5-2024

Teaching Fraction Concepts to Third Grade Students with the Support of Instructional and Assessment Strategies

Kaitlyn Brandl
kbrandl@unomaha.edu

Teaching Fraction Concepts to Third Grade Students with the Support of Instructional and Assessment Strategies

Kaitlyn Brandl

University Honors Capstone

College of Education, Health, and Human Sciences

University of Nebraska at Omaha

Senior Honors Project/Thesis

Advisor: Dr. Saundra L. Shillingstad

May 2024

Table of Contents

Abstract

This capstone project reports and analyzes the effects of utilizing differentiated instructional and assessment strategies in a third-grade classroom. The capstone will discuss the benefits and results of implementing two instructional strategies and two assessment methods during the instruction of a math unit in fraction concepts. The math unit was delivered over a period of 10 instructional days and included pre-assessment and post-assessments. Based on the data collected, student understanding and performance increased after integrating supports through differentiated instructional strategies. In this capstone, I will discuss the methods utilized to deliver instruction and assess student learning. Conclusions of the capstone found that the use of strategies such as nonlinguistic representations, cooperative learning structures, exit tickets, and self-assessments were successful in the growth of student performance and accuracy.

Keywords: instructional strategies, nonlinguistic representations, cooperative learning

Background

For the clinical practice experience, I was placed in Columbus Public Schools, located in Columbus, Nebraska. This district is comprised of five elementary schools, one middle school, and one high school. Of the five elementary buildings, I was placed at Centennial Elementary. This building is the most populated elementary building within the district. I have been completing the experience in a third-grade classroom consisting of 19 students. Within the classroom, there are five English Learners (ELs) and three students on Individualized Education

Plans (IEPs). All three IEPs are designed for specific learning disabilities (SLDs) that focus on goals in the areas of reading, math, and writing. Supervision of this project was completed by my cooperating teacher with nine years of teaching experience. Collaboration with my cooperating teacher led to the decision of the planning, implementation, and assessing of a math unit on fraction concepts.

Introduction

The focus of this capstone was to increase students' conceptual understanding of fractions in the areas of identifying unit fractions, parts of a whole, and comparing values. During the development of the unit and lessons, I followed three main objectives. First, students will be able to identify unit fractions and parts of a whole. Second, students will be able to independently identify, create, and compare fractions. Third, students will be able to utilize at least two different forms of nonlinguistic representations. These objectives also led to the guiding question: *"How will student growth and accuracy be impacted by the implementation of differentiated instructional (i.e., nonlinguistic representations and cooperative learning structures) and assessment strategies (i.e., exit tickets and self-assessments)?".*

After creating objectives and identifying the guiding question, I planned and developed the unit on fraction concepts. Before delivering the first lesson, students completed a pre-assessment. Similarly, after the unit was completed, students completed a post-assessment. Both assessments consisted of four questions with a total of five possible points. In addition to the pre- and post-assessments, students completed various exit tickets and self-assessments throughout the unit. All student samples were collected to analyze student performance and accuracy.

In selecting instructional and assessment strategies, I decided to implement two instructional strategies and two assessment methods: nonlinguistic representations and cooperative learning structures for instruction, and exit tickets and self-assessment for assessment.

Understanding of Instruction Methods

Nonlinguistic Representations

Instructional strategies are often utilized by educators to enhance learning experiences and increase student engagement when working on different skills or concepts. The first instructional strategy implemented throughout the unit was nonlinguistic representations. Nonlinguistic representations, or multiple representations, can be described as visual or physical expressions of an idea or abstract concept. Most nonlinguistic representations are seen through manipulatives (e.g., fraction tiles), visual aids (e.g., anchor charts and diagrams) and graphic organizers. This strategy allows learners to make connections and mental mappings to abstract concepts. Rau and Matthews (2017) support this use as "instructors may use visual representations (1) to familiarize students with visual conventions commonly used in the mathematics community, (2) to illustrate abstract complex concepts, (3) to enlarge the set of tools students have for engaging mathematics, and (4) to leverage students' subjective preferences and expertise" (p. 531).

Using nonlinguistic representations in mathematics provides a substantial support for students that need a visual connection when working with concepts such as fractions. These concepts can become complex for students, especially when they are asked to compare different fraction values. To help aid their conceptual understanding, nonlinguistic representations are used as a tool that students can interact with or create when distinguishing units and parts of a whole. These often allow them to see the whole that is then broken up into equal sections. Creating fractions relies on this basis and without the basic understanding of these concepts, students will not be able to identify or create fractions. Zulli and Burnett (2021) note "there are essentially four different representations of common fractions that students should progressively encounter: length, area, set and number line models" (p. 15). To effectively teach the concepts of fractions, nonlinguistic representations must first be used before moving towards fraction knowledge needed for the later stages in education.

Equally important as establishing the connection between abstract concepts (e.g, fractions) and nonlinguistic representations (e.g., fraction tiles, number lines, area, and set models), developing fluency of multiple representations requires strategic selection of the models used during instruction. This is emphasized as Zulli and Burnett (2019) state "care needs to be taken when selecting an appropriate model based on the prior experiences of the students with fractions" (p. 16). Students must develop a visual and connectional understanding of the models they are using to represent fractions. A student must first make sense of the visual being used. This can be seen through the example of shaded parts of a whole. When seeing five shaded parts of a bar with seven equally divided parts, students must develop the understanding that five parts

of the seven are shaded. This would lead to the fraction value of 5/7ths. Similarly, students must also create a connectional understanding. This is the ability to recognize similarities and differences across visual representations (Rau & Matthews, 2017, p. 535). Students must not only make sense of the representation, but also distinguish how different models are connected. This can be seen through the example of fraction bars and number lines. When seeing a fraction bar divided into seven equal parts and a number line divided into seven equal parts, students must develop the understanding that both representations show the whole of sevenths, or 7/7ths.

