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Teaching Story Problems to First-Grade Students Utilizing a Variety of Differentiated Instructional Strategies and Assessment Methods

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Abstract

This capstone project reports the differentiated instructional strategies implemented throughout a math unit in a first-grade classroom. The capstone will report the effectiveness of two instructional strategies and two assessment methods that were integrated into a math unit that focused on students' understanding of story problems with a missing addend or subtrahend. The math unit had 13 lessons taught over four weeks between the pre- and post-assessment. Based on student data, students' understanding and performance increased throughout this unit by using a variety of differentiated instructional strategies and assessment methods. In this capstone, I will report what the instructional strategies and assessment methods consisted of and the effect they had on student learning. I collected and analyzed the pre- and post-assessment data and found that nonlinguistic representations, providing feedback, exit tickets, and questioning are effective instructional strategies and assessment methods for increasing student learning.

Keywords: instructional strategies, assessment methods, nonlinguistic representations, providing feedback, exit tickets, questioning

Background

For my clinical practice placement, I was placed at Carriage Hill Elementary in a first-grade classroom in Nebraska's Papillion-La Vista Community Schools District. Carriage Hill Elementary is composed of 392 students and 31 teachers. The student-to-teacher ratio is 13:1. The first-grade class I was placed in was composed of 19 students. Carriage Hill Elementary is a Title I school, as 8% of students are eligible for Free and Reduced Lunch through the National School Lunch Program. Of the 392 students, 4% are English Language Learners (ELL). My capstone project was supervised by my cooperating teacher who has been teaching for 24 years.

In collaboration with my cooperating teacher, it was determined I would plan, implement, and assess a math unit for the students in the class.

Introduction

The goal of this project was for students to successfully solve math story problems with a missing addend or subtrahend. I created three objectives to guide my instruction for my capstone project. First, students will be able to successfully solve a math story problem with a missing addend. Second, students will be able to successfully solve a math story problem with a missing subtrahend. Third, students will be able to successfully solve math story problems with a missing addend or subtrahend when given a combination of problem types.

The guiding question of my capstone project was, *"How do differentiated instructional strategies (i.e., nonlinguistic representations and providing feedback) and assessment methods (i.e., exit tickets and questioning) affect student performance when solving math story problems with a missing addend or subtrahend?"* For this project, students completed a pre-test prior to instruction. At the end of the unit, students completed a post-test that mirrored the pre-test to assess their knowledge of solving story problems with a missing addend or subtrahend. The pre- and post-tests were composed of seven questions. While teaching the unit, I implemented two differentiated instructional strategies and assessment methods to determine if they would have a positive effect on student learning. The instructional strategies I implemented included nonlinguistic representations and providing feedback, and the assessment methods I implemented were exit tickets and questioning.

Understanding of Instruction Methods

Nonlinguistic Representations through the Concrete-Pictorial-Abstract (CPA) Strategy

Effective teachers use research-based instructional strategies to best teach students. One instructional strategy that was implemented in this unit was nonlinguistic representations. Nonlinguistic representations require students to represent their understanding of a concept in a way that does not rely solely on language (i.e., diagrams, pictures, models, manipulatives, movement, mental images, etc.). Kelly (2020) identified "a need for educators to take the lead on guiding students into creating these images and graphics to support knowledge retention" (p. 1) as "students require a balance of linguistic and nonlinguistic learning experiences in order for knowledge to stay in their long-term memory and to provide more accurate recall" (p. 1). When using nonlinguistic representations in math, the goal is for students to be able to connect the nonlinguistic representation to an equation representing the operation. By using manipulatives, students will be able to *see* what is happening. By connecting these physical representations with abstract equations, students can later visualize what is happening within the math equation when working independently. With manipulatives and other strategies (i.e., drawing a math picture, using a ten frame, etc.), students gain a greater understanding of mathematical concepts.

For children, math is an abstract concept. When combining nonlinguistic representations with the concrete-pictorial-abstract (CPA) strategy, students can manipulate objects in the concrete stage, create images in the pictorial stage, and transfer learning from the previous stages to writing in the abstract stage. Nonlinguistic representations are the foundation of the concrete and pictorial stages of the CPA strategy. According to Purwadi et al. (2019), it is recommended that teachers use the CPA strategy to teach math to young students, as the strategy has positive effects on students' mathematical conceptual understanding and mathematical representation.

Because the first two stages of the CPA strategy rely heavily on nonlinguistic representations, they pair well together to ensure that students are transferring their

understanding to the abstract. Liggett (2017) stated that "The goals of any math instruction should be to focus on helping students understand concepts. The use of manipulatives allows students to see mathematics as integration by relating procedures used in one question to procedures used in an equivalent question" (p. 88). In the concrete stage, students use manipulatives (i.e., a nonlinguistic representation) to see how a math problem is solved. This stage helps students understand a mathematical concept. In the pictorial stage, students draw a picture of manipulatives to help them in the problem-solving process. This stage allows students to begin transferring their understanding of the nonlinguistic representation into a slightly more abstract form. In the abstract stage, students connect what they know from the previous stages to create or solve an equation. This stage allows students to combine their understanding from the previous two stages in an abstract way. By using nonlinguistic representations in combination with the CPA strategy to teach mathematics, students understand abstract concepts rather than remotely using a formula to find an answer, resulting in a deeper understanding that is more likely to be stored in long-term memory.

