

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

STRATEGY INSTRUCTION AND ITS EFFECTIVENESS IN PASSING
THE MATHEMATICAL PORTION OF THE CAHSEE

A project submitted in partial fulfillment of the requirements

For the degree of Master of Arts in Special Education

Mild/Moderate Disabilities

By

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DEDICATION

This project is dedicated to the one person who will always be by my side no matter what happens in life.

We will always be connected as– mother and daughter.

Zoe Emylee, my baby girl, I am so proud of you.

You are my pride and joy.

I love you so much. Each day that passes by and I see you blossom into a beautiful young lady; brings so much joy to my heart.

I know you will accomplish so much in this world.

Te quiero mucho hija mia.

INSPIRATIONAL QUOTE

“In mathematics the art of proposing a question must be held of higher value than solving it.”

- Georg Cantor

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ABSTRACT

STRATEGY INSTRUCTION AND ITS EFFECTIVENESS IN PASSING THE MATHEMATICAL PORTION OF THE CAHSEE

By

Betty Cruz

Master of Arts Degree in Special Education

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The purpose of this research was to gather information on the progress students can make by using the following strategy: 1) reading the problem, 2) underlining the question, 3) circling important information, 4) crossing out irrelevant information not needed, and 5) with important information solving the problem. Nine senior high school students were the subjects of this research. All nine students are in the Special Day Program. The steps of the strategy were introduced and mastered by the students over a 15 week period. Outcomes are inconclusive due to teacher furlough days, as well as the fact that the date for the California State Testing was changed, and post-test was not given.

Chapter 1

Introduction

Statement of Problem

It is important for students with learning disabilities (LD) to master specific strategies that can help them pass the California High School Exit Exam (CAHSEE, California Department of Education, 2011a). The mathematical strategy examined in this research was: 1) read the problem, 2) underline the question, 3) circle important information, 4) cross-out irrelevant information, and 5) solve/create an equation to find the solution. This research project examined these steps to determine if they would assist students in achieving a higher score on the mathematical portion of the CAHSEE.

Background

As a math Special Day Program teacher, the researcher noticed that many of her students did not read instructions. Also, some students did not understand terms used in the textbook; therefore, they did not get correct answers and were confused for the rest of the chapters in the book. When introduced to the strategy that is the subject of this research, the author planned to see if it would help with her students' progress.

Research Problem

Teachers seem less likely not to use these strategies because there is not enough time in the day to teach them, Math classes are run on a very strict pacing plan (LAUSD PreK-12). In addition, many teachers do not have time to sit with individual students to teach these strategies; therefore, students with LD in this study have not mastered any type of strategy to help them pass the CAHSEE.

The Purpose

The purpose of this research was to gather information on the progress students with LD can make by using the following strategies: 1) carefully reading the problem, 2) underlining the question, 3) circling important information, 4) crossing out irrelevant information that is not needed, and 5) with the important information, solving the problem. If students are taught and use this five-step strategy during the math portion of the CAHSEE, then they will understand the problem, be able to solve them, and will increase their scores with the ultimate goal of passing the CAHSEE.

Terms

Sum: the aggregate of two or more numbers, magnitudes, quantities, or particulars as determined by or as if by the mathematical process of addition: The sum of 6 and 8 is 14.

Difference: The result of subtracting two numbers or expressions. For example, the difference between 7 and 12 is $12 - 7$, which equals 5.

Estimate: to form an approximate judgment or opinion regarding the worth, amount, size, weight, etc., of; calculate approximately

Equivalent system of equations: Systems of equations that have the same solution set.

Parentheses: The symbols (and). Singular: parenthesis. Exponents: x in the expression ax . For example, 3 is the exponent in 2^3 .

Multiplication: A method for finding the probability that both of two events occur.

Division: the operation inverse to multiplication; the finding of a quantity, the quotient, that when multiplied by a given quantity, the divisor, gives another given quantity, the dividend; the process of ascertaining how many times one number or quantity is contained in another.

Addition: A method for finding the probability that either or both of two events occurs.

Subtraction: A way of modifying a set by removing the elements belonging to another set. Subtraction of sets is indicated by either of the symbols $-$ or \setminus . For example, A minus B can be written either $A - B$ or $A \setminus B$.