By integrating nonlinguistic representations into instruction, students' understanding can be reinforced when working with abstract concepts. Developing this foundation will then allow students to quickly identify and create fractions when working independently. Building a foundation of complex concepts such as fractions is vital in the success of knowledge needed for fractional computation in later education.

Cooperative Learning

The second instructional strategy implemented during the unit was cooperative learning. Cooperative learning promotes the active learning process through group work that is dependent on success individually, and as a whole. Silva., et al (2022) state "each member of the group is responsible for learning, as well as for contributing to the learning of the other members of the group, creating an atmosphere in which everyone feels fulfilled" (p.12). Cooperative learning structures depend on effective communication and collaboration. Therefore, these structures promote academic achievement and social development.

When looking at the effects of using cooperative learning, a study conducted by Popa and Pop (2019) found that a program of interventions (instruction with cooperative learning structures) lead to positive results. “The need for teacher support, as well as the need for individual learning had minimized” when using cooperative learning groups (Popa & Pop, 2019, p. 85). This suggests that cooperative learning allows students to take active roles during their learning with minimal support. Student-centered experiences can increase student performance when structured effectively. From interviews of the 62 fourth-grade students in the study, interest in being able to interact and discuss in groups among themselves was expressed. This included holding active roles and solving tasks with the contributions of others (Popa & Pop, 2019, p. 86).

Implementing cooperative learning structures is dependent on five main principles. Silva., et al (2019) lists “positive interdependence, individual and group accountability, promotive interaction, social skills, and group processing” (Silva., et al, 2019, p. 12). With these five elements present, cooperative learning then fosters critical thinking skills that students need. As educators, it is a primary goal to develop the critical thinking skills of students as well as fostering a welcoming and collaborative environment. These areas will be necessary for success in later life.

Understanding of Assessment Methods

Exit Tickets

Assessing student understanding is an integral part of the process of learning in addition to the delivery of instruction. As educators, we must use these assessments to not only identify

student growth, but to also guide further instruction. How student learning is assessed is equally as valuable as the assessment itself. One of the assessment methods utilized throughout the unit was exit tickets. Exit tickets are defined as short tasks given to students after an activity or lesson that elicits student thinking (Fowler., et al, 2019, p. 19). Since exit tickets are short tasks, they often provide a quick snapshot of student learning at the time given. This can be beneficial as it allows teachers to clarify misconceptions, address questions, or provide feedback in a timely manner. The use of exit tickets is also supported as "exit tickets use a number of approaches, including soliciting student feedback on a lesson, promoting student self-reflection, and asking questions on class content, all as a type of formative assessment" (Kirzner., et al, 2021, p. 152).

Exit tickets have been known to be given on slips of paper or sticky notes. In recent years, teachers have begun to assign digital exit tickets utilizing technology platforms. Examples of these include Twitter, Socrative, Kahoot, and Plickers. A study conducted by Kirzner., et al (2021) examined the use of such platforms as exit tickets. From the results, it was found that students supported and valued the use of digital exit tickets during their learning. According to Kirzner., et al (2021), "online quizzes such as Kahoot allow for instant correction of student misconceptions, before the misunderstanding can solidify" (p. 165). With quick and short assessments, student learning can reveal important information while providing student engagement.

The flexibility of delivery of exit tickets makes the assessment method a desirable tool for teachers. Whether it is digital or through paper, exit tickets enhance student learning experiences. Fowler., et al (2019) emphasizes "the power of exit tickets lies not only in

informing instructional decisions – it includes the public acknowledgement of students' ideas and making adaptations of lessons, based on these responses, transparent to students" (p. 286). As a result, exit tickets provide valuable student growth data as well as opportunities for discussion.

Self-Assessments

The second assessment method utilized during the unit was self-assessments. Self-assessments are defined as "an estimate of a student's own understanding of the learning content or to his performance in an activity or task" (Wong, 2016, p. 164). The use of self-assessments can be seen through journals, checklists, and learning scales. Allowing students to self-assess can reveal student perception of their level of accuracy as well as overall class belief towards a topic or concept. By having students complete self-assessments, they are asked to form individual opinions instead of looking towards the teacher for the response. This is explained as Wong (2016) states:

> Student self-assessment, based on certain standards and criteria, engages the students in deliberate thought and reflection about what they are learning and how they are learning it. In simple terms, self-assessment involves students in thinking about the quality of their own work, rather than relying on their teacher as the sole source of evaluative judgements (p. 2).

In addition to building this skill, self-assessment can be proven to increase accuracy among students. In a study conducted by Mastnak et al. 2023, research focused on a questioning and assessment model for self-assessing before, during, and after instruction. Teachers modeled specific forms of self-questioning to help identify self-understanding. Examples of questions include statements such as "Can I …, What do I need…, and How can…?". Results found that students were able to self-asses more accurately after being introduced to the model. This is critical as "students' ability to accurately assess their knowledge can enable them to self-regulate their learning through metacognitive monitoring" (Mastnak et al., 2023, p. 180).

If utilized correctly, self-assessments can help inform not only teachers, but also students of any areas of struggle. This then provides opportunities for students to take charge in their learning by addressing their needs with teachers. Likewise, teachers may learn valuable input from students that can influence the pace or lessons that are to follow during units of instruction.

Participants

Participants of this study consisted of 19 third-grade students at Centennial Elementary. There were eight boys and 11 girls in the class. Of the 19 students, 21% qualified and received EL services. One EL student was considered a newcomer. All EL students remained in the classroom and received services from the EL specialist through the push-in model. Of the 19 Students, 16% had an IEP. These students were met by a group of students also on an IEP and received small group push-in services from the special education teacher. In addition, 2 students on an IEP received Title I reading services throughout the day. From the 19 students,

four students partake in an enrichment group that is pulled out of the classroom for advanced opportunities.

Methods and Materials

My unit on fraction concepts aligned to five Nebraska state standards for third grade mathematics.