Providing Feedback

The second instructional strategy I implemented throughout this unit was providing feedback. Feedback is vital throughout the learning process to foster independent students. Independent, or autonomous, learners should take the initiative, act independently, or take a critical stance (Hargreaves, 2013, p. 230). Teachers are constantly trying to develop autonomous learners in the classroom. However, feedback from teachers often communicates approval or disapproval of student work, which is vague and ineffective in the pursuit of autonomy (Dessie & Sewagegn, 2019). Dessie and Sewagegn (2019) stated that "effective feedback initiates thinking, helps learners to know how to improve their learning, allows learners to see the quality

of their work against that of a teacher or peer, and empowers learners to become self-regulated learners" (p. 52). This project focused heavily on providing students with valuable, specific feedback so students could close the gap in their learning (Dessie and Sewagegn, 2019).

A study conducted by Hargreaves (2013) looked at feedback from the student perspective. According to the children studied in Hargreaves' (2013) research, they "noticed that negative and positive feedback provoked emotions which could interfere with or support learning" (p. 236). Therefore, the feedback teachers provide affects students' learning either positively or negatively. The children also described some of the feedback that promoted their autonomy, specifically provocative questioning, demonstration of a strategy, and explanations of why their work was good or poor (Hargreaves, 2013, p. 242). These forms of feedback are all specific enough so students can apply suggestions to their future work while becoming autonomous learners. Fostering autonomous learners is a foundational goal in education; providing learners with specific, valuable feedback can guide them to become autonomous in their learning.

Understanding of Assessment Methods

Exit Tickets

Assessments are given to students throughout a unit so teachers can assess students' understanding and adjust instruction as needed. Effective teachers use research-based assessment methods to evaluate students' performance. According to Akhtar and Saeed (2020), "We are told that students need to learn how to become problem solvers by investigating, formulating, reflecting, listening, exploring, justifying, clarifying, modeling, and applying. Not only through instruction can education assist students in attaining these goals, but proper use of assessment (p.

82). One assessment method that was implemented in this unit was exit tickets. Fowler and Richards (2019) stated that:

> Exit tickets are short response tasks that teachers administer to students after an activity (such as a laboratory experiment) or class period. They present opportunities for teachers to elicit students' thinking without affecting their grade, provide individualized feedback, and identify learning needs or modifications to an instructional plan (p. 19).

Exit tickets are intended to be short, so the time taken to administer and assess them is not extensive.

Not only are exit tickets short in nature, but they can also be used in any subject. Exit tickets can be used to assess understanding, identify background knowledge, record strategies, and gain insight on the dynamics of small groups (Fowler & Richards, 2019, p. 19). These are a few of the ways that exit tickets can be used in the classroom. Akhtar and Saeed (2020) stated that "Exit slips have different purposes with students of different age groups and its use vary from teacher to teacher and subject to subject" (p. 84). Because exit tickets are versatile, they can be adapted to fit the needs of any student in any subject.

Exit tickets can also give students who are less likely to share a chance to share their thinking or understanding of a topic (Fowler & Richards, 2019, p. 20). By having all students share through an exit ticket, teachers can create a classroom that fosters inclusivity and autonomy in students' learning. Fowler and Richards (2019) conducted a mini-study about the effects of exit tickets in the classroom to help engage teachers in best practices. The results of the mini-study concluded that exit tickets provide valuable information to teachers regarding their instruction, and they can provide a way to engage students who are less likely to speak up in the classroom (Fowler & Richards, 2019, p. 26). Exit tickets allow teachers to quickly assess all

students' learning in any subject. Teachers should use the data collected from exit tickets to provide immediate feedback, diagnose areas of improvement, and guide planning and presentation content (Akhtar and Saeed, 2020, p. 84).

Questioning

A second assessment method implemented in this unit was questioning. Questions are an integral part of education. "A question is broadly defined as any sentence having either an interrogative form or an interrogative function" (Buchanan Hill, 2016, p. 660). Questions induce thinking. There are many types of questions (i.e., closed questions, open questions, and questions to promote higher-order thinking). All types of questions should be asked in the classroom to induce various levels of thinking. Aziza (2018) stated that "Closed questions make students answer either correctly because those questions have an exact answer," whereas open-ended questions check the correctness of an answer while also focusing on developing students' communication, mathematical ideas, reasoning, and problem-solving skills (p. 478). Higher-order thinking questions encourage students to analyze, evaluate, and synthesize. These kinds of questions should be carefully planned by the teacher to be effective (Buchanan Hill, 2016, p. 668). Teachers should be intentional about the kinds of questions they are asking based on the learning objectives of the lesson.

