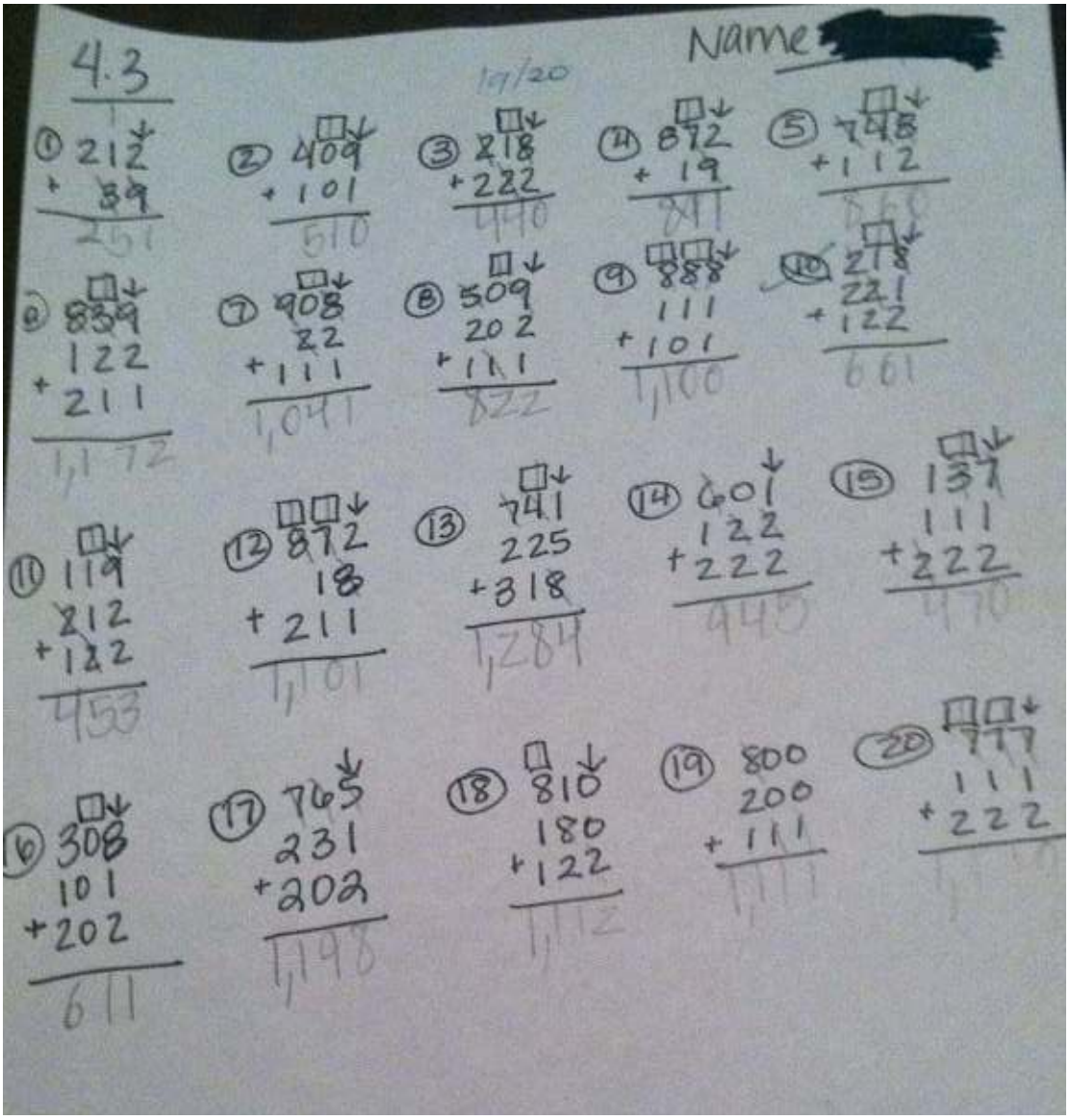
There were a lot of behavior problems today. The students seemed to be worn out by the end of the day today. The principal called some girls out of the class during my lesson today to go to the cafeteria. This interrupted my lesson a little, but we were able to continue without them and quickly catch them up once they got back to the classroom. The students are really enjoying being called to the front of the class to complete a problem. I think I will try to incorporate a race so that more than one student will be able to come to the board at once. I also need to begin allowing the students to use the whiteboards. The students did not score as well on the daily assessment to day as they have in the past few days.

One boy came up to me and said, "I didn't use my fingers today, I used the touchpoints and it was so much faster." I still have a few students who are struggling with using the touchpoints over their fingers. I need to continue working individually with these students. One girl said, "I told my family about TouchMath last night and they said 'Wow I didn't know you could do it like that.'" This girl is making great progress and it is obvious she is enjoying TouchMath. One boy said the touchpoints are especially useful with larger numbers. I am noticing that the students are starting to feel better about math. They are saying things such as, "I'm getting it," "This is easy," and "I'm glad you are teaching us this." I think it would have been beneficial to work on addition, subtraction, and multiplication during my intervention as opposed to only addition.

**Appendix K2**


4.3
Name: [redacted]
20/20
1) 100 + 100 = 200
2) 300 + 100 = 400
3) 500 + 100 = 600
4) 600 + 100 = 700
5) 700 + 100 = 800
6) 300 + 200 + 110 = 610
7) 600 + 110 + 110 = 820
8) 309 + 202 + 102 = 613
9) 429 + 102 + 201 = 732
10) 374 + 212 + 122 = 708
11) 102 + 79 + 211 = 392
12) 306 + 202 + 102 = 610
13) 399 + 101 + 11 = 511
14) 100 + 111 + 112 = 323
15) 733 + 111 + 222 = 1066
16) 229 + 120 + 211 = 560
17) 318 + 102 + 102 = 522
18) 439 + 102 + 201 = 742
19) 788 + 201 + 102 = 1091
20) 600 + 222 + 111 = 933

**Appendix K3**


4.3
Name [redacted]
19/20
① 212 + 89 = 251
② 409 + 101 = 510
③ 218 + 222 = 440
④ 872 + 19 = 891
⑤ 748 + 112 = 860
⑥ 839 + 122 + 211 = 1,172
⑦ 908 + 22 + 111 = 1,041
⑧ 509 + 202 + 111 = 822
⑨ 888 + 111 + 101 = 1,100
⑩ 218 + 221 + 122 = 661
⑪ 119 + 212 + 122 = 453
⑫ 872 + 18 + 211 = 1,101
⑬ 741 + 225 + 318 = 1,284
⑭ 601 + 122 + 222 = 945
⑮ 137 + 111 + 222 = 470
⑯ 308 + 101 + 202 = 611
⑰ 765 + 231 + 202 = 1,198
⑱ 810 + 180 + 122 = 1,112
⑲ 800 + 200 + 111 = 1,111
⑳ 777 + 111 + 222 = 1,110

# Appendix K4

**4.4-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- The students will know the TouchMath "Addition with regrouping statement" and the traditional algorithms based on place value to add triple- and four-digit computations with more than two addends that requires +1000, +2000, +1101, +1202, etc in the ones, tens, hundreds, and thousands place value columns.**
**-The students will understand that place value algorithms and the TouchMath "Addition with regrouping statement" depends on understanding that +1000, +2000, +1101, +1202 is the same as counting on and using this knowledge increases triple- and four-digit addition computational fluency.**
**-The students will be able to add triple- and four-digit computations with more than two addends that require +1000, +2000, +1101, +1202, etc in the ones, tens, hundreds and thousands place value columns using the TouchMath "Addition with regrouping statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW share a personal story about needing to add up the total cost of clothes at Old Navy so that she wouldn't spend more money than she had. TTW make the connection between adding $19.99 and 1999.

***Review:** TTW review the "Addition with counting on statement." TTW review +10, +20, +200, +100, +101, +202 +12, etc from the previous days' learning.

***Direct Instruction (ME):** TTW teach by demonstrating the addition with regrouping statement, "I must regroup if my answer is greater than 9." TTW will focus instruction on +1000, +2000, +1101, +1202, etc in the ones, tens, hundreds, and thousands place value column. TTW focus instruction on the addition of more than two addends. TTW explain to the students that +1000, +2000, +1101, +1202, etc is just like counting on. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding numbers using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 triple- and four-digit addition computations with more than two addends with regrouping using +1000, +2000, +1101, +1202, etc.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW model one last problem on the board and ask students to explain the importance of being able to add with more than two addends.

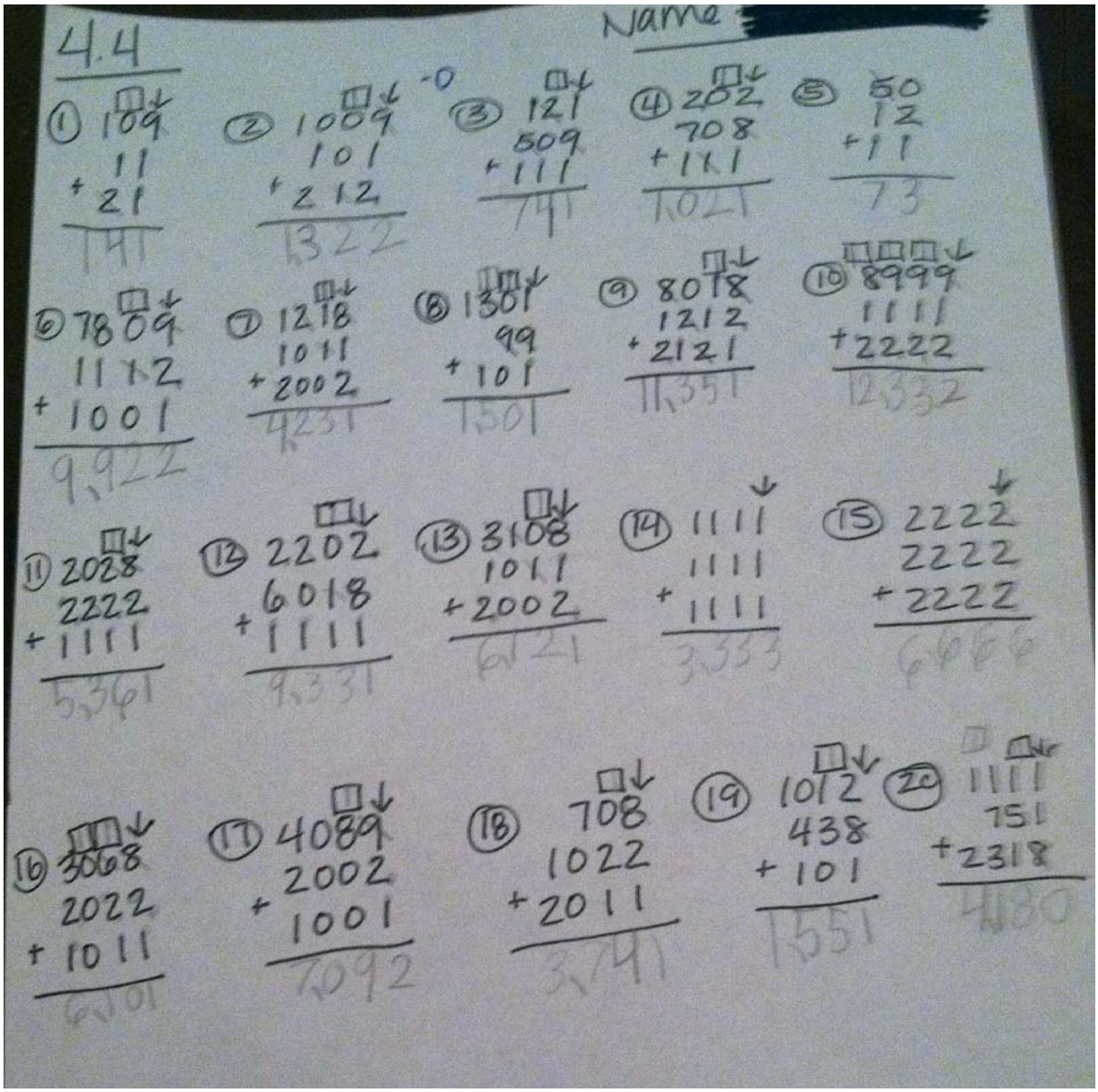
***Evaluation of Student Learning:** TTW determine the students' ability to add triple- and four-digit computations with more than two addends that require +100, +200, +110, +120, etc in the ones, tens, and hundred place value columns using the TouchMath "Addition with regrouping statement" by checking the worksheet for accuracy.