PEMDAS: An acronym for the order of operations in math-- Parenthesis, Exponents, Multiplication, Division, Addition, Subtraction

Expression: Numbers, symbols and operators (such as $+$ and \times) grouped together that show the value of something.

Value: The worth of something in terms of the amount of other things for which it can be exchanged or in terms of some medium of exchange.

Percentage: a rate or proportion per hundred; gain; benefit; profit; advantage. Symbol %.

Increase: To make greater, as in number, size, strength, or quality; augment; add to

Decrease: to diminish or lessen in extent, quantity, strength, power, subtract from

Interest: The process by which an amount of money increases over time. With interest, a fixed percentage of the money is added at regular time intervals.

Least common denominator: the smallest number that can be used for all denominators of 2 or more fractions.

Absolute value: Absolute value makes a negative number positive. Positive numbers and 0 are left unchanged. The absolute value of x is written $|x|$. We write $|-6| = 6$ and $|8| = 8$. Formally, the absolute value of a number is the distance between the number and the origin.

Median: In a set of numbers it is the value for which half the numbers are larger and half are smaller. If there are two middle numbers, the median is the arithmetic mean of the two middle numbers.

Mode: The number that occurs the most often in a list.

Mean: Another word for average.

Probability: the relative possibility that an event will occur, as expressed by the ratio of the number of actual occurrences to the total number of possible occurrences.

Graph: The picture obtained by plotting all the points of an equation

Data: individual facts, statistics, or items of information

Function: A relation for which each element of the domain corresponds to exactly one element of the range.

Slope: A number which is used to indicate the steepness of a line, as well as indicating whether the line is tilted uphill or downhill. Slope is indicated by the letter m.

Reciprocal: The reciprocal of x is $1/x$. In other words, a reciprocal is a fraction flipped upside down. Multiplicative inverse means the same thing as reciprocal.

Hypothesis and Research Question

If students are taught and use this five-step strategy during the math portion of the CAHSEE, they will understand the problems, be able to solve them correctly, and will increase their scores in order to pass the exam.

Specifically, the research question guiding this research is: Will the 5-step strategy of: 1) read the problem, 2) underline the question, 3) circle important information, 4) cross-out irrelevant information, and 5) solve the problem be effective for students with LD who have not passed the math portion of the CAHSEE?

Chapter 2 Literature Review

Data Regarding the CAHSEE

Many students and teachers do not fully comprehend the need for the CAHSEE's establishment. Many feel the CAHSEE is just another way for the state to waste money that can be used more appropriately for other resources. What many do not realize is that the CAHSEE (CDE, 2011b) was established for the purpose of demonstrating a student's grade-level competency in math and English.

The CAHSEE was first established in the Spring of 2001, and was given to ninth graders only the first year (CDE, 2011b). In October 2001, the California state legislature decided to eliminate having 9th grader take the exam; instead, it was decided to administer the CAHSEE to 10th graders statewide beginning in 2002 (CDE, 2011b).

Currently, the CAHSEE is administered only on certain dates throughout the school year selected by state superintendents. Students begin taking the CAHSEE for the first time in 10th grade. If students are not successful on their first attempt, they retake the test in the 11th and 12th grade. Students who are not successful in the 10th grade are given multiple opportunities to take and pass the exam. Students can retake the exam twice per school year in the 11th grade and up to five times during the 12th grade year (CDE, 2011b).

English-Language Arts

The CAHSEE consists of two parts: an English-language arts component and mathematics section. The questions correlate with the California Content Standards (CDE, 2011a) intended to be mastered during the eighth grade. The English-language arts section has a reading and a writing section. It consists of 79 questions and a writing task

in which the students are to respond to a specific topic. The standards addressed in this section are all through grade 10. This section covers vocabulary, informational reading and literary reading. The writing section covers writing strategies, applications and conventions and is usually a persuasive writing task (CDE, 2011a).

Mathematics

The mathematics section consists of 92 multiple-choice questions. The Algebra 1 content standards addressed are from grade 6 and 7. It also includes statistics, data analysis, probability, number sense, measurements and geometry, algebra and functions, and mathematical reasoning. Students must be able to solve problems with decimals, fractions, and percents.