How teachers ask and use questions in the classroom can affect student learning. According to Buchanan Hill (2016), there are a few variables to be considered when looking at questioning, including classroom climate (i.e., teacher responses, peer responses, etc.), the amount of wait time given after a question is asked, and feedback from the teacher after giving a response (pp. 665-667). Aziza (2018) identified different techniques when asking questions as well, including posing both oral and written questions, allowing students to respond orally or

through written responses, allowing adequate wait time, spontaneously developing additional questions based on students' answers, and posing questions to the class, small groups, and individual students (p. 477). Questioning is a complex process with many variables. Teachers need to be intentional about the questions they ask and how they ask them, while also creating a classroom climate that supports questioning as a form of assessment.

The questions that teachers ask in the classroom can be used to assess students' understanding and adjust instruction, whether immediately or in later lessons. Asking purposeful questions can help teachers assess students' understanding. Developing additional questions based on students' answers can help teachers clarify students' misconceptions. Based on the research, teachers need to deliberately plan purposeful questions to assess students.

Participants

The participants for this study were 19 first-grade students at Carriage Hill Elementary. The class was composed of eight girls and eleven boys. 11% qualify for English Language Learning (ELL) services. Of these 19 students, 21% qualify for special education services and have an Individualized Education Plan (IEP). The four students had an Individualized Education Plan in the following categories: Student 2: math, reading, writing, and speech and language, Student 11: speech and language, Student 13: math, reading, and writing, and Student: 15: math, reading, and writing. Student 4 was in the evaluation process to determine if they would qualify for special education services. Of the 19 students, one student has an Intermediate Intervention Plan (IIP) for math. These interventions were implemented after evaluating the student's winter Northwest Evaluation Association (NWEA) measure of academic progress (MAP) scores.

Methods and Materials

This math unit connected to three Nebraska state standards for first-grade students.

- 1.N.5.c Determine the unknown whole number in an addition or subtraction equation (e.g., 7 +? = 13).
- 1.N.5.f Solve authentic problems involving addition and subtraction. Within 20 in situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem by using objects, drawings, and/or equations with a symbol for the unknown number to represent the problem.
- 1.N.5.g Create an authentic problem to represent a given equation involving addition and subtraction within 20 (NE Department of Education, 2022, pp. 16-17).

Based on these standards and the assessments I would be using, I created two primary objectives for students to meet throughout the unit. The first objective was students would independently identify the meaning of addition and subtraction. The second objective was students would independently solve addition and subtraction story problems with a missing addend or subtrahend. This unit's content was divided into three sections: solving story problems with a missing addend, with a missing subtrahend, and a combination of story problems with a missing addend or subtrahend.

The Papillion-La Vista Community Schools District assesses students based on levels of proficiency. The levels are Level 1: Beginning, Level 2: Progressing, Level 3: Proficient, and Level 4: Advanced. For this project, I assessed students using the same scale. The target was for students to perform at Level 3 (Proficient) by the end of the unit. This unit was taught over 15 days (about three school weeks). A seven-question pre-test (Appendix A) was administered on the first day. The pre-test directly mirrored the post-assessment students took at the end of the unit. I encouraged students to try their best even if they were unsure how to solve a problem, so I could gain an accurate understanding of their background knowledge. I read each test question

aloud to students as they completed the pre-test. Other than this, students completed the assessment independently. After examining each student's pre-test, I used the data to plan instruction to meet the needs of students.

Using the pre-test data, I decided that my students would benefit from a variety of instruction. Because of this, I chose to teach each section of this unit in the same way, with each section allowing four days of instruction. The first day of instruction was provided in a whole-group setting following the gradual release of instruction. The second and third days of instruction were provided in a small-group setting following a math workshop model. Following analysis of the pre-test data, I noted that students were at a variety of levels. I used the data to create four groups based on ability. The fourth day of instruction was taught in the whole-group setting to review and assess the skill.

On the first day of instruction, I followed the gradual release of instruction to teach the whole class. I taught the skill by explicitly modeling and thinking aloud. Students then engaged in solving a problem with me. Next, the students solved a problem with a partner. Finally, students solved problems independently.

On the second and third days of instruction, I implemented a math workshop model. The math workshop model was composed of four stations. The first station was math with the teacher. At this station, I provided direct instruction to students. The second station students stayed at their seats. At this station, students completed story problems independently. The third station was technology. At this station, students reviewed supporting skills needed for this unit on Splash Learn (i.e., a game-based learning app) and Xtra Math. On Splash Learn, students solved addition and subtraction problems with a missing addend or subtrahend. On Xtra Math, students worked on addition and subtraction fact-fluency. The fourth station was hands-on. At

this station, students engaged in a hands-on activity with my cooperating teacher to support the content of this unit.

On the fourth day of instruction, I reviewed content with students and administered an assessment. These assessments were used to track students' progress. Assessments were also used to adjust instruction based on the needs of students.