***Reflection:**

We had a lot of behavior issues today. When my mentor is not in the room, the students tend to not listen to me. We are working on getting better at this, but the students still continue to talk and not pay attention. I noticed about 8 students using their fingers during the weekly assessment. I will need to remind the students that the touchpoints are to replace counting on their fingers. Most of the students are starting to realize that just because when I began my intervention that it was easy, now it's not so easy. I was surprised by how poorly the students did on the weekly assessment this week. Most students have been doing really well during the daily assessments, but did not follow that pattern on the weekly assessment. Based on the IP scores, most students are at the proficient level of understanding thus far. I think the students are really enjoying my intervention and are eager to learn.

I had one boy tell me that, "TouchMath is my favorite thing to do at school." One boy said, "Confusing with fingers, easier to use touchpoints." Some of the students are still drawing the touchpoints on the numerals as representation, some students just touch the points, some students use their fingers, and some use the touchpoints in their heads. The students took a lot longer today to complete the four digit computations.

**Appendix K5**


4.4
Name
① 109 + 11 + 21 = 141
② 1009 + 101 + 212 = 1322
③ 121 + 509 + 111 = 741
④ 202 + 708 + 111 = 1021
⑤ 50 + 12 + 11 = 73
⑥ 7809 + 1112 + 1001 = 9,922
⑦ 1218 + 1011 + 2002 = 4231
⑧ 1301 + 99 + 101 = 1501
⑨ 8018 + 1212 + 2121 = 11,351
⑩ 8999 + 1111 + 2222 = 12,332
⑪ 2028 + 2222 + 1111 = 5,361
⑫ 2202 + 6018 + 1111 = 9,331
⑬ 3108 + 1011 + 2002 = 6121
⑭ 1111 + 1111 + 1111 = 3,333
⑮ 2222 + 2222 + 2222 = 6666
⑯ 3068 + 2022 + 1011 = 6101
⑰ 4089 + 2002 + 1001 = 7092
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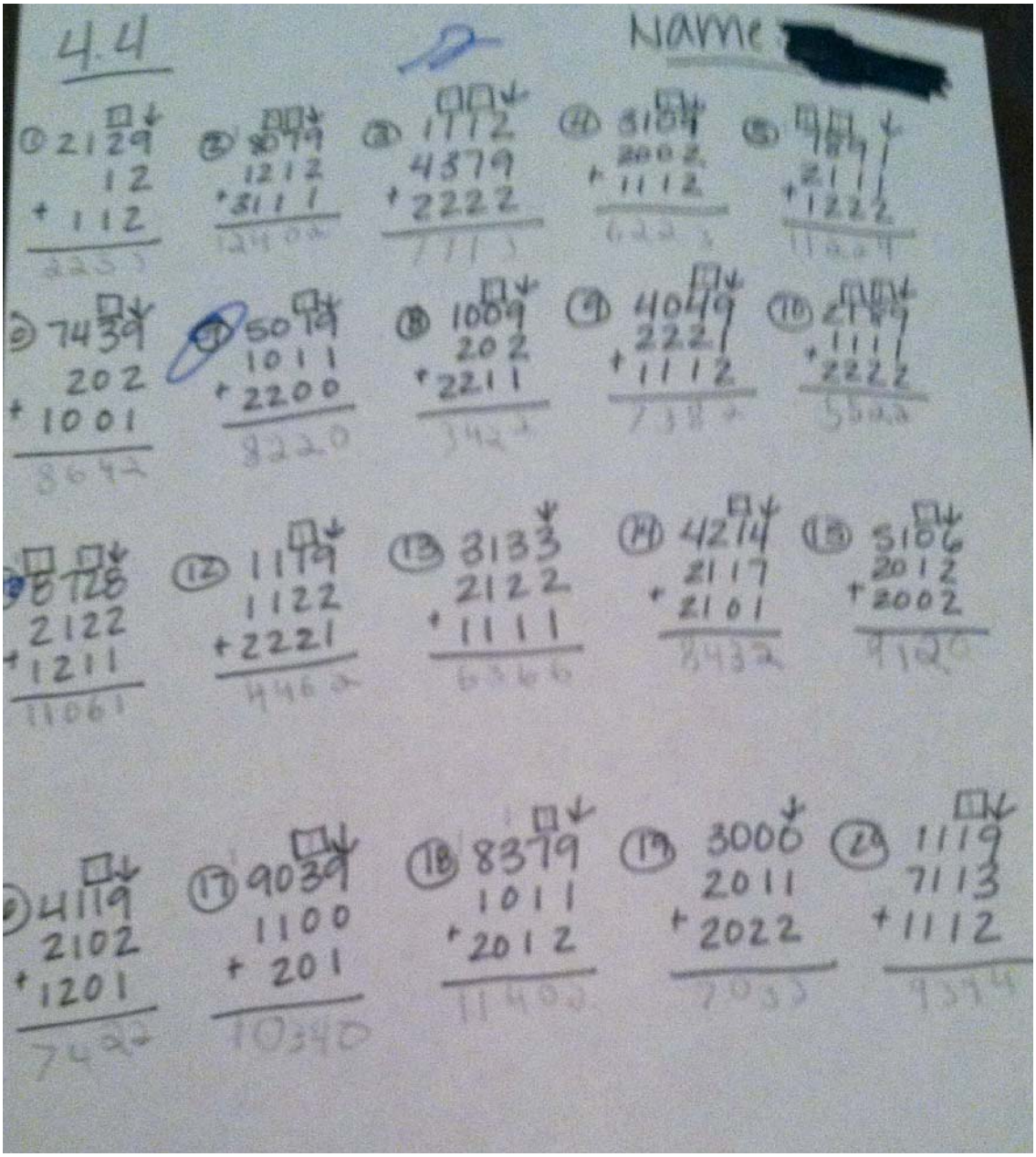
⑲ 1012 + 438 + 101 = 1551
⑳ 1111 + 751 + 2318 = 4180

**Appendix K6**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11 2122 +1211
12 1179 1122 +2221
13 8133 2122 +1111
14 4214 2117 +2101
15 5106 2012 +2002
16 4119 2102 +1201
17 9039 1100 +201
18 8379 1011 +2012
19 3000 2011 +2022
20 1119 7113 +1112

# Appendix L1

**5.1-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**-TLW know the TouchMath "Addition with counting on" and the traditional algorithms based on place value to add single-digit computations that requires the addition of doubles in the ones place value column. TLW also know that when the same number is added together it is called a double.**
**-TLW understand that place value algorithms and the TouchMath "Addition with counting on statement" depends on understanding that doubles are the same addend twice and using this knowledge increases single-digit addition computational fluency.**
**-TLW be able to add equal single-digit groups together to find the sum of the double in the ones place value column using the TouchMath "Addition with counting on statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problems.

**Materials**

- Paper, pencil, Daily assessment, Worksheets,
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*
- http://www.prometheanplanet.com/en-us/Resources/Item/32643/doubles-rap#.UvGEohaVzFI

**Procedures:**
***Schema Activation:** TTW ask if the students have ever heard of seeing double. TTW explain that when you have double vision that you are seeing more than one of something.

***Review:** TTW quickly review all doubles with a promethean board flipchart.

***Direct Instruction (ME):** TTW teach by demonstrating the addition with counting on statement, "I touch the greater (est) number, say its name, and continue counting on the TouchPoints of the other number(s)." TTW will focus instruction on doubles in the ones place value column. TTW focus instruction on the addition of two addends. TTW explain to the students that doubles are the same addend twice and that when adding TL should be able to quickly know the sum of the double. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding doubles using the statement: "I touch the greater (est) number, say its name, and continue counting on the TouchPoints of the other number(s)." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 single- or double-digit addition computations using doubles.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

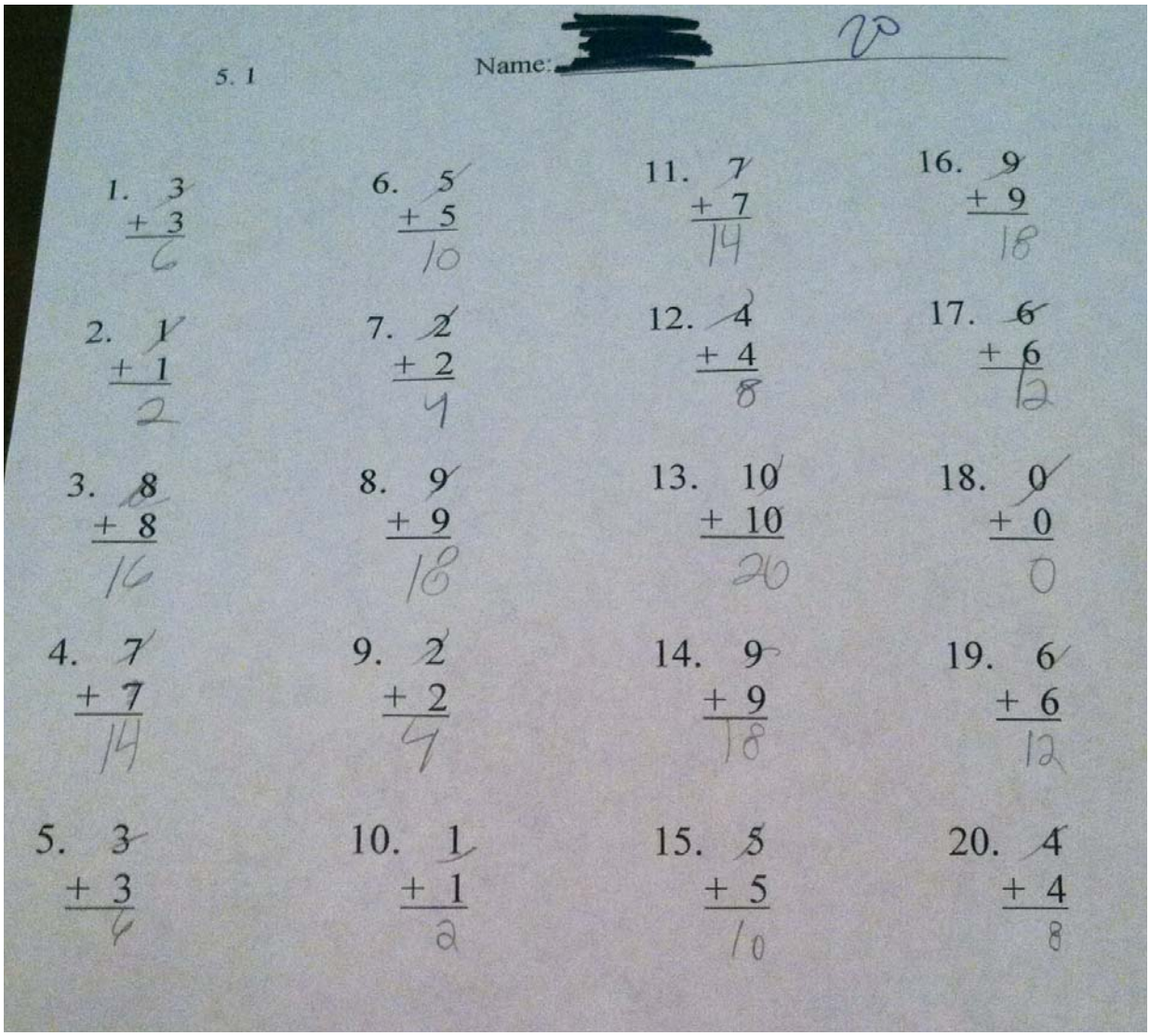
***Closure:** TTW reiterate the importance of being able to quickly compute doubles in their head quickly and accurately.

***Evaluation of Student Learning:** TTW determine the students' ability to add equal single-digit groups together to find the sum of the double in the ones place value column using the TouchMath "Addition with counting on statement" by checking the worksheet for accuracy.