- 3.N.2.a Partition two-dimensional figures into equal areas and express the area of each part as a unit fraction of the whole.
- 3.N.2.b Find parts of a whole using visual fraction models.
- 3.N.2.c Represent and understand a fraction as a number on a number line.
- 3.N.2.d Show and identify equivalent fractions using visual representations including pictures, manipulatives, and number lines.
- 3.N.2.f Compare and order fractions having the same numerators or denominators by reasoning about their size.

To follow these standards and track student progress, my unit included three main objectives. First, students would develop a conceptual understanding of fractions and parts of a whole. Second, students would independently identify, create, and compare fractions. Third, students would utilize at least two different forms of nonlinguistic representations. Throughout the unit, lessons focused on three main domains: identifying, creating, and comparing fraction values.

Columbus Public Schools has utilized a four-point proficiency scale at the elementary

level for the last two years. These are defined as 1) Beginning, 2) Progressing, 3) Meeting, and 4) Advanced. However, due to inconsistency with the scales, it was decided to assess using percentages. The learning targets were set to have students perform at proficiency by the end of the unit. Proficiency was then defined as 60% and above.

Students were taught over a period of 10 days. Each lesson was broken up to teach content across two days. Prior to beginning the unit, a pre-assessment (Appendix A) was given. The pre-test included questions from each domain (identifying, creating, and comparing). Questions were varied to include multiple choice and open response items. As questions were read aloud, students were also encouraged to complete the assessment without assistance. After delivering the test, samples were collected to record and analyze data. This then helped me plan and guide the unit on fraction concepts.

From the pre-assessment, responses showed that there was limited knowledge on fraction concepts. It was determined that students would need explicit instruction and concrete definitions of vocabulary such as numerator, denominator, whole, and parts of a whole. Students would also need a variety of visuals to help make connections across abstract concepts. Each visual would also need to be defined and differentiated to create visual fluency. In addition to this, instruction would need to be paced with the gradual release model. Students must master basic concepts before adding on to more complex problems.

Instructional Methods

Throughout the unit, two research-based instructional strategies were utilized to

support student learning and reach unit objectives set. The first strategy I implemented was nonlinguistic representations. Nonlinguistic representations were used to help students visualize concepts such as parts of a whole and whole. Students often had access to anchor charts, diagrams, and manipulatives (e.g., fraction tiles). For lessons on identifying fractions, students utilized nonlinguistic representations through anchor charts and fraction tiles. This helped them quickly find values of numerators, denominators, and parts of a whole. Lessons that focused on creating fractions often included fraction bar and number line strips. Students were able to create their own visual representations following the examples previously shown on anchor charts or with fraction tiles. When completing lessons on comparing fractions or finding equivalent values, students accessed fraction tiles the most (Appendix B). This method of nonlinguistic representation allowed students to visually see which fractions were greater or determine that several fractions are equal. Overall, students had continuous access to multiple representations that had allowed them to create and apply their own visuals when completing tasks. Results on assessments and homework reflected positive outcomes.

In addition to nonlinguistic representations, the second instructional strategy integrated was cooperative learning. Cooperative learning promotes group work and boosts academic achievement through opportunities that encourage social skills. Students in my class responded well to this strategy as many excel during learning opportunities that include discussion and collaboration. Several cooperative learning structures were utilized throughout the 10-day period. These include round robin, graffiti brainstorm, and numbered heads. Looking at lessons that centered around identifying fractions, students participated in graffiti

brainstorm. This structure began by splitting students into different groups and providing a different colored marker to each group. The groups would then start at a poster and discuss the task or problem given before writing answers down on the poster. Then, students would rotate to the next poster before repeating the process. This structure was largely based on discussion and allowed learners to see different ideas from each group shown in their distinct color. When working on creating fractions, students participated in round robin. This structure also began by splitting students into groups or teams. Each group received a fraction bar slips and whiteboard marker. Students then had the opportunity to choose their individual role for the activity (i.e. identifier, scribe, assessor, spokesperson). As fraction values were shown on the board using dominoes, students discussed to identify and create fractions on the fraction bar slip before checking and sharing answers for points.

The final product had to show the fraction and all elements needed in the visual representation (Appendix C). This structure was also differentiated to include creating fractions on a number line. The last cooperative structure used with students during lessons on comparing fractions was numbered heads. This structure separated students into groups of four while providing a number for each student. During the activity different sets of comparison problems were displayed on the board. Students had to utilize fraction tiles and work together to determine if the fractions were equivalent, less than, or greater than. Answers would then be written on a whiteboard. In this structure, a random number (1-4) would be called out to share their answer and thought process with the whole group. This promoted accountability as every member of the group had to be ready to explain their work. From the three cooperative

learning structures, student learning and engagement increased.

Assessment Methods

To measure and monitor student progress throughout the unit, two research-based assessment strategies were also utilized. The first method of assessment implemented was exit tickets. Exit tickets were delivered at the end of the second day of each lesson. From these, I chose to analyze three exit tickets for student results. Each ticket focused on a different domain: identifying, creating, and comparing fractions. The first exit ticket was given on a slip of paper and designed using the Frayer Model graphic organizer (Appendix D). This assessment asked students to identify the numerator, denominator, parts of a whole, and equation for the fraction three-fourths. Then, students completed the second exit ticket through the online platform Quizizz. This platform allows students to answer questions through multiple choice, open response, or drawings. Students assessed their knowledge on creating fractions by answering two multiple choice questions and creating two drawings. The third exit ticket assessed knowledge on comparing fractions by having students complete a quick four question quiz on a slip of paper. Students were given a visual of two different fractions and asked to compare the values to determine if they were equal, less than, or greater than. During this assessment, students had access to fraction tiles but were encouraged to complete problems without manipulatives if possible. After delivering each exit ticket, samples were collected and recorded. This data was then analyzed to measure progress and guide instruction for the following lessons.

The second assessment method implemented during the unit was self-assessment.