Throughout this unit, I implemented two research-based instructional strategies to identify if these strategies would have a positive effect on student learning and achievement. The first instructional strategy I implemented in this unit was nonlinguistic representations through the concrete-pictorial-abstract (CPA) strategy. Nonlinguistic representations supported the content of this unit. Students used a nonlinguistic representation (i.e., a call and response paired with movement) to identify the meaning of addition and subtraction. Students also used nonlinguistic representations (e.g., manipulatives, ten frames, drawing a math picture) to solve story problems with a missing addend or subtrahend. I taught students this skill using the CPA strategy. All students were taught by using manipulatives in the concrete stage (Appendix B), drawing math pictures in the pictorial stage, and writing equations in the abstract stage.

The second instructional strategy I implemented in this unit was providing feedback. Students were given specific feedback in a variety of forms frequently throughout this unit. On written assignments, I provided written feedback to improve student performance. This feedback communicated approval or disapproval of student work (e.g., marking correct and incorrect answers) and provided specific feedback regarding incorrect responses (e.g., *your answers need labels, check your math picture*) (Appendix C). Before taking the post-test, I conferenced with students individually about the final formative assessment. I provided students with specific praise for problems students answered correctly (e.g., "You knew that this problem was an

addition problem because it was putting two numbers together—good job!"), and I modeled how to solve problems that students answered incorrectly.

Throughout this unit, I also implemented two research-based assessment methods to identify if these methods would have a positive effect on student learning and achievement. The first assessment method I implemented in this unit was exit tickets. I administered at least one exit ticket to assess each kind of story problem I taught throughout the unit. For example, students completed a four-question exit ticket that had them solve four story problems with missing subtrahends (Appendix D).

The second assessment method I implemented in this unit was questioning. Throughout this unit, I used a variety of questions to assess my students' understanding. I asked both open- and close-ended questions (e.g., How did you solve the problem? What is your answer?). I also spontaneously asked questions based on my students' responses (e.g., How did you know you needed to add?) to explain their thinking or to address misconceptions. Questions were asked in all settings, including whole-group, small-group, and individually, to monitor student learning.

Before taking the post-test, students reviewed the content that would be assessed. On the last day of instruction, I administered the post-test (Appendix E). I immediately assessed the post-tests to determine students' growth and proficiency. I used the data collected to determine if the instructional strategies and assessment methods implemented throughout this unit impacted student learning and achievement.

Results/Data Analysis

Appendixes A and E include the pre- and post-tests taken for this unit. Tables 1 and 2 represent the student and question data I collected from these assessments. The horizontal axis shows the question number and level of difficulty for each question based on the proficiency

scale. The vertical axis shows each student. The symbol "1" is used to represent a correct answer. The symbol "PC" is used to represent a partially-correct answer. A partially-correct answer was not counted toward a student's total score. However, a partially correct response did affect what proficiency level students were placed in. To be placed at a level of proficiency, students must have answered most of the questions in the previous level correctly. The total score column to the right also communicates the students' level of proficiency. Red shows beginning, yellow shows progressing, green shows proficient, and blue shows advanced. This data assisted in the planning and implementation of instruction for this unit.

Pre-Assessment

Question Proficiency Scale	**Level 2 Progressing**		**Level 3 Proficient**				**Level 4 Advanced**	
Question #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total Score**
Student 1	1	1	1	1	1	1	1	7/7
Student 2	1	1	1	1	1	1		6/7
Student 3	PC	PC	1	1				2/7
Student 4	PC	PC		1	1	1		3/7
Student 5	PC		1	1	1	1		4/7
Student 6	PC	PC	1		1			2/7
Student 7	1	PC	1		1	1		4/7
Student 8	1	1	1	1	1	1		6/7
Student 9	PC	PC		1	1	1		3/7
Student 10	PC	1			1	1		3/7
Student 11	PC	PC		1	1	1		3/7

Student 12	PC	PC		1	1	1	1	4/7
Student 13	PC	PC	1					1/7
Student 14	PC	PC		1	1	1		3/7
Student 15	PC	PC	1	1	1	1		4/7
Student 16	PC	PC	1	1	1	1		4/7
Student 17	PC	PC	1			1		2/7
Student 18								0/7
Student 19								0/7
Total # of Correct Responses	4/19	4/19	11/19	12/19	14/19	14/19	2/19	

Table 1: The table above reports the data from the pre-test used to assess students before the unit. The data shown in this table assisted me in planning this unit, as I was able to plan whole-group instruction based on the number of correct responses per question and create ability-based groups for math workshop based on the total number of correct responses per student.

Post-Assessment

Question Proficiency Scale	**Level 2 Beginning**		**Level 3 Proficient**				**Level 4 Advanced**	
Question #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total Score**
Student 1	1	1	1	1	1	1	1	7/7
Student 2	1	1	1	1	1	1	PC	6/7
Student 3	1	1	1	1	1	1		6/7
Student 4	1	1	1	1	1	1		6/7
Student 5	1	1	1	1	1	1	1	7/7

Student 6	1	1	1	1	1	1	PC	6/7
Student 7	1	1	PC	1	1	1	PC	5/7
Student 8	1	1	1	1	1	1		6/7
Student 9	1	1	1	1	1	1	1	7/7
Student 10	1	1	1	1	1	1		6/7
Student 11	1	1	1	1	1	1	PC	6/7
Student 12	PC	1	1	1	1	1	PC	5/7
Student 13	1			1	1	1		4/7
Student 14	1	1		1	1			4/7
Student 15	1	1	1	1	1	1	PC	6/7
Student 16	1	1	1	1	1	1		6/7
Student 17	1	1	1	1	PC	1		5/7
Student 18	PC							0/7
Student 19	1	1		PC	PC	PC		2/7
Total # of Correct Responses	17/19	17/19	14/19	17/19	16/19	16/19	3/19	

Table 2: The table above reports the data from the post-test used to assess students after the unit. The data shown in this table assisted me in understanding the learning that took place throughout the unit.