***Reflection:**

Today's lesson was really easy for most of the students. We worked with addition of single-digit doubles. Most of the students were able to recall this information from previous learning. When I was directly teaching, most of the students were getting the answers right, but once they were required to do it on their own, they were struggling. I think that the student's were trying to rush to finish their sheet so that they could go practice their musical program. I changed the time for action research today, and it really seemed to mess them up. I plan to not change this time anymore. Most of the students are telling me that touchpoints are actually helping them. I only have a couple of students that are telling me that it is hard to go from fingers to touchpoints. One boy, said, "I told my parents, and they say TouchMath is cool and that they didn't know that worked." I noticed that two boys took an extremely long time answering the twenty questions today. I plan to help these two boys tomorrow. Multiple students told me that addition is easier with the touchpoints.

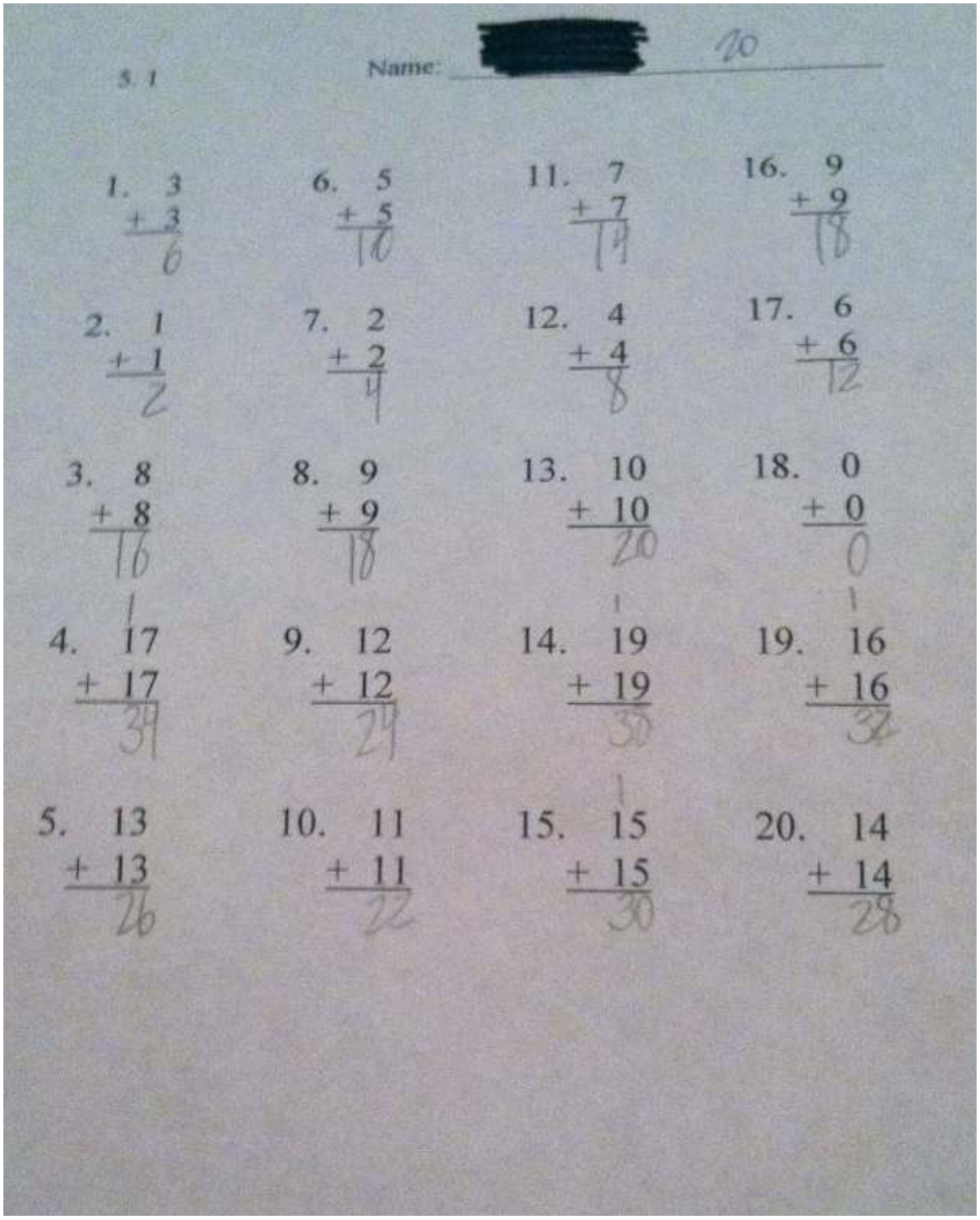
**Appendix L2**



5. 1 Name: [redacted] P

| | | | |
|---|---|---|---|
| 1. 3 + 3 = 6 | 6. 5 + 5 = 10 | 11. 7 + 7 = 14 | 16. 9 + 9 = 18 |
| 2. 1 + 1 = 2 | 7. 2 + 2 = 4 | 12. 4 + 4 = 8 | 17. 6 + 6 = 12 |
| 3. 8 + 8 = 16 | 8. 9 + 9 = 18 | 13. 10 + 10 = 20 | 18. 0 + 0 = 0 |
| 4. 7 + 7 = 14 | 9. 2 + 2 = 4 | 14. 9 + 9 = 18 | 19. 6 + 6 = 12 |
| 5. 3 + 3 = 4 | 10. 1 + 1 = 2 | 15. 5 + 5 = 10 | 20. 4 + 4 = 8 |

**Appendix L3**



5.1 Name: [redacted] 20

| | | | |
|---|---|---|---|
| 1. 3 + 3 = 6 | 6. 5 + 5 = 10 | 11. 7 + 7 = 14 | 16. 9 + 9 = 18 |
| 2. 1 + 1 = 2 | 7. 2 + 2 = 4 | 12. 4 + 4 = 8 | 17. 6 + 6 = 12 |
| 3. 8 + 8 = 16 | 8. 9 + 9 = 18 | 13. 10 + 10 = 20 | 18. 0 + 0 = 0 |
| 4. 17 + 17 = 39 | 9. 12 + 12 = 24 | 14. 19 + 19 = 30 | 19. 16 + 16 = 32 |
| 5. 13 + 13 = 26 | 10. 11 + 11 = 22 | 15. 15 + 15 = 30 | 20. 14 + 14 = 28 |

# Appendix M1

**6.2-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- TLW know the TouchMath "Addition without regrouping statement" and the traditional algorithms based on place value to add double-digit computations with two or more addends that requires doubles addition facts in the ones and tens place value columns.**
**-TLW understand that place value algorithms and the TouchMath "Addition without regrouping statement" depends on understanding that doubles are the same addend twice and using this knowledge increases single- and double-digit addition computational fluency.**
**-TLW be able to add equal single- and double-digit groups together to find the sum of the double in the ones and tens place value columns using the TouchMath "Addition without regrouping statement." The computations will contain more than two addends.**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW show a picture of two vanilla ice cream cones. TTW make the connection between the ice cream cones and doubles.

***Review:** TTW review the difference between a number and a numeral – number is how many and numeral is the symbol for that number.

***Direct Instruction (ME):** TTW teach the addition without regrouping statement, "I start on the side with the arrow. The arrow is in the ones column on the right side." TTW will focus instruction on doubles in the ones and tens place value column. TTW focus instruction on the addition of more than two addends. . TTW explain to the students that doubles are the same addend twice and that when adding TL should be able to quickly know the sum of the double and be able to quickly add the other addend in the computations. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding doubles using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 single- and double-digit addition computations without regrouping using doubles with more than two addends.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

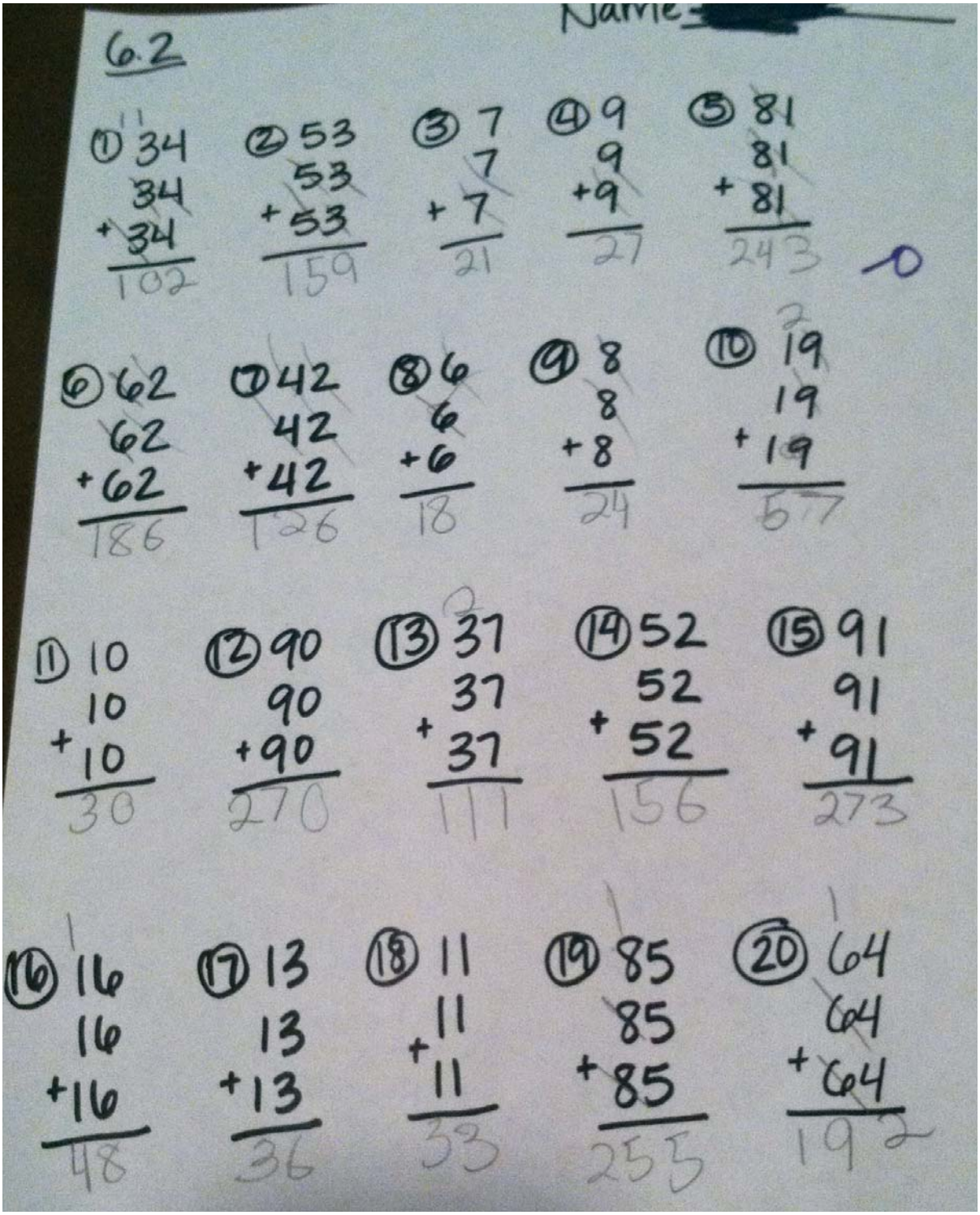
***Closure:** TTW reiterate the adding without regrouping strategy by showing one last example. TTW remind students that the purpose of today's lesson was to learn to add doubles quickly and accurately without a calculator.

***Evaluation of Student Learning:** TTW determine the students' ability to add single and double digit computations with more than two addends incorporating doubles in the ones and tens place value columns using the TouchMath "Addition with counting on statement" by checking the worksheet for accuracy.