Each self-assessment was given at the end of the first day of the lesson. These assessments often consisted of questionnaires that asked students to reflect on their level of understanding. In designing the self-assessments, students were given the "I can.." statements set for the lesson. Students would then have to rate their level of understanding utilizing the district proficiency scale (1-4) or circle the visual that matched their response (i.e. emoji, traffic light, hand signal). For additional reflection, some self-assessments asked students to elaborate on their rating by showing what they knew. This can be seen through the "I can.. Here's How.." assessment (Appendix E). If students had agreed with the statement, they were asked to provide an example. From these different forms of self-assessing, students were able to share their own opinions of student learning as well as show me how the whole group was feeling after each lesson.

To conclude the unit, a post-assessment was delivered on day 10 (Appendix F). This assessment mirrored the pre-assessment with different values for each question. Again, students were asked to complete questions focusing on the areas of identifying, creating, and comparing fractions. The assessment included four questions but was rated on a five-point scale. This was due to several tasks that asked students to generate an answer. After completing the assessment, all samples were collected to record results and analyze student growth for the unit. The samples from pre- and post- assessments were used to determine student proficiency and the impacts of instructional and assessment strategies utilized.

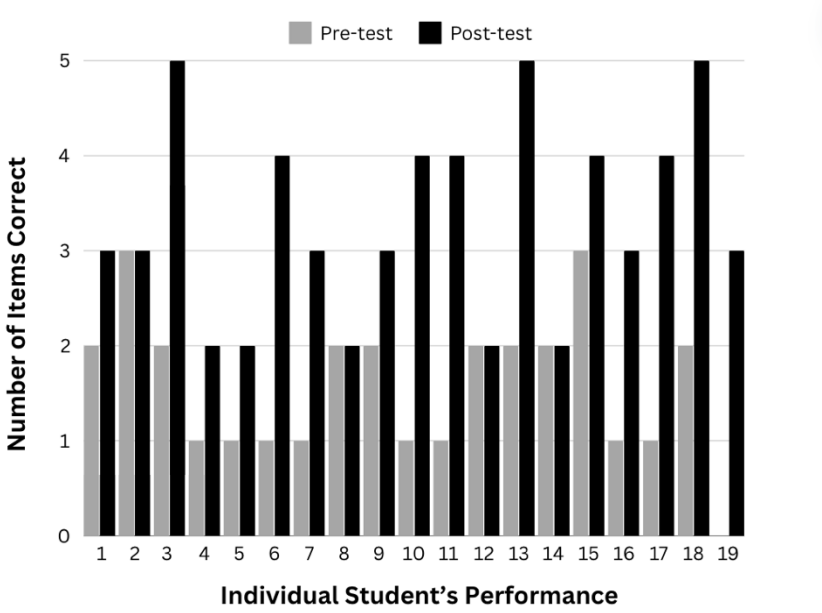
Results/Data Analysis

As data and samples were collected throughout the unit, results were continuously recorded and analyzed. Appendix A and F include the pre- and post- assessments integrated during the unit. Figure 1 shows the comparison of the assessments for each individual student. The x-axis shows each student in the class and the y-axis shows the number of items they received correct. Pre-assessment results are shown in grey while post-assessment results are shown in black. Both assessments were scored out of five points.

Figure 2 shows the data collected from all three exit tickets. The x-axis shows the individual student, and the y-axis shows the number of items they received correct. Each exit ticket is defined by a different colored bar. Exit ticket 1 results are shown in grey, followed by exit ticket 2 in red and exit ticket 3 in black. All three exit tickets were scored out of four points.

Figure 1

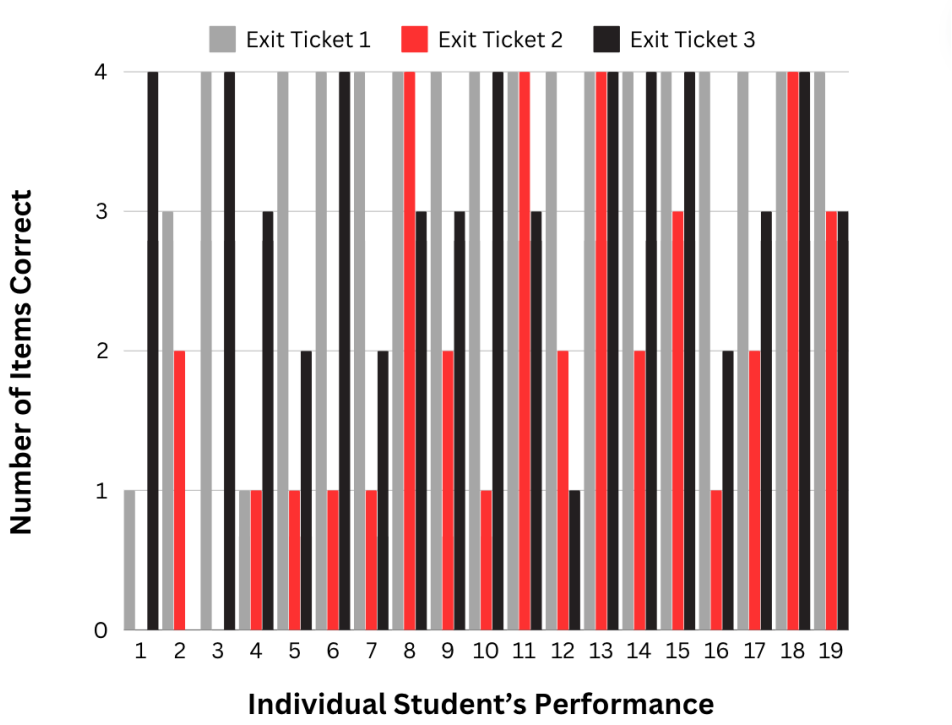
Pre- and Post-Assessment



Note. The graph above reports the data from the pre- and post- assessment delivered in the unit. The data shown in grey was used to help plan and guide the unit. Pre-assessment results showed the need for explicit instruction and a limited baseline of knowledge. Student 19 was absent on day 1 of the unit.

Figure 2

Exit Ticket Data



Note. The graph above reports the data from three exit tickets delivered in the unit. Exit ticket 1 (shown in grey) assessed student knowledge on concepts of identifying fractions. Exit ticket 2 (shown in red) assessed student knowledge on concepts of creating fractions. Exit ticket 1 (shown in black) assessed student knowledge on concepts of comparing fractions. Students with missing data were absent on the day the exit ticket was delivered.