Scoring and Passage Rates

A score of 350 on each section is considered a passing score. School districts receive the scores within 10 weeks of the administered exam. Students and parents receive the scores 10 weeks after the administered exam. Students do not need to pass both parts of the exam during the same test administration to satisfy the requirement. The student has until his or her senior year to pass the exam. If the student is having difficulty passing the exam, the school can provide additional support (CDE, 2011b).

CAHSEE passage rates have increased steadily over the last few years. According to Slater(2011), the 2010–2011 exam results showed increasing passage rates among most demographic subgroups of students by the end of their senior year. This is due to increased awareness of the need for passage, additional standards based instruction, recommended electives like CAHSEE preparatory math or English, and intensive tutoring. Some schools have begun administering diagnostic pre-tests to determine any

weaknesses in order to target instruction based on a particular student's needs (CDE, 2011c). In addition to student-based instruction, test-taking skills are also addressed to give each student a chance to become proficient. Nearly 95% of students from the Class of 2011 met the CAHSEE (Slater).

In 2005, WestEd conducted research and found that about 30% of students with specific learning disabilities who took the exam passed on their first attempt, compared to 74% of those students without disabilities. What does this mean for students who have an IEP and are protected by IDEA? This exam has become a major obstacle for students with special needs.

Special Education and the CAHSEE

The CAHSEE is a difficult exam for students with special needs to pass; therefore the school districts are pushing teachers to help this population of students pass the exam. This will force educators to narrow the curriculum by teaching to the test and neglecting additional standards not covered on the exit exam (CDE, 2011c).

As stated by Warren and Grodsky (2009), a generation ago, students earned their high school diplomas by attending classes, completing the required assignments, and earning passing grades, staying out of trouble. Since the late 1970s, a growing number of states have made it a requirement for students to pass an exit exam. These exams have become a major challenge for many students. The national experiment of requiring passage of an exit exam has not produced the desired results. These exit exams have actually reduced high school graduation rates (Warren & Grodsky). In states with minimum competency exit exams, the graduation rate declined 1%; for states with higher competency exit exams, the graduation rate declined 2%. This means that every

percentage point that goes down is equivalent to 35,000 students not graduating from high school (Warren, Jenkins, & Kulick, 2006). Therefore, many educators, parents, and critics argue these exams are unfair to students who have not had sufficient opportunities to master the tested content due to a disability or limited English proficiency. These exit exams are not working, and it is time to try something new to allow students with special needs the opportunity to pass exit exams. Social promotion is a root problem, and a system of elementary and middle school exit exams are needed in order to ensure high schools are not burdened with students who have not been adequately prepared to pass a test as they have never been held accountable to pass any test.

Jacobson (2005) stated that on August 25, 2005, an agreement was made between the state and legal-advocacy center for people with disabilities allowing students with an Individualized Education Program (IEP) who have met all graduation requirements to graduate from high school without passing an exit exam. In order for students to receive this waiver, they must have taken the exam at least twice since their sophomore year, taken it at least once during their senior year, and taken courses to help them succeed on the two parts of the exam. This agreement was only granted for one year. So, what has happened to students in subsequent years?

In the 2009-2010 school year, California Education Code Section 60852.3 provided an exemption that all students who: 1) meet graduation requirements for receiving a high school diploma, 2) have an IEP, and 3) are not able to pass the CAHSEE are still required to attempt it every time it is administered. This waiver helps students with special needs to stay in school and work toward earning a diploma, not a certificate of completion. Many students do not get discouraged and continue to

attempt to take and pass the CAHSEE. As of 2012, this waiver is still in place. It is up to the State Board of Education to change this policy.

Students with special needs are fortunate to have this waiver; however, teachers are still being pressured to teach students “test-taking strategies” to help them pass the exam. There are so many test-taking strategies that educators are not able to determine which ones will help meet all students’ needs.

Test Taking Skills

It is important for teachers to understand a student’s learning style. If a teacher does not understand the student’s needs, it will be difficult to effectively teach that student. It is important for the teacher to understand what will and will not work with his or her students. When teaching students test taking strategies, it is vital that the student also practice the strategies until he or she comprehends the importance of the techniques. It can be difficult to teach special education students new skills, but it is not impossible. These techniques can help students if they are motivated to learn and use them wisely during both parts of the CAHSEE (Maccini & Gagnon).