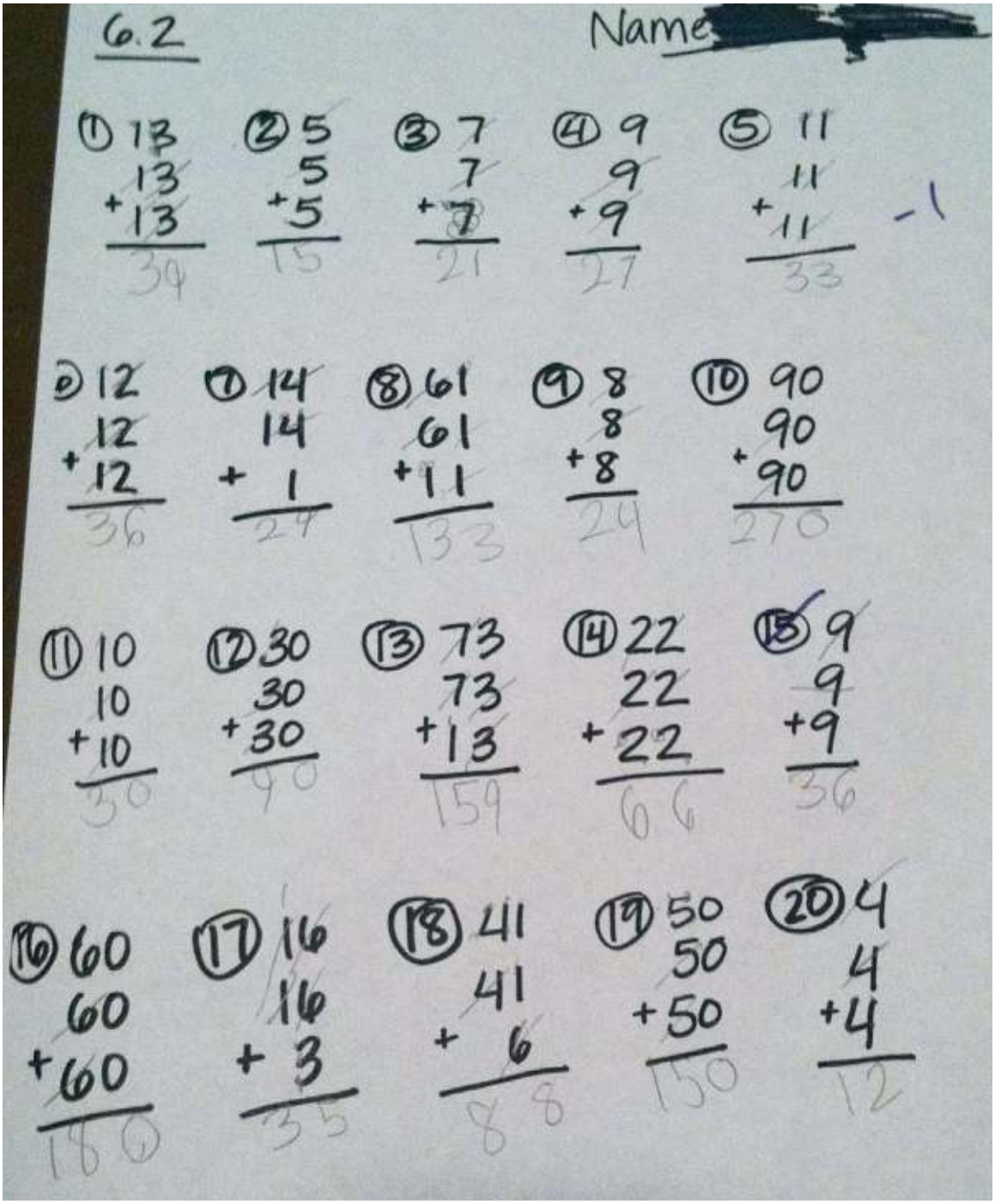
***Reflection:**

The lesson today was really fast. I spent a lot of time reviewing the issues I've seen on the IP. I spent time today having individual conferences with each child about how they have been performing thus far during the intervention. This was a great experience. I was able to see that most students are grasping TouchMath. I did realize that four students are struggling with the addition process. I told these four students that I will work one-on-one with them tomorrow to help their addition computational fluency increase. I also reviewed the touchpoints on 6-9. The students seem to struggle the most with 6-9. I showed the students how to skip count by two's on the touchpoints. We had a difficult time with behavior today. I need to have the students interact with the lesson more maybe this will improve behavior.

**Appendix M2**


6.2
Name
① 34 + 34 = 102
② 53 + 53 = 159
③ 7 + 7 = 21
④ 9 + 9 = 27
⑤ 81 + 81 = 243
⑥ 62 + 62 = 186
⑦ 42 + 42 = 126
⑧ 6 + 6 = 18
⑨ 8 + 8 = 24
⑩ 19 + 19 = 57
⑪ 10 + 10 = 30
⑫ 90 + 90 = 270
⑬ 37 + 37 = 111
⑭ 52 + 52 = 156
⑮ 91 + 91 = 273
⑯ 16 + 16 = 48
⑰ 13 + 13 = 36
⑱ 11 + 11 = 33
⑲ 85 + 85 = 255
⑳ 64 + 64 = 192

**Appendix M3**


6.2
Name
① 13 + 13 + 13 = 39
② 5 + 5 + 5 = 15
③ 7 + 7 + 7 = 21
④ 9 + 9 = 27
⑤ 11 + 11 = 33
⑥ 12 + 12 + 12 = 36
⑦ 14 + 14 + 1 = 29
⑧ 61 + 61 + 11 = 133
⑨ 8 + 8 + 8 = 24
⑩ 90 + 90 + 90 = 270
⑪ 10 + 10 + 10 = 30
⑫ 30 + 30 + 30 = 90
⑬ 73 + 73 + 13 = 159
⑭ 22 + 22 + 22 = 66
⑮ 9 + 9 + 9 = 36
⑯ 60 + 60 + 60 = 180
⑰ 16 + 16 + 3 = 35
⑱ 41 + 41 + 6 = 88
⑲ 50 + 50 + 50 = 150
⑳ 4 + 4 + 4 = 12

# Appendix N1

**7,3-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- TLW know the TouchMath "Addition with regrouping statement" and the traditional algorithms based on place value to add double- and triple-digit computations that requires near doubles addition facts in the ones, tens, and hundreds place value column.**
**-TLW understand that place value algorithms and the TouchMath "Addition with regrouping statement" depends on understanding that near doubles are doubles plus one or two more and using this knowledge increases double- and triple-digit addition computational fluency.**
**-TLW be able to add double- and triple- digit groups together to find the sum of the near double in the ones, tens, and hundreds place value columns using the TouchMath "Addition with regrouping statement."**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:** TTW show pictures of a yellow car and a red car. (same model) TTW make the connection between the cars and near doubles.

***Review:** TTW review near doubles from the previous days' learning.

***Direct Instruction (ME):** TTW teach by demonstrating the addition with regrouping statement, "I must regroup if my answer is greater than 9." TTW will focus instruction on near doubles in the ones, tens, and hundreds place value column. TTW focus instruction on the addition of two addends. TTW explain to the students that near doubles are close to doubles except you add one, two, or three more and TL should be able to quickly know the sum of the near double. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding near doubles using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 single-, double, and triple-digit addition computations with regrouping using near doubles in the ones, ten, and hundreds place value columns.

***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

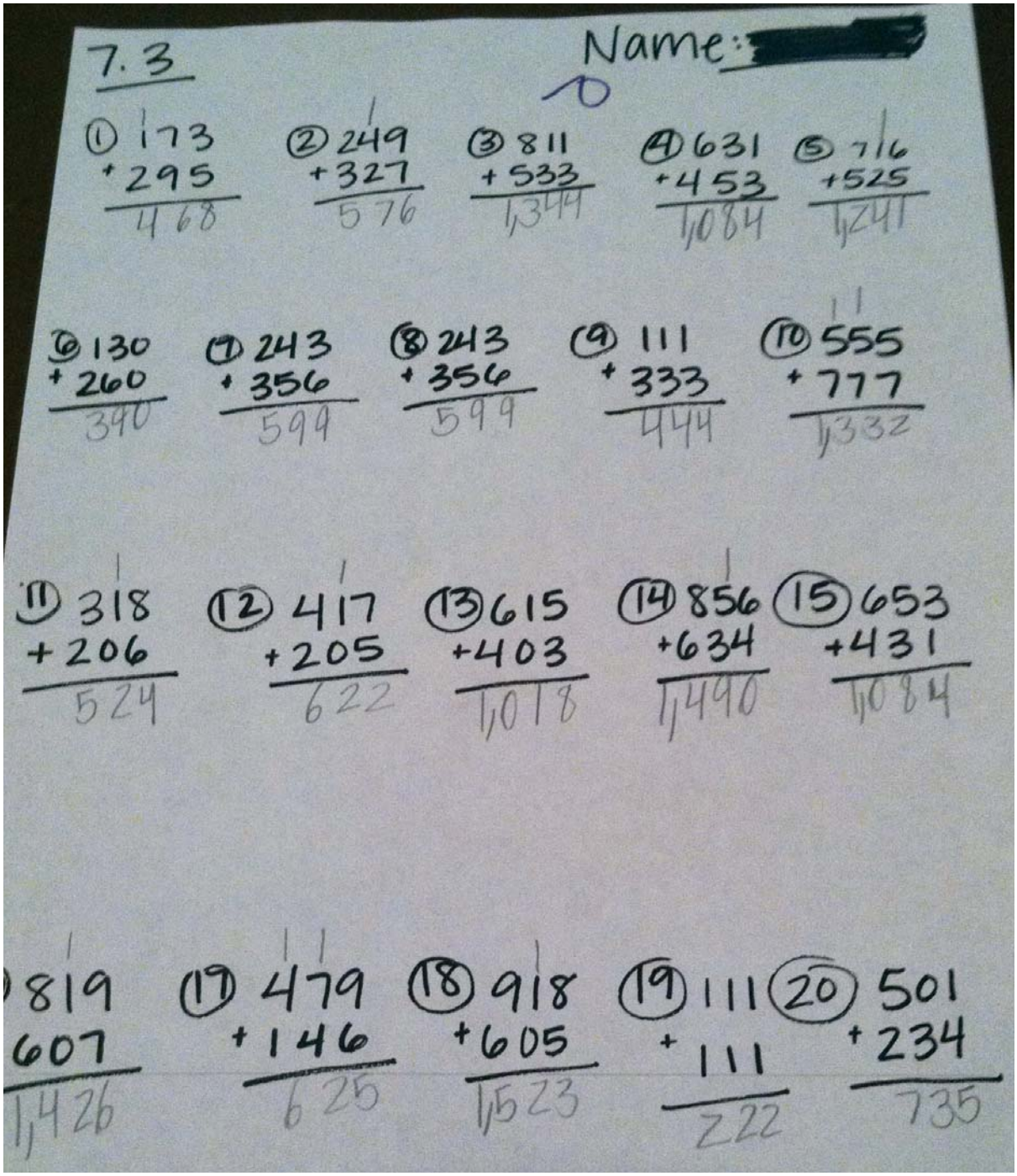
***Closure:** TTW reiterate the adding with regrouping strategy by showing one last example. TTW remind students that the purpose of today's lesson was to learn to add near doubles in any place value columns quickly and accurately without a calculator.

***Evaluation of Student Learning:** TTW determine the students' ability to add double- and triple-digit groups together to find the sum of the near double in the ones, tens, and hundreds place value columns using the TouchMath "Addition with regrouping statement" by checking the worksheet for accuracy.