Student Growth

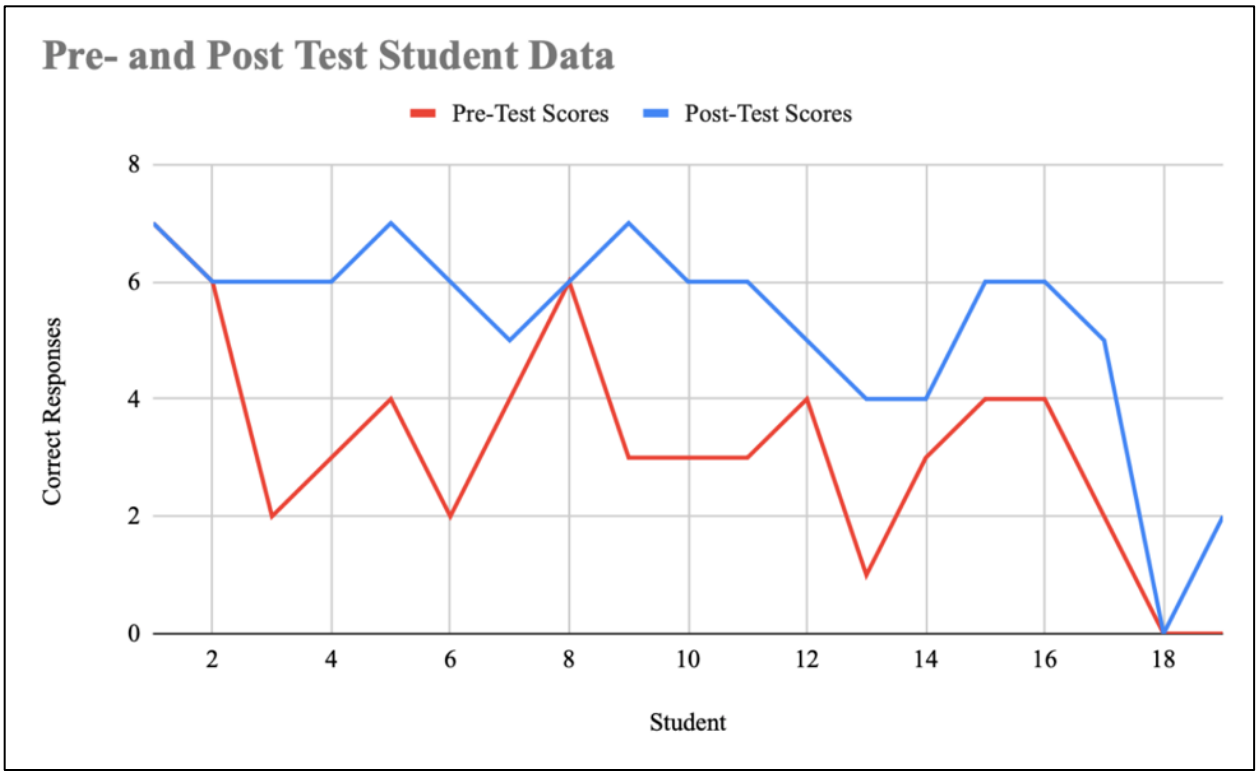

Figure 1: This line graph represents students' pre-test scores compared to their post-test scores. The vertical axis shows the number of correct responses. The horizontal axis shows each student. The red line shows students' pre-test scores, and the blue line shows students' post-test scores. The line graph data shows that most students increased their score from the pre- to post-test.

Discussions and Conclusions

The data collected throughout this unit provided valuable information to plan instruction for whole- and small groups. Based on the pretest data shown in Table 1, I knew I had students performing at a variety of levels. Because of this, I created differentiated small groups. I grouped students based on the pre-test data to ensure I was teaching to the instructional level of each group. There was one group at a beginning level, two groups at a progressing level, and one group at a proficient level. I differentiated each math workshop station to reflect these levels.

The math workshop model was implemented after students received one full day of whole-group direct instruction about a skill to set the foundation for learning.

Students 3, 6, 10, and 17 were placed at a beginning level of proficiency based on the pre-test. These students were placed in a beginning group. When working with the teacher, this group was provided with explicit direct instruction to support their ability to solve story problems with a missing addend or subtrahend. I used think-alouds frequently with this group to expose them to the metacognitive language needed to reach proficiency. I also used manipulatives with these students to assist in building a strong conceptual understanding of story problems with a missing addend or subtrahend. The other math workshop stations were differentiated to meet the instructional level of these students. For example, at the beginning of this unit, students were given story problems with missing addends or subtrahends within 10 to build their understanding before solving problems within 20.