Discussions and Conclusion

From the student data collected, much of my unit was planned or adapted to meet the needs that students were showing through their performance. The pre-test had showed that

students had a limited baseline of knowledge and allowed me to be conscious of the type of instruction needing to be delivered. Students would need to have concrete definitions of concepts and supports through visuals put in place to supplement lesson materials. The pre-test results also showed that only two students were considered proficient. This meant that all students would need tools to build foundational knowledge.

Throughout the unit, students were asked to complete three exit tickets to collect data. Each ticket focused on a certain concept of fractions. These included identifying, creating, and comparing fractions. Exit ticket 1 (identifying) revealed that 89% of the class was proficient. From those who had not reached proficiency, conversations were held to identify areas of struggle or to emphasize the pacing of completing tasks. Exit ticket 2 (creating) revealed 74% of the class was proficient. Eleven students needed reinforcement of dividing equal parts on fraction bars and number lines. From this, extra opportunities for review were built into instructional time. Students continued to work both in groups and independently to reinforce concepts. Exit ticket 3 (comparing fractions) was the lowest ticket delivered with 72% being proficient. From this, I added extra review activities and cooperative structures for whole group instruction and provided one on one instruction for individual students. Several students were also pulled for small group instruction with specialists that they received services from.

By the end of the unit, I was able to analyze student data on the post-test to determine that the instructional and assessment strategies utilized were beneficial. After implementing the strategies, 14 out of 19 students attained proficiency. Scores between the pre- and post-tests saw a growth ranging from zero to three points. Of those that did not reach proficiency,

four students were identified and analyzed to look at needs for intervention. Students four, five, eight, twelve, and fourteen did not reach proficiency. Students five and twelve receive language services and were added to small group instruction with a specialist. Students four, eight, and fourteen were identified as struggling throughout the unit. From this, one on one intervention was given to help clarify concepts. These students were also asked to show their work or thought process when working independently.

The effects of using nonlinguistic representations were positive. Students had been able to visualize abstract concepts of fractions through a variety of forms (i.e. anchor charts, models, fraction tiles). Being able to create these mappings greatly helped students. Additionally, visual fluency was created. Each student had been able to utilize at least two different forms of nonlinguistic representations (i.e. fraction bars and number lines). The unit objectives had been met. Therefore, nonlinguistic representations provided a positive impact on student learning and growth.

Similarly, cooperative learning saw positive impacts in the classroom. Students were able to work together to complete tasks and grow social connections. This class responded well to discussion and collaboration. As a result, cooperative structures helped identify whole group understanding as well as individuals who needed extra peer support. Students completed all tasks with minimal support which then created an environment for student-centered learning to take place.

In choosing methods of assessing student understanding, exit tickets provided to be a valuable form of delivering assessments. Students responded well to the short tasks often

given with exit tickets. These assessments also allowed me to adapt instruction throughout the unit. By seeing results in real-time, I was also able to give immediate feedback. This was helpful as it helped set up students for the following lesson. Exit tickets showed improvement for students and identified those who were still struggling. Overall, this method was beneficial for measuring student progress and engagement.

Using self-assessments was also an effective method of seeing student understanding. Having students form their own opinions of student understanding showed me which students needed more encouragement, support, or opportunities for enrichment. Creating a routine of student-centered learning also showed students that they are capable of reaching lesson targets independently. From self-assessing, students can also share if they are struggling. This then opens up opportunities for reflective conversations so that students may receive the support that they need to confidently reach the “I can...” statements. This method created positive outcomes for both students and instructors.

Looking at overall growth throughout the unit, the whole group improved from 11% proficient to 74% proficient. This showed an increase by 63%. Growth results proved to support the use of differentiated instructional and assessment strategies in the classroom.

Understanding how students best learn is a large part of being an educator. For students in this class, interactive opportunities and discussion-based learning worked well for the whole group. Although positive results were achieved, it is still important to focus on the gaps that are existent. All students learn differently and at different stages. Making sure that they are receiving the support that they need while differentiating instruction in a key focus.

From this capstone, I saw that utilizing research-based instructional and assessment strategies enhances instruction. This has now influenced how I approach and plan to approach instruction in the future. By focusing in on strategies that help support learners and using student data to inform instruction, educators can identify how to best support each and all students.

References

Fowler, K., Windschitl, M., & Richards, J. (2019). Exit Tickets: Understanding students, adapting instruction, and addressing equity. Science Teacher, 86(8), 18–26. https://doi-org.leo.lib.unomaha.edu/10.1080/00368555.2019.12293416

Kirzner, R. S., Alter, T., & Hughes, C. A. (2021). Online Quiz as Exit Ticket: Using Technology to Reinforce Learning in Face to Face Classes. Journal of Teaching in Social Work, 41(2), 151–171. https://doi-org.leo.lib.unomaha.edu/10.1080/08841233.2021.1898521

Nebraska Department of Education. (2022, Sept. 2). *Nebraska mathematics standards.* Nebraska Department of Education. https://www.education.ne.gov/wp-content/uploads/2017/07/2015_Nebraska_College_and_Career_Standards_for_Mathematics_Vertical.pdf.

Mastnak, A., Zuljan, M. V., & Magajna, Z. (2023). Self-Assessment by Self-Questioning in the Instructional and Practical Phases of Mathematics Learning. Pedagogy Studies / Pedagogika, 149(1), 163–184. https://doi-org.leo.lib.unomaha.edu/10.15823/p.2023.149.8

Popa, C., & Pop, M. (2019). Cooperative Learning – Applications for Children from Primary School. Journal Plus Education /Educația Plus, 22(1),78–87.