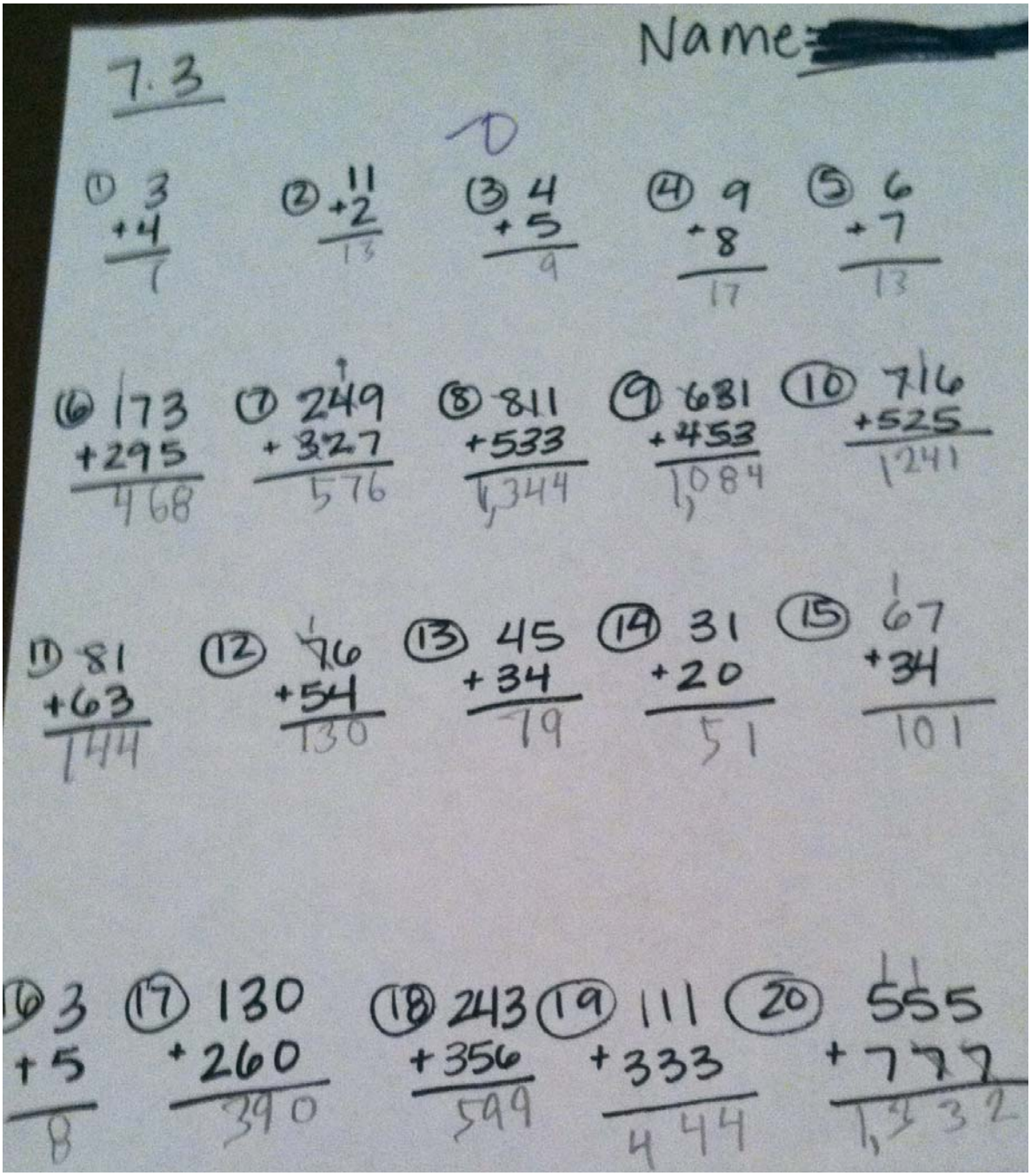
***Reflection:**
Today's lesson was rather long. Once the students finished their worksheet, I allowed them to get a white board and dry erase board and practice making and answering their own problems. The students really enjoyed this! I think I should have been doing this all along. The students really enjoyed making large problems and being able to answer them. Today was a great day!

One girl said, "TM is my favorite thing to do." Another girl said, "TM actually has made me faster!" One boy was really excited when he saw we were doing TM. Another boy said (during breakfast and morning work), "Use your touchpoints." One boy said, "I like this math, it's fun."

**Appendix N2**


7.3
Name: [redacted]
10
① 173 + 295 = 468
② 249 + 327 = 576
③ 811 + 533 = 1,344
④ 631 + 453 = 1,084
⑤ 716 + 525 = 1,241
⑥ 130 + 260 = 390
⑦ 243 + 356 = 599
⑧ 243 + 356 = 599
⑨ 111 + 333 = 444
⑩ 555 + 777 = 1,332
⑪ 318 + 206 = 524
⑫ 417 + 205 = 622
⑬ 615 + 403 = 1,018
⑭ 856 + 634 = 1,490
⑮ 653 + 431 = 1,084
⑰ 819 + 607 = 1,426
⑰ 479 + 146 = 625
⑱ 918 + 605 = 1,523
⑲ 111 + 111 = 222
⑳ 501 + 234 = 735

**Appendix N3**


Name: [redacted]
7.3
1) 3 + 4 = 7
2) 11 + 2 = 13
3) 4 + 5 = 9
4) 9 + 8 = 17
5) 6 + 7 = 13
6) 173 + 295 = 468
7) 249 + 327 = 576
8) 811 + 533 = 1,344
9) 681 + 453 = 1,084
10) 716 + 525 = 1241
11) 81 + 63 = 144
12) 76 + 54 = 130
13) 45 + 34 = 79
14) 31 + 20 = 51
15) 67 + 34 = 101
16) 3 + 5 = 8
17) 130 + 260 = 390
18) 243 + 356 = 599
19) 111 + 333 = 444
20) 555 + 777 = 1,332

# Appendix O1

**8.4-----**
**Title:** Action Research Project- TouchMath and Addition Computational Fluency
**Common Core Standards:**

- 3.NBT.A.2- Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.
- NCTM: Compute fluently and make reasonable estimate- develop fluency in adding, subtracting, multiplying, and dividing whole numbers.

**Student Learning Goals**
**- TLW know the TouchMath "Addition with regrouping statement" and the traditional algorithms based on place value to add triple- and four-digit computations with more than two addends that requires near doubles in the ones, tens, hundreds, and thousands place value columns.**
**-TLW understand that place value algorithms and the TouchMath "Addition with regrouping statement" depends on understanding that near doubles are doubles plus one or two more and using this knowledge increases triple- and four-digit addition computational fluency.**
**-TLW be able to add triple- and four-digit computations that require near doubles in the ones, tens, hundreds and thousands place value columns using the TouchMath "Addition with regrouping statement." The computations will contain more than two addends.**

***Daily assessment:** TLW take a 15 second quiz that has one single-, one double-, and one triple-digit addition computation problem.

**Materials**

- Paper, pencil, Daily assessment, Worksheets
- Resources: TouchMath Manual, Research, *Mathematics: A Good Beginning*

**Procedures:**
***Schema Activation:**

***Review:** TTW review near doubles in the ones, tens, and hundreds place value columns from the previous days' learning.

***Direct Instruction (ME):** TTW teach by demonstrating the addition with regrouping statement, "I must regroup if my answer is greater than 9." TTW will focus instruction on near doubles in the ones, tens, hundreds, and thousands place value column. TTW focus instruction on the addition of more than two addends. TTW explain to the students that near doubles are close to doubles except you add one, two, or three more and TL should be able to quickly know the sum of the near double. TTW explain that the goal today is to be able to compute the answers in their head quickly and correctly.

***Guided Practice (WE):** TT and TLW practice adding near doubles using the statement: "I start on the side with the arrow. The arrow is in the ones column on the right side." TT and TLW practice addition computations using the statement learned.

***Independent Practice (THEY):** TLW complete a worksheet that consists of 20 triple- and four-digit addition computations with regrouping using near doubles with more than two addends.

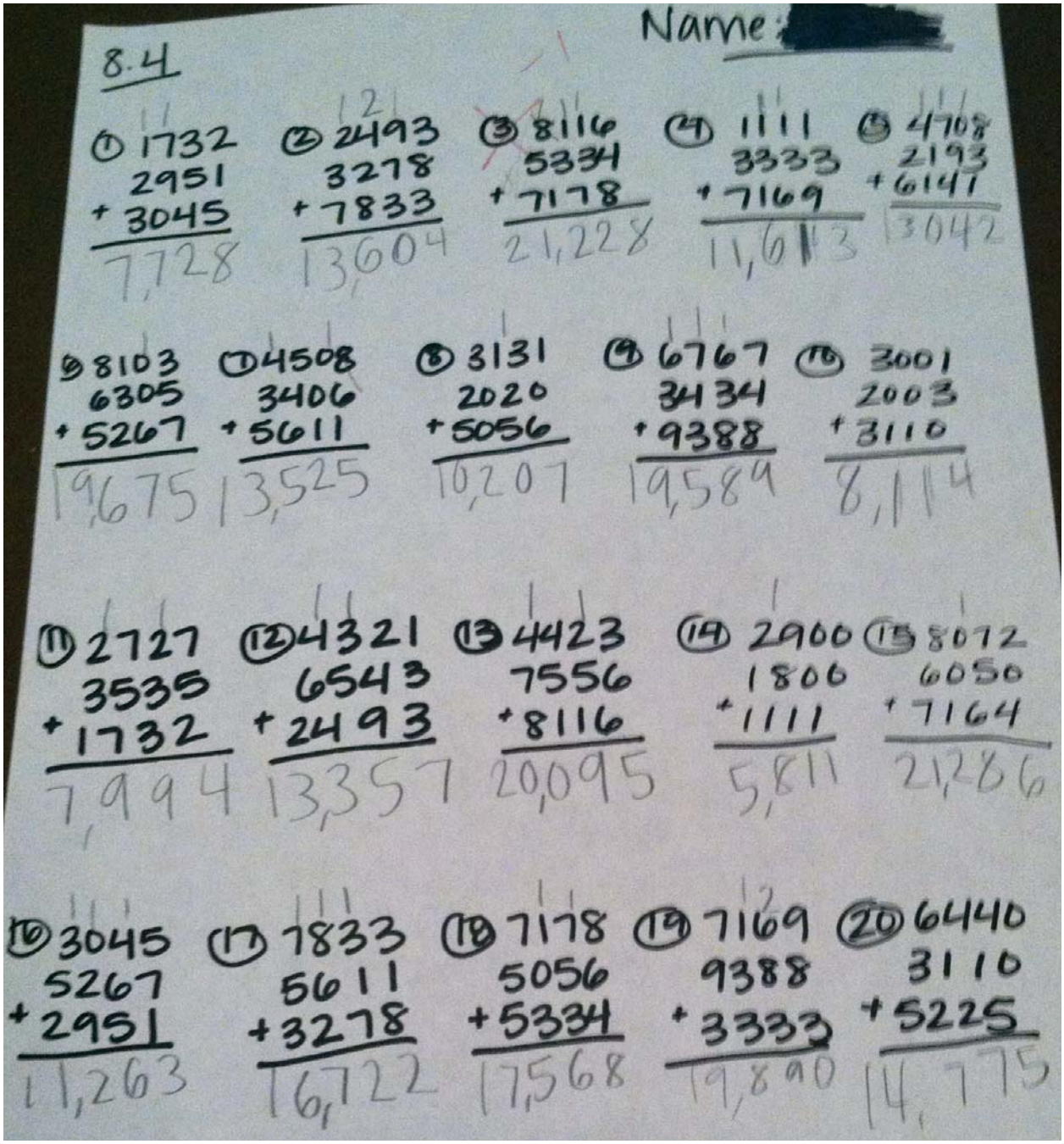
***Differentiation:** The lesson will be differentiated for readiness levels. Students who need more/larger numbers to add will be given different worksheets. Students who may need manipulative materials will be given those. Students who do not need to use the touchpoints will demonstrate fluency/ accuracy without that.

***Closure:** TTW reiterate the adding with regrouping strategy by showing one last example. TTW have three students model how to complete four digit computations with near doubles.