According to Gersten and Clarke (2007), the six most effective strategies for teaching students with difficulties in mathematics are: 1) visual and graphic depictions of problems, 2) systematic and explicit instruction, 3) student think-aloud, 4) use of structured peer-assisted learning activities involving heterogeneous ability groupings, 5) formative assessment data provided to teachers, and 6) formative assessment data provided directly to students. Gersten and Clarke’s research focused on evidence-based practices for teaching students with disabilities in mathematics. Results indicated these approaches are moderately effective for special education students. Think-alouds can be

an advantage for students with special needs because they encourage them to think out loud while they work. It is also beneficial for student to share their thinking with their peers (Gersten & Clarke). If students master these skills then they will be able to increase their test scores.

According to Chard (2011), it is important for students to have a wide range of background knowledge/experience in order to understand more complex mathematical problems. Students who lack this knowledge/experience will benefit from instruction that includes pre-teaching in order to ensure they will be successful with new content material. Differentiated instruction and scaffolding is needed to help students acquire background knowledge (Chard).

Montague (2008) states that in order to improve mathematical problem solving for students with LD, the focus should be on self-regulation. Self-regulation is the ability to regulate one's cognitive activities with the processes and functions associated with metacognition. Metacognition is the knowledge and awareness of one's cognitive strengths and weaknesses (Montague). Self-regulation strategies include self-instruction, self-questioning, self-monitoring, and self-reinforcement. These strategies help the student gain access to cognitive processes that facilitate learning. Some interventions used during direct instruction include: drills and probes, repeated feedback, rapidly paced instructions, individualized instructions, breaking the tasks into sequence of steps, the use of diagrams, small group instruction, and direct questioning by the teacher. Montague's research indicates that in order for students to be successful, time on tasks is needed in order for them to master the given skills. Having sufficient time is crucial for students with LD because mastery does not happen for students with special needs due to their

specific disability and the impact that it may have on their achievement without sufficient time for them to master the given skill set.

Chapter 3

The 5-Strategy Process

The researcher has noticed that students with special needs have a difficult time solving math problems on state exams. From her experience of administering the California High School Exit Exam (CAHSEE) math portion, she has witness her students just bubbling in any answer when it came to word problems and/or other problems that the students find to be difficult. Seeing her students struggle made her realize that students are lacking test taking skills. Therefore, the researcher decided that she would teach her 6th period math class ‘5-strategies’ that can help them during state exams. The 5-step strategy is: 1) to read the problem, 2) underline the question, 3) circle important information, 4) cross-out irrelevant information, and 5) solve the problem. In order to determine her student’s current level of abilities, a pretest was administered to estimate the students’ knowledge base and level of comfort with word problems.

Step 1: Read the Problem

The first strategy is to read the problem. This is the most important step because without reading the problem, the student will not be able to solve it with any accuracy. They should read the problem at least twice to fully understand it and the vocabulary terms used. Ability and patience to re-read the problems are crucial to their comprehension. The researcher is a firm believer in repetition, repetition, and repetition!

Step 2: Underline the Question

The second step of the strategy is to underline the question. This helps the student understand the information that is crucial in order to solve the problem.

Step 3: Circle Important Information

After underlining the question, the student must circle important information. This information will generally consist of items such as numbers, equations, rate, time, and monitor/units.

Step 4: Cross-out Irrelevant Information

Irrelevant information could be words, names of places, and/or dates. Misleading and/or extraneous words should be crossed out. This will depend on what is being asked to be solved in the equation.

Step 5: Solve the Problem

Once the student has gone through all the steps, he or she should be able to find an answer to the problem. By underlining the question, the student will know what information is needed to solve the problem. It is crucial that the student follow each step in strategy order, adhere to PEMDAS rules, and follow specific statements like “less than” or “increasing.”

An Example

In a recent election 1,394 people voted for Paul, 942 voted for Paige and 847 voted for Ramona. How many more votes did Paige receive than Ramona?

Step 1: Read the problem.