Students 4, 5, 9, 11, 12, 15, and 16 were placed at a progressing level of proficiency based on the pre-test. These students were divided into two progressing groups. When working with the teacher, these groups received direct instruction that focused on building their skills to reach proficiency. The progressing groups worked on grade-level materials at all stations to support their learning.

Students 1, 2, 7, and 8 were placed at a proficient level based on the pre-test. When working with the teacher, this group received instruction to extend their learning. They worked on solving story problems with a missing addend or subtrahend within 30. They also worked on solving story problems with multiple addends, one of which was missing. This group worked on grade-level materials or extension activities at all stations

Some students were not placed in groups for math workshop. Students 13, 14, and 19 all qualified for special education services in math. These students received modified instruction from the special education teacher. They were also assessed using a modified assessment. Student 18 was being evaluated for special education services when this unit was being taught. This student was working with teachers on number identification, counting, and adding and subtracting within 10. These four students did not meet proficiency based on post-test scores.

After analyzing the data from the post-test, I concluded that the instructional strategies and assessment methods implemented in this unit had positive effects on student learning. After students received differentiated instruction, 16 out of 19 students increased their scores and 15 out of 19 students met proficiency. Using nonlinguistic representations through the CPA strategy was an effective instructional strategy. I found that students gained a conceptual understanding of what was happening within the story problems they were solving. By using nonlinguistic representations (e.g., manipulatives, ten frames, drawing math pictures), students were able to *see* what was happening within story problems with a missing addend or subtrahend. Students were then able to extend this understanding to an abstract equation, developing a conceptual understanding of the content. After reviewing the post-test scores, I concluded that using nonlinguistic representations through the CPA strategy positively affected student learning and achievement.

Providing feedback was also an effective instructional strategy. I found that providing students with specific feedback improved their performance. Positive feedback increased students' confidence in their abilities to complete the math computations. I also found that corrective feedback was meaningful. Students were able to see the gaps in their learning and

were given explicit instruction on how to improve following corrective feedback. After students saw these gaps in their learning, they made corrective steps to improve performance.

Using exit tickets as an assessment method was effective. I found that using exit tickets to assess students' understanding provided valuable information that I used to adjust my instruction. For example, when examining the exit ticket I administered for story problems with missing addends, I noticed that students were not labeling their answers. Because of this, I spent the beginning portion of the following lesson explicitly teaching how to label an answer. After this, most students were correctly labeling their answers. Exit tickets provided me with information regarding my students' understanding.

Questioning as an assessment method was also effective. The questions I asked helped me understand where my students were in their learning of the unit's content. The close-ended questions I asked allowed me to see if students were solving the story problems correctly or incorrectly. The open-ended questions I asked allowed me to learn how students were solving story problems. Based on these responses, I addressed misconceptions, praised the correct use of a strategy, or asked further questions to gain a better understanding of what a student was communicating. Students' responses provided valuable insight into their progress, and therefore, provided me with valuable information that I used to adjust my instruction.

The data collected from the pre-test shows that students did not know how to identify the meaning of addition and subtraction or solve story problems with a missing addend or subtrahend before receiving instruction. On the pre-test, students correctly answered 59 out of 114 grade-level questions (not including the advanced-level question), which is 52%. On the post-test, students correctly answered 97 out of 114 grade-level questions, which is 85%. This data suggests a 33% increase in student achievement. The data from the pre- and post-tests

suggest that the instructional strategies and assessment methods implemented throughout this unit had positive effects on students' learning and achievement.

All students are different, and therefore, all students learn differently. Using a variety of instructional strategies and assessment methods is a research-based teaching practice that enhanced my instruction. Based on the results of this capstone project, I plan to implement this practice into my future teaching because it was effective in increasing students learning and achievement. I would recommend that other teachers implement these practices into their teaching as well. By differentiating the instructional strategies and assessment methods used in the classroom, teachers can appeal to the needs and learning styles of all students in the classroom. I found that integrating differentiated instructional strategies and assessment methods created an environment that nurtured every student, no matter their ability I believe this should be every teacher's goal.

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Appendixes

Appendix A: Pre-Test

Below is a copy of the pre-test given to students to assess understanding before the unit.

Name: _____

Indicator(s): MA1.2.3.a: Solve real-world problems involving addition and subtraction within 20 in situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).

Level 2

Directions: Answer the questions.

1. What does the word **add** mean?

2. What does the word **subtract** mean?

Level 3

Directions: Solve the problems. Show your work.

3. Sam has 16 toy boats. 8 of the boats are green. The rest are blue. How many toy boats are blue?

4.
Kim came to school with 7 new pencils. She gave some to her friends. Now she has 4. How many pencils did she give away?