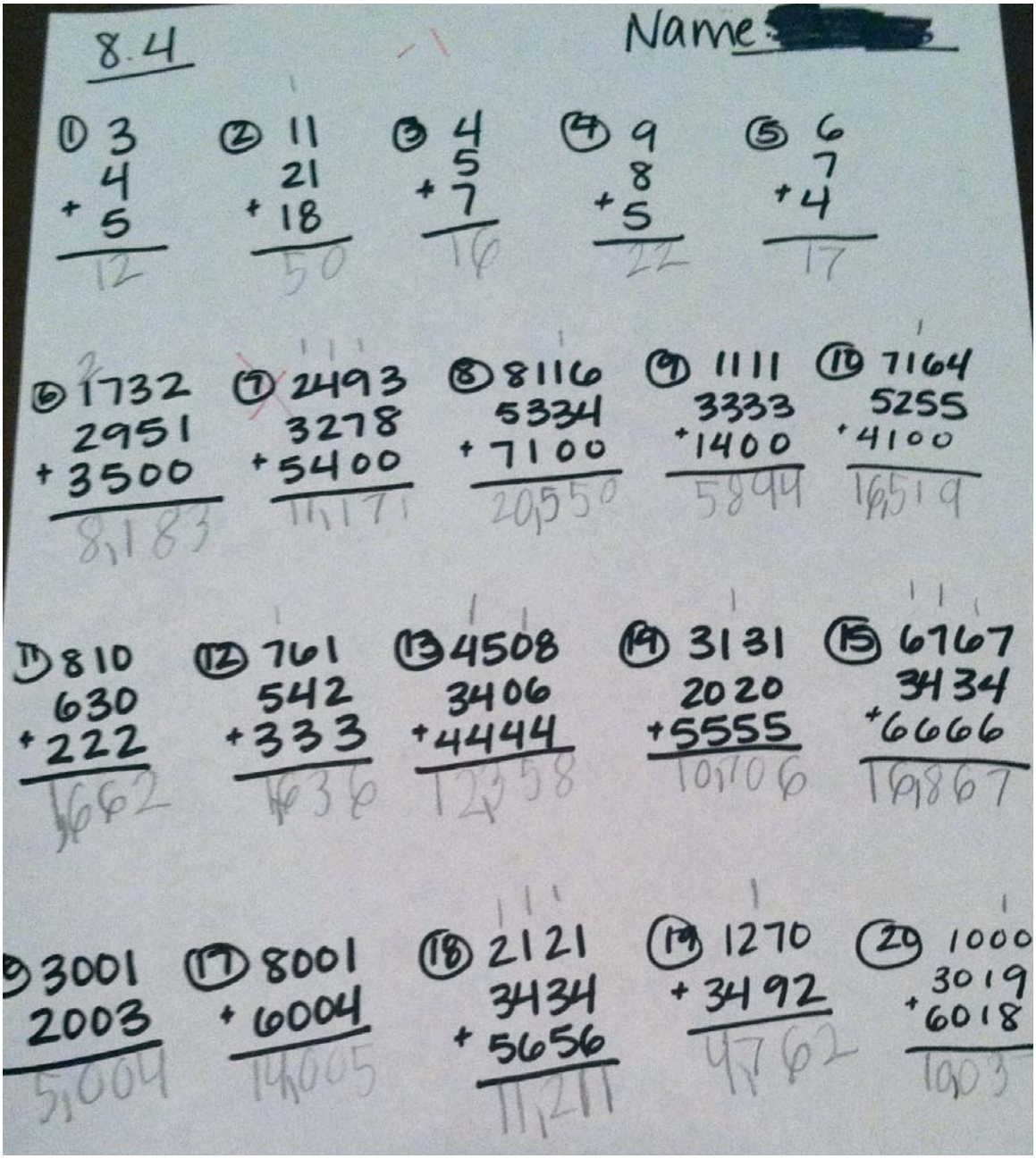
***Evaluation of Student Learning:** TTW determine the students' ability to add triple- and four-digit computations incorporating near doubles in the ones, tens, hundreds, and thousands place value columns and using the TouchMath "Addition with regrouping statement" by checking the worksheet for accuracy.

***Reflection:**
Today's lesson went really well. The students have been working really hard over the past eight weeks. I told the students that next week is our last week doing TM and all of the students let out a sad sigh. They are enjoying working on this. I had one student come up to me today and show me a book she made for TM. I was completely touched. I did not expect this. I cannot wait to include this in my research report. Most of the students are saying that touchpoints has helped them be able to get the correct answer fast. I am excited by this because that what I was working towards.

**Appendix O2**


Name: [redacted]
8.4
① 1732 + 2951 + 3045 = 7,728
② 2493 + 3278 + 7833 = 13,604
③ 8116 + 5334 + 7178 = 21,228
④ 1111 + 3333 + 7169 = 11,613
⑤ 4708 + 2193 + 6147 = 13042
⑥ 8103 + 6305 + 5267 = 19,675
⑦ 4508 + 3406 + 5611 = 13,525
⑧ 3131 + 2020 + 5056 = 10,207
⑨ 6767 + 3434 + 9388 = 19,589
⑩ 3001 + 2003 + 3110 = 8,114
⑪ 2727 + 3535 + 1732 = 7,994
⑫ 4321 + 6543 + 2493 = 13,357
⑬ 4423 + 7556 + 8116 = 20,095
⑭ 2900 + 1806 + 1111 = 5,811
⑮ 8072 + 6050 + 7164 = 21,286
⑯ 3045 + 5267 + 2951 = 11,263
⑰ 7833 + 5611 + 3278 = 16,722
⑱ 7178 + 5056 + 5334 = 17,568
⑲ 7169 + 9388 + 3333 = 19,890
⑳ 6440 + 3110 + 5225 = 14,775

**Appendix O3**


8.4
Name: [redacted]
① 3 + 4 + 5 = 12
② 11 + 21 + 18 = 50
③ 4 + 5 + 7 = 16
④ 9 + 8 + 5 = 22
⑤ 6 + 7 + 4 = 17
⑥ 1732 + 2951 + 3500 = 8,183
⑦ 2493 + 3278 + 5400 = 11,171
⑧ 8116 + 5334 + 7100 = 20,550
⑨ 1111 + 3333 + 1400 = 5844
⑩ 7164 + 5255 + 4100 = 16,519
⑪ 810 + 630 + 222 = 1662
⑫ 761 + 542 + 333 = 1636
⑬ 4508 + 3406 + 4444 = 12,358
⑭ 3131 + 2020 + 5555 = 10,706
⑮ 6767 + 3434 + 6666 = 16,867
⑯ 3001 + 2003 = 5,004
⑰ 8001 + 6004 = 14,005
⑱ 2121 + 3434 + 5656 = 11,211
⑲ 1270 + 3492 = 4762
⑳ 1000 + 3019 + 6018 = 10,037

## Appendix P

| Student | Test #1- Single digit | Test #2-Single and Double Digit | Test #3-Double and Triple Digit | Test #4-Triple Digit | Test #5- Double and Triple Digit with more than two addends |
|---|---|---|---|---|---|
| 189 | 30 | 29 | 0 | 0 | 0 |
| 797 | 30 | 29 | 6 | 1 | 0 |
| 388 | 29 | 29 | 11 | 1 | 0 |
| 214 | 29 | 30 | 8 | 3 | 0 |
| 200 | 30 | 30 | 15 | 9 | 6 |
| 904 | 30 | 30 | 4 | 0 | 0 |
| 520 | 30 | 28 | 2 | 0 | 0 |
| 256 | 29 | 27 | 22 | 15 | 6 |
| 357 | 30 | 30 | 18 | 0 | 1 |
| 650 | 30 | 30 | 19 | 13 | 7 |
| 506 | 30 | 29 | 17 | 7 | 0 |
| 125 | 29 | 21 | 0 | 0 | 0 |
| 771 | 30 | 30 | 10 | 7 | 1 |
| 493 | 30 | 30 | 11 | 4 | 1 |
| 680 | 30 | 30 | 7 | 6 | 4 |
| 617 | 29 | 30 | 0 | 0 | 0 |
| 859 | 30 | 29 | 16 | 5 | 1 |
| 402 | 30 | 22 | 8 | 5 | 0 |
| 891 | 30 | 30 | 21 | 14 | 5 |
| 817 | 30 | 30 | 28 | 13 | 3 |
| 264 | 29 | 25 | 2 | 0 | 0 |
| 979 | 30 | 30 | 7 | 2 | 1 |
| 374 | 30 | 30 | 21 | 11 | 3 |
| 271 | 30 | 11 | 1 | 0 | 0 |

## Appendix Q

| Student | Pretest | Posttest |
|---|---|---|
| 189 | 59 | 103 |
| 797 | 66 | 83 |
| 388 | 70 | 108 |
| 214 | 70 | 98 |
| 200 | 90 | 115 |
| 904 | 64 | 100 |
| 520 | 60 | 79 |
| 256 | 99 | 121 |
| 357 | 79 | 111 |
| 650 | 99 | 110 |
| 506 | 83 | 105 |
| 125 | 50 | 83 |
| 771 | 78 | 101 |
| 493 | 76 | 89 |
| 680 | 77 | 96 |
| 617 | 59 | 100 |
| 859 | 81 | 112 |
| 402 | 65 | 98 |
| 891 | 100 | 105 |
| 817 | 104 | 118 |
| 264 | 56 | 85 |
| 979 | 70 | 125 |
| 374 | 95 | 114 |
| 271 | 42 | 75 |

**Appendix R1**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 1 Average | Week 1 Test |
|---|---|---|---|---|---|---|
| 189 | 3 | 1 | 2 | 1 | 1.75 | 8 |
| 797 | 2 | 0 | 2 | 2 | 1.5 | 8 |
| 388 | 1 | 1 | 1 | 1 | 1 | 4 |
| 214 | 2 | 1 | 1 | 2 | 1.5 | 8 |
| 200 | 3 | 2 | 2 | 2 | 2.25 | 15 |
| 904 | | 1 | 1 | 1 | 1 | 8 |
| 520 | | 0 | 1 | 1 | 0.67 | 9 |
| 256 | 2 | | | | 2 | |
| 357 | 3 | 1 | 2 | 2 | 2 | 12 |
| 650 | 3 | 2 | 3 | | 2.67 | |
| 506 | 3 | 2 | 3 | 2 | 2.5 | 15 |
| 125 | | 1 | 1 | 2 | 1.33 | 7 |
| 771 | 3 | 2 | 1 | 2 | 2 | 9 |
| 493 | 2 | 3 | 2 | 1 | 2 | 13 |
| 680 | 2 | 2 | 2 | 2 | 2 | 13 |
| 617 | 2 | 1 | 1 | 1 | 1.25 | 3 |
| 859 | 1 | 2 | 2 | 2 | 1.75 | 14 |
| 402 | 2 | 0 | 1 | 1 | 1 | 14 |
| 891 | | 2 | 1 | 2 | 1.67 | 15 |
| 817 | 3 | 2 | 3 | 3 | 2.75 | 15 |
| 264 | | | | | - | |
| 979 | 3 | 3 | 1 | 3 | 2.5 | 10 |
| 374 | 2 | 1 | 3 | 3 | 2.25 | 14 |

**Appendix R2**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 2 Average | Weekly Test 2 |
|---|---|---|---|---|---|---|
| 189 | 1 | 1 | 1 | 2 | 1.25 | 9 |
| 797 | 2 | 0 | 0 | 2 | 1 | 6 |
| 388 | 1 | 1 | 1 | 1 | 1 | 9 |
| 214 | 2 | 1 | 2 | 2 | 1.75 | 10 |
| 200 | 3 | 2 | 2 | 2 | 2.25 | 14 |
| 904 | 1 | 1 | 1 | 2 | 1.25 | 8 |
| 520 | 2 | 0 | 1 | 1 | 1 | 7 |
| 256 | | 2 | 2 | 2 | 2 | 15 |
| 357 | 3 | 2 | 2 | 2 | 2.25 | 10 |
| 650 | | 0 | 0 | 2 | 0.67 | 13 |
| 506 | 3 | 1 | 1 | 2 | 1.75 | 8 |
| 125 | 2 | 1 | 2 | 1 | 1.5 | 8 |
| 771 | 2 | 1 | 2 | 1 | 1.5 | 8 |
| 493 | 2 | 2 | 1 | 1 | 1.5 | 8 |
| 680 | 2 | 2 | 2 | 1 | 1.75 | 4 |
| 617 | absent | 1 | 2 | 1 | 1.33 | 8 |
| 859 | 2 | 2 | 1 | 2 | 1.75 | 5 |
| 402 | 2 | 2 | 2 | 2 | 2 | 13 |
| 891 | 2 | 1 | 2 | 2 | 1.75 | 15 |
| 817 | 3 | 3 | 3 | 2 | 2.75 | 15 |
| 264 | | 1 | 2 | 2 | 1.67 | 3 |
| 979 | 3 | 1 | 2 | 2 | 2 | 11 |
| 374 | 2 | 2 | 2 | 2 | 2 | 15 |