First the problem was read aloud, and then quietly themselves. It has been observed by the researcher that many students with special need are tactile learners, and the ability to formulate the words in their mouths significantly improves their ability to comprehend the task at hand.

Step 2: Underline the question.

In a recent election 1,394 people voted for Paul, 942 voted for Paige and 847 voted for Ramona. How many more votes did Paige receive than Ramona?

Step 3: Circle important information.

In a recent election 1,394 people voted for Paul, 942 voted for Paige and 847 voted for Ramona. How many more votes did Paige receive than Ramona?

Step 4: Cross-out irrelevant information

~~In a recent election~~ 1,394 people voted for Paul, 942 voted for Paige and 847 voted for Ramona. How many more votes did Paige receive than Ramona?

Step 5: Solve the problem

~~In a recent election~~ 1,394 people voted for Paul, 942 voted for Paige and 847 voted for Ramona. How many more votes did Paige receive than Ramona?

(See Appendix A for student work sample).

This five-step –strategy is going to help the students solve math problems they thought they could not solve. These simple steps, if followed in order, will help students increase their test scores, their ability to comprehend, and their sense of self-worth.

Chapter 4

Evaluation

The test group consisted of two girls and three boys. All five students are seniors who have not yet passed the CAHSEE. They are all in the Special Day Program at Chatsworth High School. Each student has his or her specific needs. The students were taught using the Elmo and video projector. Incorporating technology into the lesson is an excellent way for students to see the document and listen to what is being taught by the teacher.

A survey was administered prior to the instructional component to determine the students feeling and attitudes about testing (See Appendix B for questionnaire).

After the questionnaire was completed a pre-test was administered which consisted of 30 released CAHSEE test questions (See Appendix C for sample questions). The purpose for pre-testing students was to determine if they used any type of test taking strategy already. Any and all testing materials including scratch paper were collected and analyzed to determine how much work was done verses how much guessing was done. The students were asked before the exam to take the test as if it were the actual CAHSEE.

The findings were that many of the students simply circled any answer without actually working out the problems due in large part to the tests multiple-choice format.

After the test, the students were asked how they arrived at their answer and many of them said “I guessed on many of them” and “we don’t need to pass it anyways.” The students were aware of the waiver for special education which has been in place since the inception of the CAHSEE, so the pervasive sentiment was that the test only needed to be attempted and not passed, therefore, there was little to no effort made to

actually take the test.

After the pre-test was evaluated and the student's feelings toward exams were determined, it was evident that the students were not able or willing to attempt word problems in mathematics. A multi-step strategy was necessary to give students the ability to evaluate, compute, and solve word problems. Each step needed to be carefully taught, modeled, and reinforced over the next several weeks. The most difficult steps for the students were 1 and 3. Many students with specific learning disabilities tend to skip problems involving reading as a general rule, deciding that the task is too difficult and therefore not worth their time, effort, or expense of energy.

Getting the students to read the problems was a difficult task in and of itself. When the students saw the number of words in the problem, they tended to believe it was impossible for them to solve. The students were informed of the importance of taking the time to read each problem word for word. The girls took the time to read each problem carefully in the test group, but the boys just skimmed them. When this tendency became evident, the class was stopped and each problem was read aloud, and then the students were broken up into peer group and were asked to read the questions to their peer partners. This technique of working with a peer partner was very successful and it was evident that the students read the problems more carefully (See Appendix D for CAHSEE released questions).

The second most difficult step for the student to comprehend was step 3: circling important information. During the initial introduction of step 3 it became evident later that the students had a lower level of comprehension that was earlier believed. After checking the handout it became evident that the students did not understand how to circle

important information. The students were not able to differentiate between useful and extraneous information. It was necessary to add another week to the third step in order to fully explain useful versus extraneous information. The Elmo and screen projector were used to demonstrate the step which enable the students to see, hear, and comprehend the appropriate steps needed to solve a word problem (See Appendix E for handout, See Appendix F to see a student's mistake, and Appendix G for a student work sample after re-teaching step 3).