5.
Jack found 5 rocks on the playground and 8 rocks on the sidewalk. How many rocks did he find?

6.
Jen had 9 pieces of gum. She chewed 5 pieces on Monday. How many pieces of gum does Jen have left?

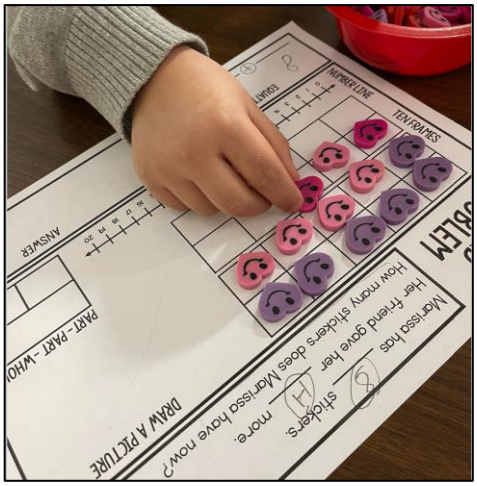
Level 4

Directions: Solve the problems. Show your work.

7.
Ty is collecting pennies. He collected 26 pennies on Monday, 12 pennies on Tuesday, and some more pennies on Wednesday. Ty collected 50 pennies altogether. How many pennies did Ty collect on Wednesday?

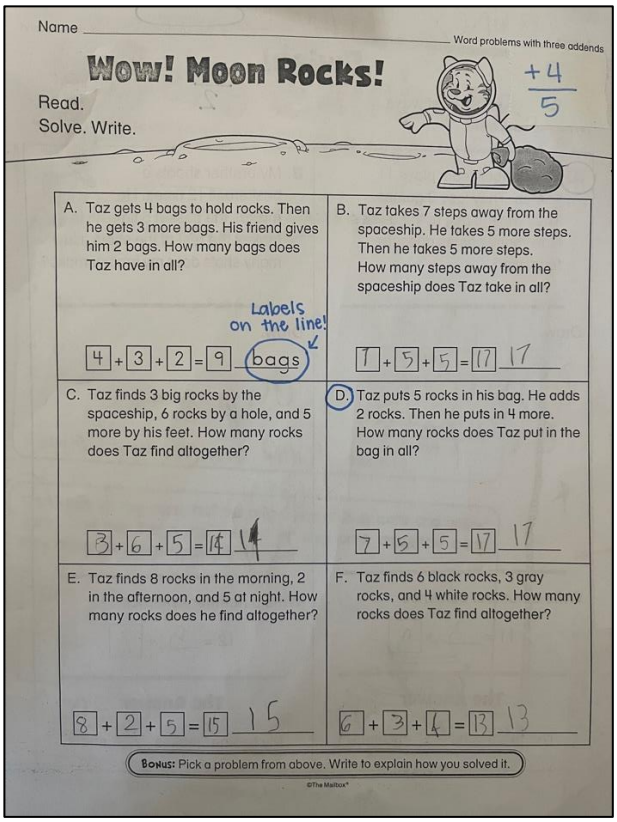
Appendix B: Student Work Sample—Manipulatives

Below is photograph of a student work sample as the student was solving a story problem using manipulatives.



Appendix C: Student Work Sample—Feedback

Below is an example of a student practice page with specific written feedback.


Name _____ Word problems with three addends

Wow! Moon Rocks!

Read.
Solve. Write.

+4
5

A. Taz gets 4 bags to hold rocks. Then he gets 3 more bags. His friend gives him 2 bags. How many bags does Taz have in all?

Labels on the line!

4 + 3 + 2 = 9 bags

B. Taz takes 7 steps away from the spaceship. He takes 5 more steps. Then he takes 5 more steps. How many steps away from the spaceship does Taz take in all?

7 + 5 + 5 = 17 17

C. Taz finds 3 big rocks by the spaceship, 6 rocks by a hole, and 5 more by his feet. How many rocks does Taz find altogether?

3 + 6 + 5 = 14 14

D. Taz puts 5 rocks in his bag. He adds 2 rocks. Then he puts in 4 more. How many rocks does Taz put in the bag in all?

7 + 5 + 5 = 17 17

E. Taz finds 8 rocks in the morning, 2 in the afternoon, and 5 at night. How many rocks does he find altogether?

8 + 2 + 5 = 15 15

F. Taz finds 6 black rocks, 3 gray rocks, and 4 white rocks. How many rocks does Taz find altogether?

6 + 3 + 4 = 13 13

Bonus: Pick a problem from above. Write to explain how you solved it.