**Appendix R3**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 3 Average | Week 3 Test |
|---|---|---|---|---|---|---|
| 189 | 3 | 2 | 2 | 1 | 2 | 13 |
| 797 | 3 | 1 | 0 | 2 | 1.5 | 10 |
| 388 | 1 | 2 | 1 | 2 | 1.5 | 13 |
| 214 | 1 | 1 | 2 | 2 | 1.5 | 8 |
| 200 | 3 | 2 | 2 | 2 | 2.25 | 15 |
| 904 | 3 | 2 | 3 | 2 | 2.5 | 13 |
| 520 | 1 | 2 | 1 | 2 | 1.5 | 9 |
| 256 | 3 | 2 | 2 | 3 | 2.5 | 13 |
| 357 | 3 | 3 | 2 | 3 | 2.75 | 13 |
| 650 | 3 | 3 | 2 | 3 | 2.75 | 14 |
| 506 | 2 | 2 | 2 | 3 | 2.25 | 15 |
| 125 | 1 | 2 | 1 | 0 | 1 | 10 |
| 771 | 3 | 3 | 2 | 2 | 2.75 | 14 |
| 493 | 2 | 2 | 1 | 2 | 1.75 | 15 |
| 680 | 2 | 1 | 2 | 2 | 1.75 | 6 |
| 617 | 2 | 1 | 1 | 2 | 1.5 | 11 |
| 859 | 3 | 1 | 2 | 2 | 2 | 15 |
| 402 | 3 | 1 | 2 | 2 | 2 | 15 |
| 891 | 3 | 2 | 2 | 2 | 2.25 | 15 |
| 817 | 3 | 3 | 3 | 3 | 3 | 15 |
| 264 | 2 | 1 | 1 | 1 | 1.25 | 14 |
| 979 | 3 | 2 | 3 | 3 | 2.75 | 15 |
| 374 | 3 | 2 | 2 | 3 | 2.5 | 14 |
| 271 | | | | 2 | 2 | 10 |

**Appendix R4**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 4 Average | Week 4 Test |
|---|---|---|---|---|---|---|
| 189 | 3 | 3 | 2 | 2 | 2.5 | 8 |
| 797 | 0 | 0 | 2 | 2 | 1 | 9 |
| 388 | 3 | 3 | 2 | 2 | 2.5 | 12 |
| 214 | 2 | 3 | 1 | 1 | 1.75 | 9 |
| 200 | 3 | 3 | 2 | 2 | 2.5 | 14 |
| 904 | 2 | 3 | 2 | 1 | 2 | 8 |
| 520 | 3 | 3 | 2 | 1 | 2.25 | 8 |
| 256 | 3 | 2 | 2 | 2 | 2.25 | 15 |
| 357 | 3 | 0 | 2 | 1 | 1.5 | 11 |
| 650 | 3 | 3 | 2 | 2 | 2.5 | 11 |
| 506 | 3 | 3 | 2 | 1 | 2.25 | 11 |
| 125 | 1 | 3 | 2 | 0 | 1.5 | 5 |
| 771 | 3 | 3 | 2 | 2 | 2.5 | 13 |
| 493 | 2 | 3 | 1 | 1 | 1.75 | 8 |
| 680 | 2 | 3 | 1 | 2 | 2 | 9 |
| 617 | 1 | 3 | 1 | 1 | 1.5 | 6 |
| 859 | 3 | 3 | 2 | 2 | 2.5 | 14 |
| 402 | 2 | 3 | 2 | 2 | 2.25 | 7 |
| 891 | 3 | 3 | 2 | 2 | 2.5 | 15 |
| 817 | 2 | 3 | 3 | 3 | 2.75 | 15 |
| 264 | 3 | 3 | 1 | 2 | 2.25 | 7 |
| 979 | 3 | 3 | 3 | 3 | 3 | 13 |
| 374 | 3 | 3 | 2 | 2 | 2.5 | 15 |
| 271 | 2 | 2 | 2 | 1 | 1.75 | 6 |

**Appendix R5**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 5 average | Week 5 Test |
|---|---|---|---|---|---|---|
| 189 | 0 | 3 | 3 | 2 | 2 | 11 |
| 797 | 1 | 1 | 1 | 3 | 1.5 | 14 |
| 388 | 1 | 0 | 1 | 3 | 1.25 | 14 |
| 214 | 2 | 1 | 1 | 3 | 1.75 | 12 |
| 200 | 1 | 1 | 1 | 3 | 1.5 | 11 |
| 904 | 1 | 2 | 2 | 2 | 1.75 | 12 |
| 520 | 1 | 1 | 1 | 1 | 1 | 15 |
| 256 | 2 | 3 | 3 | 3 | 2.75 | 15 |
| 357 | 3 | 2 | 2 | 3 | 2.5 | 15 |
| 650 | 2 | 2 | 2 | 2 | 2 | 15 |
| 506 | 2 | 3 | 3 | 3 | 2.75 | 15 |
| 125 | 2 | 1 | 1 | 1 | 1.25 | 10 |
| 771 | 2 | 3 | 3 | 2 | 2.5 | 13 |
| 493 | 1 | 1 | 1 | 3 | 1.5 | 11 |
| 680 | 2 | 2 | 2 | 1 | 1.75 | 7 |
| 617 | 2 | 1 | 1 | 2 | 1.5 | 7 |
| 859 | 3 | 2 | 2 | 2 | 2.25 | 14 |
| 402 | 2 | 1 | 0 | 3 | 1.5 | 7 |
| 891 | 2 | 3 | 3 | 3 | 2.75 | 14 |
| 817 | 3 | 3 | 3 | 3 | 3 | 15 |
| 264 | 1 | 2 | 2 | 2 | 1.75 | 11 |
| 979 | 2 | 3 | 3 | 3 | 2.75 | 15 |
| 374 | 3 | 2 | 2 | 3 | 2.5 | 15 |
| 271 | 0 | 1 | 1 | 1 | 0.75 | 6 |

**Appendix R6**

| | Day 1 | Day 2 | Day 3 | Day 4 | Week 6 Average | Week 6 Test |
|---|---|---|---|---|---|---|
| 189 | 2 | 3 | 3 | 2 | 2.5 | 12 |
| 797 | 1 | 3 | 1 | 2 | 1.75 | 9 |
| 388 | 3 | 3 | 2 | 2 | 2.5 | 15 |
| 214 | 3 | 3 | 2 | 1 | 2.25 | 8 |
| 200 | 3 | 3 | 2 | 1 | 2.25 | 12 |
| 904 | 3 | 3 | 2 | 1 | 2.25 | 9 |
| 520 | 3 | 2 | 0 | 1 | 1.5 | 11 |
| 256 | 3 | 3 | 2 | 3 | 2.75 | 13 |
| 357 | 3 | 3 | 3 | 3 | 3 | 15 |
| 650 | 0 | 3 | 3 | 3 | 2.25 | 11 |
| 506 | 3 | 3 | 2 | 2 | 2.5 | 15 |
| 125 | 3 | 2 | 2 | 1 | 2 | 8 |
| 771 | 3 | 3 | 2 | 2 | 2.5 | 12 |
| 493 | 2 | 3 | 2 | 0 | 1.75 | 9 |
| 680 | 3 | 3 | 2 | 2 | 2.5 | 8 |
| 617 | 2 | 3 | 2 | 0 | 1.75 | 12 |
| 859 | 1 | 3 | 2 | 1 | 1.75 | 14 |
| 402 | 3 | 3 | 2 | 2 | 2.5 | 9 |
| 891 | 3 | 2 | 2 | 2 | 2.25 | 14 |
| 817 | 3 | 3 | 3 | 3 | 3 | 15 |
| 264 | 2 | 2 | 1 | 2 | 1.75 | 7 |
| 979 | 3 | 3 | 3 | 3 | 3 | 14 |
| 374 | 2 | 3 | 2 | 2 | 2.25 | 10 |
| 271 | 2 | 2 | 2 | 1 | 1.75 | 5 |

**Appendix R7**

| | 1 | 2 | 3 | 4 | Week 7 Average | Week 7 Test |
|---|---|---|---|---|---|---|
| 189 | 3 | 3 | 2 | 3 | 2.75 | 15 |
| 797 | 3 | 1 | 3 | 3 | 2.5 | 13 |
| 388 | 3 | 3 | 3 | 3 | 3 | 12 |
| 214 | 1 | 2 | 3 | 3 | 2.25 | 12 |
| 200 | 3 | 3 | 3 | 3 | 3 | 15 |
| 904 | 2 | 3 | 3 | 3 | 2.75 | 12 |
| 520 | 2 | 3 | 3 | 3 | 2.75 | 8 |
| 256 | 3 | 3 | 3 | 3 | 3 | 15 |
| 357 | 3 | 3 | 3 | 3 | 3 | 15 |
| 650 | 3 | 3 | 3 | 3 | 3 | 15 |
| 506 | 3 | 3 | 3 | 3 | 3 | 15 |
| 125 | 2 | 2 | 3 | 1 | 2 | 12 |
| 771 | 3 | 3 | 3 | 3 | 3 | 15 |
| 493 | 1 | 3 | 3 | 3 | 2.5 | 14 |
| 680 | 3 | 3 | 3 | 3 | 3 | 13 |
| 617 | 3 | 2 | 3 | 3 | 2.75 | 14 |
| 859 | 3 | 3 | 3 | 3 | 3 | 15 |
| 402 | 3 | 3 | 2 | 3 | 2.75 | 14 |
| 891 | 3 | 3 | 3 | 3 | 3 | 15 |
| 817 | 3 | 3 | 3 | 3 | 3 | 15 |
| 264 | 2 | 3 | 2 | 3 | 2.5 | 11 |
| 979 | 3 | 3 | 3 | 3 | 3 | 15 |
| 374 | 2 | 3 | 3 | 3 | 2.75 | 14 |
| 271 | 1 | 3 | 2 | 2 | 2 | 6 |

**Appendix R8**

| | 1 | 2 | 3 | 4 | Week 8 Average | Week 8 Test |
|---|---|---|---|---|---|---|
| 189 | 3 | 2 | 3 | 3 | 2.75 | 15 |
| 797 | 1 | 3 | 2 | 2 | 2 | 14 |
| 388 | 2 | 2 | 2 | 3 | 2.25 | 15 |
| 214 | 2 | 3 | 3 | 3 | 2.75 | 12 |
| 200 | 2 | 2 | 3 | 3 | 2.5 | 15 |
| 904 | 1 | 2 | 2 | 0 | 1.25 | 14 |
| 520 | 1 | 2 | 3 | 1 | 1.75 | 11 |
| 256 | 2 | 2 | 3 | 3 | 2.5 | 14 |
| 357 | 3 | 3 | 3 | 3 | 3 | 15 |
| 650 | 2 | 2 | 3 | 3 | 2.5 | 15 |
| 506 | 3 | 3 | 3 | 3 | 3 | 15 |
| 125 | 1 | 2 | 2 | 3 | 2 | 14 |
| 771 | 2 | 2 | 3 | 3 | 2.5 | 15 |
| 493 | 2 | 2 | 3 | 3 | 2.5 | 13 |
| 680 | 2 | 2 | 3 | 3 | 2.5 | 15 |
| 617 | 2 | 3 | 3 | 3 | 2.75 | 14 |
| 859 | 2 | 2 | 3 | 3 | 2.5 | 15 |
| 402 | 2 | 2 | 2 | 1 | 1.75 | 15 |
| 891 | 2 | 3 | 2 | 3 | 2.5 | 15 |
| 817 | 3 | 3 | 3 | 3 | 3 | 15 |
| 264 | 2 | 2 | 1 | 1 | 1.5 | 12 |
| 979 | 3 | 3 | 3 | 3 | 3 | 15 |
| 374 | 3 | 3 | 3 | 3 | 3 | 14 |
| 271 | 1 | 2 | 2 | 2 | 1.75 | 10 |