Rau, M., & Matthews, P. (2017). How to make "more" better? Principles for effective use of multiple representations to enhance students' learning about fractions. *ZDM - Mathematics Education*, *49*(4), 531–544. https://doi-org.leo.lib.unomaha.edu/10.1007/s11858-017-0846-8

Silva, H., Lopes, J., Dominguez, C., & Morais, E. (2022). Think-Pair-Share and Roundtable: Two Cooperative Learning Structures to Enhance Critical Thinking Skills of 4th Graders. International Electronic Journal of Elementary Education, 15(1), 11–21. https://doi-org.leo.lib.unomaha.edu/10.26822/iejee.2022.274

Wong, H. M. (2016). I can assess myself: Singaporean primary students' and teachers' perceptions of students' self-assessment ability. Education 3-13, 44(4), 442–457. https://doi-org.leo.lib.unomaha.edu/10.1080/03004279.2014.982672

Zulli, M., & Burnett, J. (2021). Using multiple fraction representations to build a foundation of success in mathematics. Australian Primary Mathematics Classroom, 26(2), 15–16.

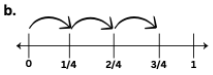
Appendix

Appendix A: Pre-Assessment

Name: _____

1. Circle the fraction that DOESN'T belong

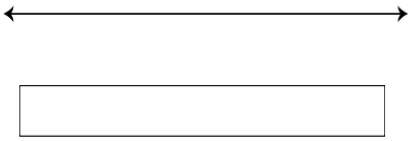
a. 

b. 

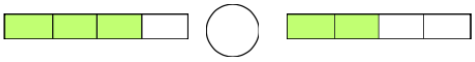
c. 

d. 