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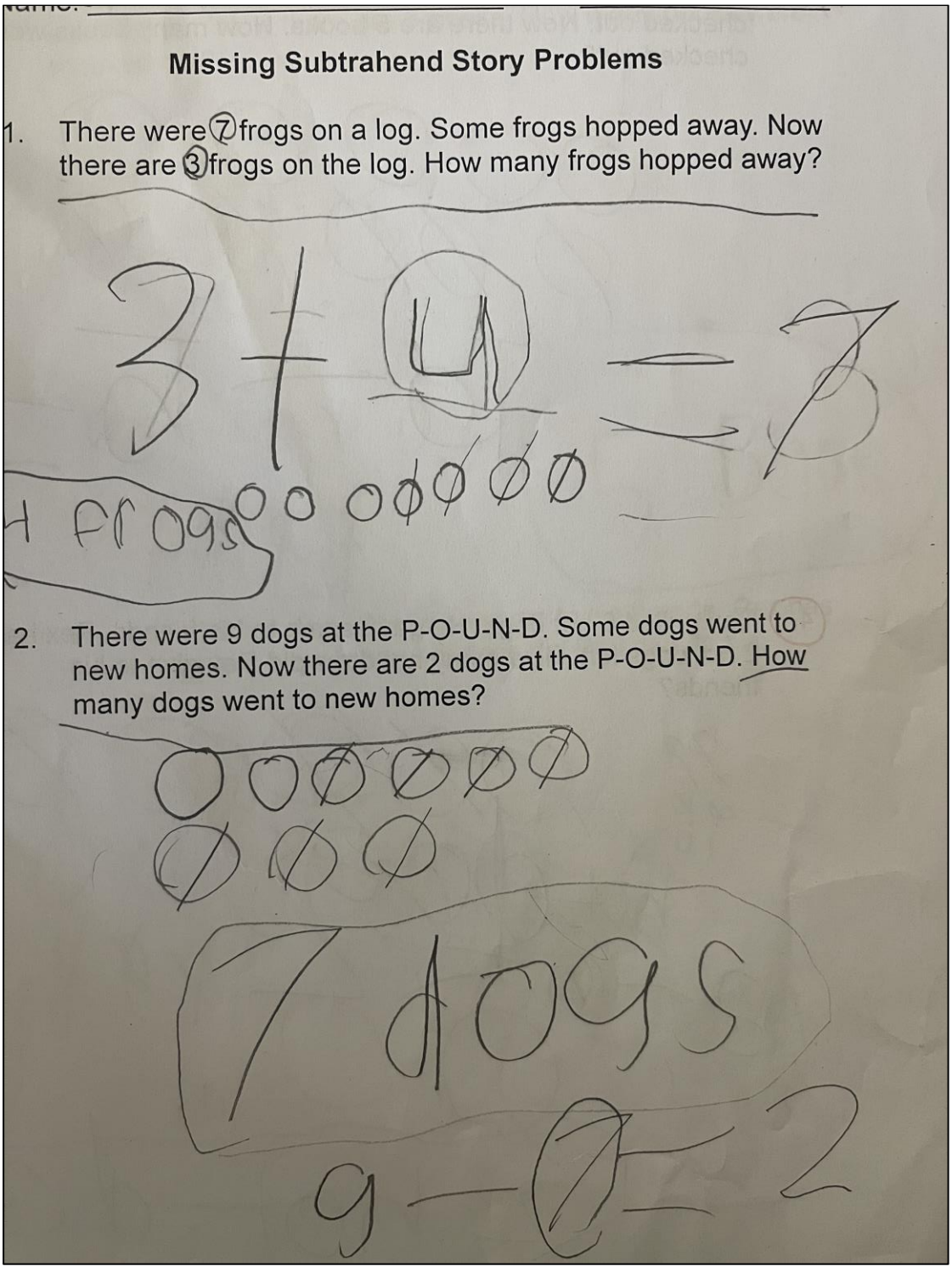
Appendix D: Student Work Sample—Exit Ticket

Below is an example of a completed exit ticket used to assess students' ability to solve story problems with a missing subtrahend.



Missing Subtrahend Story Problems

1. There were 7 frogs on a log. Some frogs hopped away. Now there are 3 frogs on the log. How many frogs hopped away?

3 + 4 = 7

4 frogs

2. There were 9 dogs at the P-O-U-N-D. Some dogs went to new homes. Now there are 2 dogs at the P-O-U-N-D. How many dogs went to new homes?

7 dogs

9 − 7 = 2

Appendix E: Post-Test

Below is a copy of the post-test given to students to assess understanding at the end of the unit.

Name: _____

Indicator(s): MA1.2.3.a: Solve real-world problems involving addition and subtraction within 20 in situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).

Level 2

Directions: Answer the questions.

1. What does the word **add** mean?

2. What does the word **subtract** mean?

Level 3

Directions: Solve the problems. Show your work.

3. Zion has 12 toy cars. 6 of the cars are green. The rest are blue. How many toy cars are blue?

4.
Caitlyn came to school with 9 new pencils. She gave some to her friends. Now she has 2. How many pencils did she give away?

5.
Emiliano found 6 rocks on the playground and 7 rocks on the sidewalk. How many rocks did he find?

6.
Brooklyn had 10 pieces of gum. She chewed 6 pieces on Monday. How many pieces of gum does Brooklyn have left?

Level 4

Directions: Solve the problems. Show your work.

7.
Matthew is collecting pennies. He collected 23 pennies on Monday, 16 pennies on Tuesday, and some more pennies on Wednesday. Matthew collected 50 pennies altogether. How many pennies did Matthew collect on Wednesday?