**Appendix S**

| Student | Test #1-Single digit | Test #2-Single and Double Digit | Test #3-Double and Triple Digit | Test #4-Triple Digit | Test #5-Double and Triple Digit with more than two addends |
|---|---|---|---|---|---|
| 189 | 30 | 29 | 0 | 0 | 0 |
| 797 | 30 | 29 | 6 | 1 | 0 |
| 388 | 29 | 29 | 11 | 1 | 0 |
| 214 | 29 | 30 | 8 | 3 | 0 |
| 200 | 30 | 30 | 15 | 9 | 6 |
| 904 | 30 | 30 | 4 | 0 | 0 |
| 520 | 30 | 28 | 2 | 0 | 0 |
| 256 | 29 | 27 | 22 | 15 | 6 |
| 357 | 30 | 30 | 18 | 0 | 1 |
| 650 | 30 | 30 | 19 | 13 | 7 |
| 506 | 30 | 29 | 17 | 7 | 0 |
| 125 | 29 | 21 | 0 | 0 | 0 |
| 771 | 30 | 30 | 10 | 7 | 1 |
| 493 | 30 | 30 | 11 | 4 | 1 |
| 680 | 30 | 30 | 7 | 6 | 4 |
| 617 | 29 | 30 | 0 | 0 | 0 |
| 859 | 30 | 29 | 16 | 5 | 1 |
| 402 | 30 | 22 | 8 | 5 | 0 |
| 891 | 30 | 30 | 21 | 14 | 5 |
| 817 | 30 | 30 | 28 | 13 | 3 |
| 264 | 29 | 25 | 2 | 0 | 0 |
| 979 | 30 | 30 | 7 | 2 | 1 |
| 374 | 30 | 30 | 21 | 11 | 3 |
| 271 | 30 | 11 | 1 | 0 | 0 |

## Appendix T

| | Pre-test | Post-test |
|---|---|---|
| 189 | Below Basic | Basic |
| 797 | Below Basic | Basic |
| 388 | Below Basic | Proficient |
| 214 | Below Basic | Basic |
| 200 | Basic | Proficient |
| 904 | Below Basic | Basic |
| 520 | Below Basic | Basic |
| 256 | Basic | Proficient |
| 357 | Basic | Proficient |
| 650 | Basic | Proficient |
| 506 | Basic | Proficient |
| 125 | Below Basic | Basic |
| 771 | Basic | Basic |
| 493 | Basic | Basic |
| 680 | Basic | Basic |
| 617 | Below Basic | Basic |
| 859 | Basic | Proficient |
| 402 | Below Basic | Basic |
| 891 | Basic | Proficient |
| 817 | Basic | Proficient |
| 264 | Below Basic | Basic |
| 979 | Below Basic | Proficient |
| 374 | Basic | Proficient |
| 271 | Below Basic | Below Basic |

**Appendix U**

t-Test: Paired Two Sample for Means

| | *Variable 1* | *Variable 2* |
|---|---|---|
| Mean | 101.4166667 | 74.66666667 |
| Variance | 185.4710145 | 285.1884058 |
| Observations | 24 | 24 |
| Pearson Correlation | 0.731105101 | |
| Hypothesized Mean Difference | 0 | |
| df | 23 | |
| t Stat | 11.30521826 | |
| P(T<=t) one-tail | 3.59894E-11 | |
| t Critical one-tail | 3.484964375 | |
| P(T<=t) two-tail | 7.19788E-11 | |
| t Critical two-tail | 3.767626804 | |

**Appendix V**

| Girls | | | | | Boys | | |
|---|---|---|---|---|---|---|---|
| Student | Post | Pre | Difference | Student | Post | Pre | Difference |
| 189 | 103 | 59 | 44 | 214 | 98 | 70 | 28 |
| 797 | 83 | 66 | 17 | 904 | 100 | 64 | 36 |
| 388 | 108 | 70 | 38 | 520 | 79 | 60 | 19 |
| 200 | 115 | 90 | 25 | 357 | 111 | 79 | 32 |
| 256 | 121 | 99 | 22 | 125 | 83 | 50 | 33 |
| 650 | 110 | 99 | 11 | 493 | 89 | 76 | 13 |
| 506 | 105 | 83 | 22 | 617 | 100 | 59 | 41 |
| 771 | 101 | 78 | 23 | 859 | 112 | 81 | 31 |
| 680 | 96 | 77 | 19 | 402 | 98 | 65 | 33 |
| 891 | 105 | 100 | 5 | 817 | 118 | 104 | 14 |
| 271 | 75 | 42 | 33 | 264 | 85 | 56 | 29 |
| | | | | 979 | 125 | 70 | 55 |
| | | | | 374 | 114 | 95 | 19 |

t-Test: Two-Sample Assuming Unequal Variances

| | *Variable 1* | *Variable 2* |
|---|---|---|
| Mean | 23.54545455 | 29.46154 |
| Variance | 128.8727273 | 132.7692 |
| Observations | 11 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 21 | |
| t Stat | -1.263361629 | |
| P(T<=t) one-tail | 0.110152855 | |
| t Critical one-tail | 1.720742903 | |
| P(T<=t) two-tail | 0.220305709 | |
| t Critical two-tail | 2.079613845 | |

**Appendix W**

| ELL | | | | NonELL | | |
|---|---|---|---|---|---|---|
| Post | Pre | Difference | | Post | Pre | Difference |
| 103 | 59 | 44 | | 83 | 66 | 17 |
| 98 | 70 | 28 | | 108 | 70 | 38 |
| 114 | 95 | 19 | | 115 | 90 | 25 |
| 79 | 60 | 19 | | 100 | 64 | 36 |
| 83 | 50 | 33 | | 121 | 99 | 22 |
| 96 | 77 | 19 | | 111 | 79 | 32 |
| 112 | 81 | 31 | | 110 | 99 | 11 |
| 98 | 65 | 33 | | 105 | 83 | 22 |
| 105 | 100 | 5 | | 101 | 78 | 23 |
| 118 | 104 | 14 | | 89 | 76 | 13 |
| 85 | 56 | 29 | | 100 | 59 | 41 |
| | | | | 125 | 70 | 55 |
| | | | | 75 | 42 | 33 |

t-Test: Two-Sample Assuming Unequal Variances

| | *Variable 1* | *Variable 2* |
|---|---|---|
| Mean | 24.90909091 | 28.30769 |
| Variance | 117.8909091 | 153.5641 |
| Observations | 11 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 22 | |
| t Stat | -0.716011243 | |
| P(T<=t) one-tail | 0.240758026 | |
| t Critical one-tail | 1.717144374 | |
| P(T<=t) two-tail | 0.481516051 | |
| t Critical two-tail | 2.073873068 | |

## Appendix X

| Regular Attendance | | | | Irregular attendance | | | |
|---|---|---|---|---|---|---|---|
| Student | Post | Pre | Difference | Student | Post | Pre | Difference |
| 189 | 103 | 59 | 44 | 797 | 83 | 66 | 17 |
| 214 | 98 | 70 | 28 | 388 | 108 | 70 | 38 |
| 200 | 115 | 90 | 25 | 520 | 79 | 60 | 19 |
| 904 | 100 | 64 | 36 | 650 | 110 | 99 | 11 |
| 256 | 121 | 99 | 22 | 271 | 75 | 42 | 33 |
| 357 | 111 | 79 | 32 | | | | |
| 650 | 110 | 99 | 11 | | | | |
| 506 | 105 | 83 | 22 | | | | |
| 125 | 83 | 50 | 33 | | | | |
| 771 | 101 | 78 | 23 | | | | |
| 493 | 89 | 76 | 13 | | | | |
| 680 | 96 | 77 | 19 | | | | |
| 617 | 100 | 59 | 41 | | | | |
| 859 | 112 | 81 | 31 | | | | |
| 402 | 98 | 65 | 33 | | | | |
| 891 | 105 | 100 | 5 | | | | |
| 817 | 118 | 104 | 14 | | | | |
| 264 | 85 | 56 | 29 | | | | |
| 979 | 125 | 70 | 55 | | | | |
| 374 | 114 | 95 | 19 | | | | |

t-Test: Two-Sample Assuming Unequal Variances

| | *Variable 1* | *Variable 2* |
|---|---|---|
| Mean | 26.75 | 23.6 |
| Variance | 145.7763158 | 129.8 |
| Observations | 20 | 5 |
| Hypothesized Mean Difference | 0 | |
| df | 6 | |
| t Stat | 0.546289009 | |
| P(T<=t) one-tail | 0.302285266 | |
| t Critical one-tail | 1.943180281 | |
| P(T<=t) two-tail | 0.604570532 | |
| t Critical two-tail | 2.446911851 | |

## Appendix Y1

| RESULT | CONCLUSION | IMPLICATION | RECOMMENDATIONS For Class | RECOMMENDATIONS For Future |
|---|---|---|---|---|
| One hundred percent of students' addition computational fluency scores increased significantly after mathematical instruction incorporating the *TouchMath* program was implemented. | One hundred percent of students computed addition better after the implementation of mathematical instruction incorporating the *TouchMath* program. | Mathematical instruction incorporating the *TouchMath* program may improve students' addition computational fluency. | Use mathematical instruction incorporating the *TouchMath* program with all students.<br><br>Use mathematical instruction incorporating the *TouchMath* program with lower grades. | Use mathematical instruction incorporating the *TouchMath* program with a lower grade.<br><br>Use mathematical instruction incorporating the *TouchMath* program with subtraction, multiplication, and division. |
| One hundred percent of the males' and females' addition computational fluency scores improved notably. However, males' scores increase 6 points more than females' scores. | Males' and females' addition computational fluency scores improved about the same after the implementation of mathematical instruction incorporating the *TouchMath* program. | Mathematical instruction incorporating the *TouchMath* program is equally effective for boys and girls when used to impact addition computational fluency. | Use mathematical instruction incorporating the *TouchMath* program with both boys and girls. | Use mathematical instruction incorporating the *TouchMath* program with both boys and girls in lower grades. |
| One hundred percent of students' scores, regardless of first language spoken, increased notably. However, non-ELL students' scores increase 3 points more than ELL students' scores. | ELL and non-ELL students' addition computational fluency scores improved about the same after the implementation of mathematical instruction incorporating the *TouchMath* program. | Mathematical instruction incorporating the *TouchMath* program is equally effective for ELL and non-ELL students when used to impact addition computational fluency. | Use mathematical instruction incorporating the *TouchMath* program with all students regardless of first language spoken. | Use mathematical instruction incorporating the *TouchMath* program with all students regardless of first language spoken in lower grades. |

## Appendix Y2

| | | | | |
|---|---|---|---|---|
| Daily scores fluctuated slightly as each addition skill was introduced, but increased notably from the beginning week to the ending week of the study. | Addition computational fluency scores increased as more mathematical instruction incorporating the *TouchMath* program was taught. | Mathematical instruction incorporating the *TouchMath* program may be cumulative and may impact total math skills. | Use in combination with subtraction, multiplication, and division. | Use a different daily and weekly assessment. |
| One hundred percent of students' scores, regardless of attendance, increased notably. However, students' scores who had regular attendance increased by 3 points more than students' with irregular attendance. | Irregular attendance did not impact the students' ability to achieve. | Mathematical instruction incorporating the *TouchMath* program is equally effective for student with regular and irregular attendance when used to impact addition computational fluency. | Implement the *TouchMath* program throughout the school year with addition, subtraction, multiplication, and division. | Reduce the number of weeks of the intervention. |
| Students transferred *TouchMath* knowledge to other mathematical instruction. | Transferred touchpoints to homework, Benchmark practice, and SuccessMaker. | Mathematical instruction incorporating the *TouchMath* program may improve other math skills. | Use in combination with subtraction, multiplication, and division. | Use in combination with subtraction, multiplication, and division. |
| Students' attitude towards math improved. | Students felt better about math after being taught a strategy that provides the correct answer every time. | Mathematical instruction incorporating the *TouchMath* program impacts addition computational fluency as well as attitude towards math. | Use in combination with other math instruction to increase math attitude. | Find the correlation between improved addition computational fluency and math attitude. |
| Before the study there were no scores in the advanced or proficient categories. After the study, there were zero scores in the advance category and 11 scores in the proficient category. | Mathematical instruction incorporating the *TouchMath* program improved students' scores who scored at below basic better than students who scored in the basic category. | Mathematical instruction incorporating the *TouchMath* program is more effective for below basic and basic students than for higher-achieving students. | Use with below basic or basic achievement students. | Research design be changed to allow a comparison of a similar class. |