Limitations

The most difficult thing about this whole process was that as soon as the students mastered a given strategy, new students were enrolled in the class making it necessary to take time away from new teaching to bring the new students up to speed. In total four new students were enrolled during the weeks the class was learning to solve word problems. The class grew from five to nine students. It was necessary to review and re-teach various parts of the process in order to have all students at the same skill level and ability. This added about one week per step.

Another limitation was that there was not sufficient time to administer a post test due to teacher furlough days and California State testing (CST's) which had been moved up three weeks from the original calendared school year. At this time it is impossible to determine students; willingness to use this strategy in the future. It is the hope of this educator that the students in the test group will take this strategy with them and use them the next time they take the CAHSEE.

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Appendix A.

Student work sample.



5-step Strategy

- 1) Read the problem
- 2) Underline the question.
- 3) circle important info.
- 4) cross out unimportant info.
- 5) solve.

Ex:

~~In a recent election 1,394 people~~
~~voted for Paul, 942 voted for Paige~~
~~and 847 voted for Ramona. How many~~
~~more votes did Paige receive~~
~~than Ramona?~~

$$\begin{array}{r} 942 \\ - 847 \\ \hline 95 \end{array}$$

95 more votes

Appendix B.

Sample of student questionnaire.

Name (Optional) _____

Date _____

Math Strategies Questionnaire

1. On a scale of 1-10, 1 being the lowest and 10 being the highest, how would you as a student rate your own math skills? Explain your answer.

2. What are some math skills that you as a student feel you are lacking? _____

3. What math class are you in (example: Algebra 1, Geometry, Algebra 2)? Do you know what your current grade is in your math class?

4. Do you like or dislike your current math class? Explain your answer.

Appendix C.

CAHSEE Released Questions.

California High School Exit Examination

Number Sense

7. If Freya makes 4 of her 5 free throws in a basketball game, what is her free throw shooting percentage?

- A 20%
- B 40%
- C 80%
- D 90%

M00223

8. Some students attend school 180 of the 365 days in a year. About what part of the year do they attend school?

- A 18%
- B 50%
- C 75%
- D 180%

M00047

9. What is the fractional equivalent of 60%?

- A $\frac{1}{6}$
- B $\frac{3}{6}$
- C $\frac{3}{5}$
- D $\frac{2}{3}$

M02152

10. The cost of an afternoon movie ticket last year was \$4.00. This year an afternoon movie ticket costs \$5.00. What is the percent increase of the ticket from last year to this year?

- A 10%
- B 20%
- C 25%
- D 40%

M02158

11. The price of a calculator has decreased from \$12.00 to \$9.00. What is the percent of decrease?

- A 3%
- B 25%
- C 33%
- D 75%

M02868

12. Sally puts \$200.00 in a bank account. Each year the account earns 8% simple interest. How much interest will be earned in three years?

- A \$16.00
- B \$24.00
- C \$48.00
- D \$160.00

M02119

Appendix D.

Pre-test answered by a student.

California High School Exit Examination

Number Sense

7. If Freya makes 4 of her 5 free throws in a basketball game, what is her free throw shooting percentage?

A 20%
B 40%
 C 80%
D 90%

M00223

8. Some students attend school 180 of the 365 days in a year. About what part of the year do they attend school?

A 18%
 B 50%
C 75%
D 180%

M00047

9. What is the fractional equivalent of 60%?

A $\frac{1}{6}$
B $\frac{3}{6}$
 C $\frac{3}{5}$
D $\frac{2}{3}$

M02152

10. The cost of an afternoon movie ticket last year was \$4.00. This year an afternoon movie ticket costs \$5.00. What is the percent increase of the ticket from last year to this year?

A 10%
B 20%
C 25%
D 40%

M02158

11. The price of a calculator has decreased from \$12.00 to \$9.00. What is the percent of decrease?

A 3%
 B 25%
C 33%
D 75%

M02868

12. Sally puts \$200.00 in a bank account. Each year the account earns 8% simple interest. How much interest will be earned in three years?

A \$16.00
B \$24.00
C \$48.00
 D \$160.00

M02119

No work shown on how the student got the answers.

Appendix E.

Sample of the handout used with students.