2. Show 2/5 on the number line and fraction bar



3. Compare the fractions. Use <, >, or =

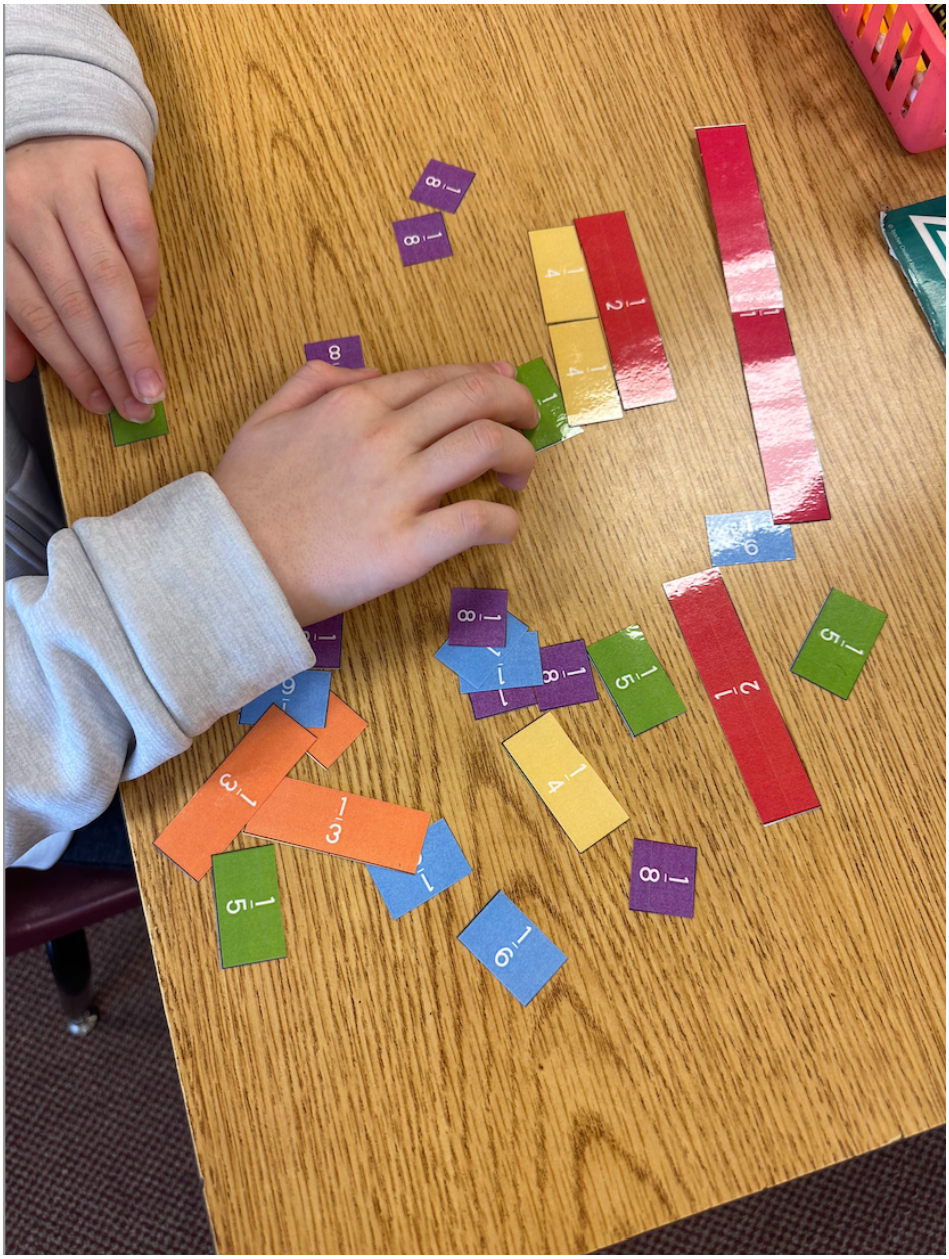


$$\frac{2}{3} \quad \bigcirc \quad \frac{2}{2}$$

4. Circle the 2 fractions that are equal

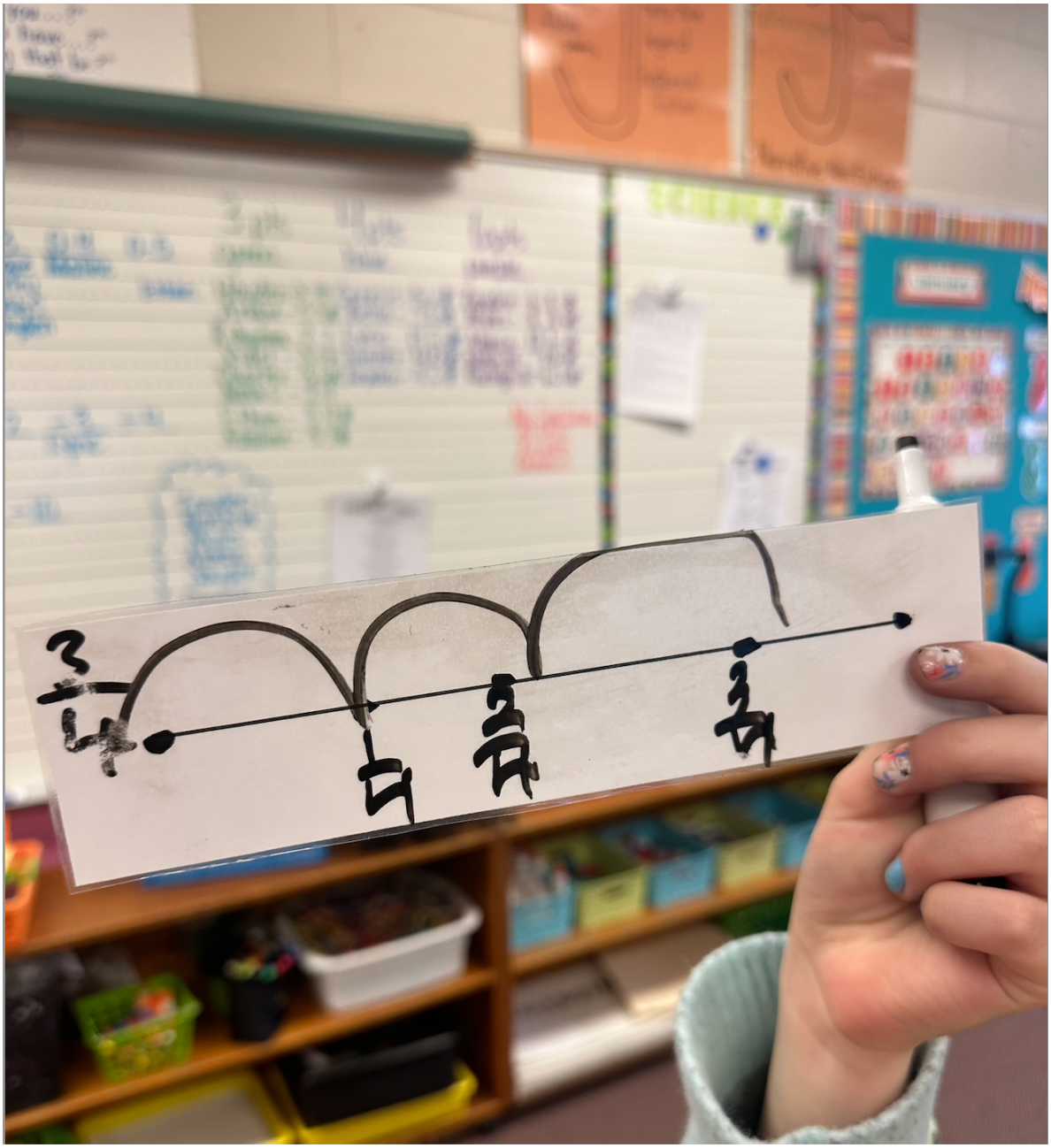
Note. Pre-assessment delivered before beginning unit of instruction.

Appendix B: Manipulatives – Fraction Tiles



Note. Photograph of a student utilizing manipulatives to create equivalent fractions.

Appendix C: Student Work Sample from Cooperative Learning – Round Robin

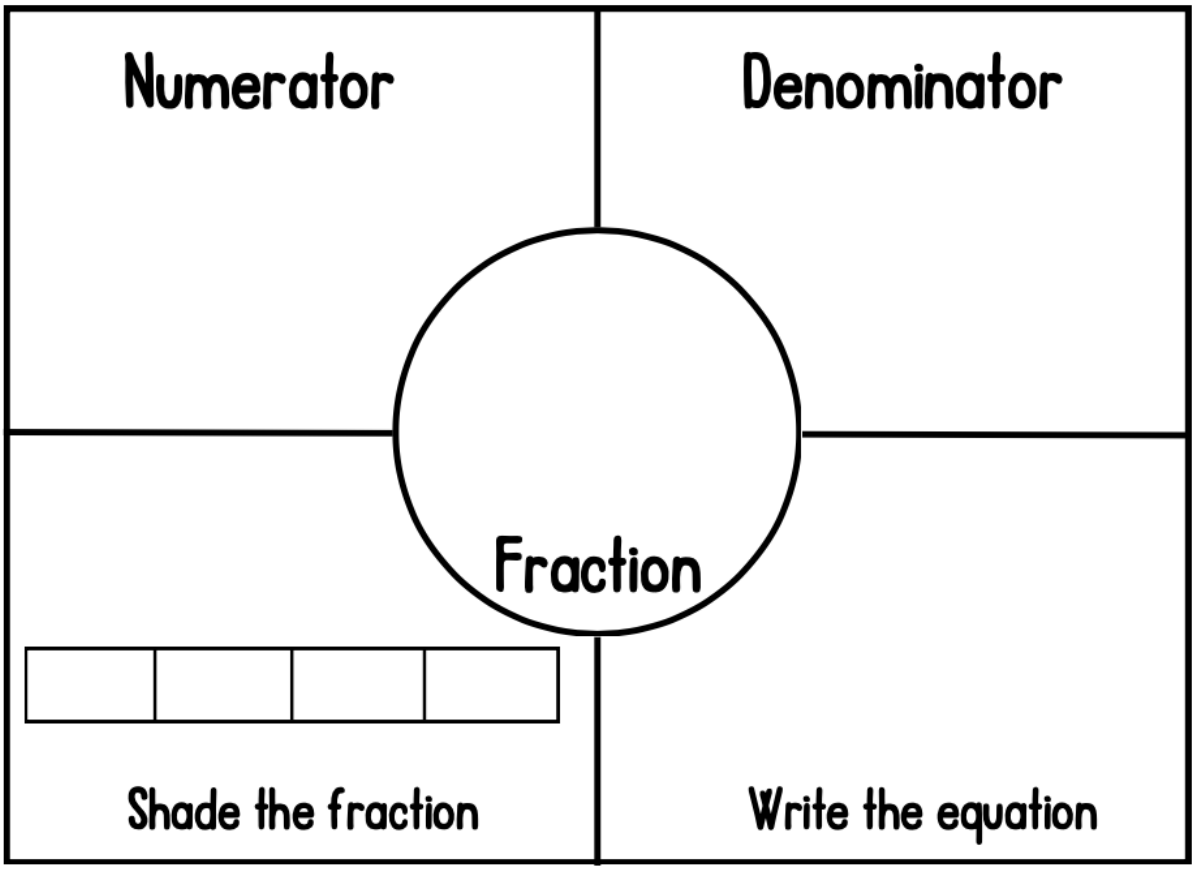


Note. Photograph of a completed number line made during the round robin cooperative learning activity.

Appendix D: Exit Ticket 1 – Frayer Model

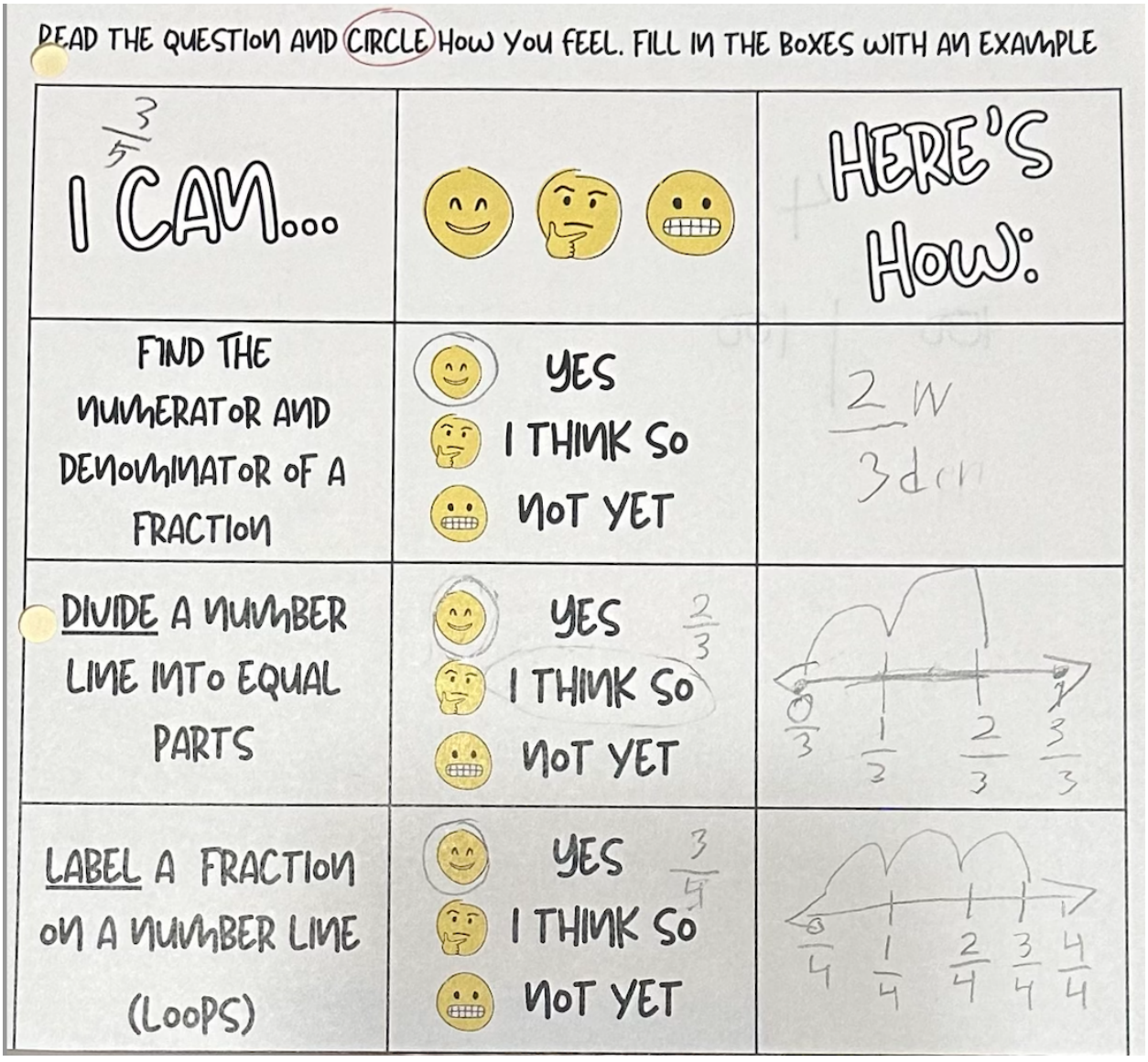
Name _____

Fill in the boxes with the parts of a fraction. Shade and write out the fraction.



Note. The first exit ticket was delivered utilizing the Frayer Model graphic organizer.

Appendix E: Student Work Sample of Self-Assessment – "I can.. Here's How.."



Note. Example of a student's completed "I can.. Here's How" self-assessment.

Appendix F: Post-Assessment

Name: _____

1. Circle the fraction that DOESN'T belong

a. 

b. 

c. 

2. Show 3/4 on the number line and fraction bar. Label the fractions and add jumps.

3. Compare the fractions. Use <, >, or =

$$\frac{6}{3} \quad \bigcirc \quad \frac{4}{3}$$

4. Circle the 2 fractions that are equal

Note. Post-Assessment delivered after finishing the unit of instruction.