Kuta Software - Infinite Pre-Algebra

Name _____

Two-Step Equation Word Problems

Date _____ Period__

- 1) 331 students went on a field trip. Six buses were filled and 7 students traveled in cars. How many students were in each bus?
- 2) Aliyah had \$24 to spend on seven pencils. After buying them she had \$10. How much did each pencil cost?
- 3) The sum of three consecutive numbers is 72. What are the smallest of these numbers?
- 4) The sum of three consecutive even numbers is 48. What are the smallest of these numbers?
- 5) You bought a magazine for \$5 and four erasers. You spent a total of \$25. How much did each eraser cost?
- 6) Maria bought seven boxes. A week later half of all her boxes were destroyed in a fire. There are now only 22 boxes left. With how many did she start?
- 7) Sumalee won 40 super bouncy balls playing horseshoes at her school's game night. Later, she gave two to each of her friends. She only has 8 remaining. How many friends does she have?
- 8) Imani spent half of her weekly allowance playing mini-golf. To earn more money her parents let her wash the car for \$4. What is her weekly allowance if she ended with \$12?

Appendix F.

Sample of student errors.

Kuta Software - Infinite Pre-Algebra

Two-Step Equation Word Problems

Name _____

Period 6

1) 331 students went on a field trip. Six buses were filled and 7 students traveled in cars. How many students were in each bus?

2) Aliyah had \$24 to spend on seven pencils. After buying them she had \$10. How much did each pencil cost?

3) The sum of three consecutive numbers is 72. What are the smallest of these numbers?

4) The sum of three consecutive even numbers is 48. What are the smallest of these numbers?

5) You bought a magazine for \$5 and four erasers. You spent a total of \$25. How much did each eraser cost?

6) Maria bought seven boxes. A week later half of all her boxes were destroyed in a fire. There are now only 22 boxes left. With how many did she start?

7) Sumalee won 40 super bouncy balls playing horseshoes at her school's game night. Later, she gave two to each of her friends. She only has 8 remaining. How many friends does she have?

8) Imani spent half of her weekly allowance playing mini-golf. To earn more money her parents let her wash the car for \$4. What is her weekly allowance if she ended with \$12?

The student circled the whole problem.

Appendix G.

Student work sample.

Kuta Software - Infinite Pre-Algebra

Two-Step Equation Word Problems

- 1) 331 students went on a field trip. Six buses were filled and 7 students traveled in cars. How many students were in each bus?

$$\begin{array}{r} 331 \\ - 7 \\ \hline 324 \end{array} \quad \begin{array}{r} 324 \\ \div 6 = 54 \end{array}$$

54

- 3) The sum of three consecutive numbers is 72. What are the smallest of these numbers?

- 5) You bought a magazine for \$5 and four erasers. You spent a total of \$25. How much did each eraser cost?

$$\begin{array}{r} 25 \\ - 5 \\ \hline 20 \end{array} \quad \begin{array}{r} 20 \\ \div 4 = 5 \end{array}$$

5

- 7) Sumalee won 40 super bouncy balls playing horseshoes at her school's game night. Later, she gave two to each of her friends. She only has 8 remaining. How many friends does she have?

$$\begin{array}{r} 40 \\ - 8 \\ \hline 32 \end{array} \quad \begin{array}{r} 32 \\ \div 2 = 16 \end{array}$$

16 friends

- 2) Aliyah had \$24 to spend on seven pencils. After buying them she had \$10. How much did each pencil cost?

$$\begin{array}{r} 24 \\ - 10 \\ \hline 14 \end{array} \quad \begin{array}{r} 14 \\ \div 7 = 2 \end{array}$$

2

- 4) The sum of three consecutive even numbers is 48. What are the smallest of these numbers?

- 6) Maria bought seven boxes. A week later half of all her boxes were destroyed in a fire. There are now only 22 boxes left. With how many did she start?

$$\begin{array}{r} 22 \\ \div 2 = 11 \\ \hline 11 \end{array} \quad \begin{array}{r} 11 \\ \times 2 = 22 \end{array}$$

30 boxes

- 8) Imani spent half of her weekly allowance playing mini-golf. To earn more money her parents let her wash the car for \$4. What is her weekly allowance if she ended with \$12?

$$\begin{array}{r} 12 \\ - 4 \\ \hline 8 \end{array}$$

\$8 per week