5-2023

Teaching Time and Graphs with Differentiated Instruction and Assessment Strategies

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University Honors Capstone

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Senior Honors Project/Thesis

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May 2023

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Abstract

This capstone reports the effectiveness of using differentiated instructional and assessment strategies to improve student performance in math. Based on pretest data, instruction was planned and implemented to best meet the needs of each student to help them succeed. This unit started with a pretest, had ten days of lessons and instruction, and then concluded with a post-test. Based on student data, student performance and learning increased by using differentiated instruction and instructional strategies that were adapted to help each student. Using feedback, nonlinguistic representations (a big piece of assessment), think-pair-shares, and physical models/manipulatives, students successfully showed the increase in learning they experienced.

Keywords: nonlinguistic representations, feedback, think-pair-shares, models, instructional strategies, assessment strategies

Background

For my clinical practice placement, I was placed in Birchcrest Elementary School which is a part of the Bellevue Public Schools District. Birchcrest has a student-to-teacher ratio of 21:1 for kindergarten through 6th grade students. It is considered a Title I school and has 15 classroom teachers and as a school, 35 certified staff members. While at Birchcrest, I was with a group of seventeen 2nd-grade students. My project was supervised by my cooperating teacher who has been teaching for 11 years. Together, we decided that for my capstone project, I would plan, implement, and research a math unit for the students we work with every day.

Introduction

The goal of the project was for the students to successfully tell time to 5 minutes from analog clocks and draw and interpret data from different graphs to solve problems related to those graphs. I created three objectives that guided my planning of instruction to help meet the goal of my capstone project. The first objective was for the students to be able to write and tell time from analog clocks to the nearest 5 minutes using A.M. and P.M. The second objective was for students to be able to measure the lengths of objects and take those measurements and create a line plot to record their data. I created labels and scales to assist students in understanding the data. The final objective was for students to be able to draw a bar graph and pictograph to represent sets of data. From these graphs and data, students would solve word problems that required them to compare, add, and subtract to interpret the data.

The guiding question of my project was, *"How does student performance when telling time, creating graphs, and analyzing data on graphs improve when differentiated instruction and various instructional strategies, like think-pair-share and nonlinguistic representations, are purposefully planned into the lesson?"* The unit started with a pretest of eighteen questions to assess student's prior knowledge. Following the analysis of the pretest I began planning the unit. As I planned the unit, I integrated research based instructional and assessment strategies in the individual lessons. The unit concluded with a post-test that was the same as the pretest.

Understanding of Instruction Methods

Think-Pair-Share

To help students gain a new understanding of any topic, research has noted that teachers must use research-based instructional strategies that are proven effective to give students the best chance for success. The instructional strategy, think-pair-share, was integrated into the math unit. This strategy is also known as a turn and talk and is associated with cooperative learning. Researchers Mundelsee and Jurkowski (2021) defined the three steps of this strategy. First, students think about the question that was asked on their own. Second, they pair up with a classmate and talk about the answers they have brainstormed. During this time, the students share, discuss, and challenge one another's ideas. Finally, the students finish their conversations and share their ideas with the whole class (Mundelsee & Jurkowski, 2021).

When it comes to answering questions in front of the whole class, experience has shown that many students do not raise their hands. This could be for many reasons. They may not know the answer to the question, they could have an answer but worry that it is wrong so they will not raise their hand, or students simply may not have enough confidence or motivation to want to raise their hand to participate at school. Because of these reasons and more, Mundelsee and Jurkowski (2021) focused a study on possible reasons why students do not raise their hands. During their study, they observed students' motivation or shyness in raising their hands to answer a question without the teacher using a think-pair-share. Then, they looked at the effect a think-pair-share had on this. After a social studies lesson with a group of ninth-grade students, their results showed that by integrating the think-pair-share strategy, more students raised their hands to answer questions. According to Mundelsee and Jurkowski (2021), "exchanging ideas with a partner is an essential condition to foster elaboration of ideas and confidence in sharing them in class" (p. 9). They observed that when students had opportunities to talk to their peers about a question, or if they did not have an answer to begin with, they created an answer based on their peers' ideas. They found that if the student was not sure if their answer was right or wrong, they could collaborate with a peer to discuss what could be the correct answer. Finally, they found that if students received validation of their answer by their peers, the students' confidence increased. "The combined effect of individual preparation and receiving validation of their ideas from their partner might increase the self-confidence of students" (Mundelsee & Jurkowski, 2021, p. 3). Think-pair-shares are a gateway for teachers to use because it not only increases self-confidence in students answering questions and classroom participation, but it increases the quality of answers and responses students share with the class.

Think-pair-share is a research-based strategy to integrate into lessons because it provides students more think-time and opportunities to be involved in the discussion of the question being asked. During the first step, students receive think-time for a question. Then, by enforcing the pairing stage where each student discusses the question, the students become more engaged in their learning. Silva et al. (2022) shared that, “Think-Pair-Share enables great oral and written argumentation, the discussion of different perspectives, and increases the quality of responses by increasing the waiting time” (p. 13). When more time is given to think about an answer and then discuss it, the quality of responses increases immensely. Silva et al. (2022) conducted a study with fourth-grade students to show how collaborative learning (think-pair-share) increases critical thinking skills for students. Critical thinking is a skill for students to help them avoid making mistakes in the classroom. According to Silva et al. (2022), “critical thinking is purposeful, rational, and goal-oriented thinking” (p. 12). While participating in observations, argumentations, making inferences, and more, students can produce better responses by using those critical thinking skills (Silva et al., 2022). Through participation in think-pair-shares, students practice and enhance their critical thinking skills to help them be successful in and outside of the classroom.

Physical Models and Manipulatives

A second strategy that sets students up for success is the incorporation of physical models and manipulatives in the classroom. A physical model or manipulative is a hands-on tool a student can use to help them develop a deeper understanding of a topic. According to Goodman et al., (2016), “manipulatives provide concrete examples of abstract concepts” (p. 59). In their study connected to spatial tasks, Goodman et al., (2016) found that physical representations are an easy and simple way to get students involved in a lesson. When students are given objects to touch and manipulate, they are more engaged in their work to solve a problem. Research has found that students prefer physical manipulatives over digital tools. For example, Goodman et al., (2016) noted that, "physical books are also reported as the overwhelming favorite modality among readers" (p. 59). When students use physical manipulatives like books or math tools, higher outcomes of success are reported because of the increased participation this strategy provides students. Physical models/representations provide opportunities for students to take control of their learning because they get to manipulate the tools in front of them. They can take in information directly and clearly to help them solve problems. Goodman et al. (2016) noted in their research that physical manipulatives have been used for many years. A meta-analysis was conducted and, "found that the use of physical manipulatives in math education tends to improve retention, problem-solving, and transfer" (Goodman et al., 2016, p. 59). Retention is a critical component for students because it allows them to take those skills with them to upcoming units and future grade levels.

Even with the constant evolution of technology in the classroom, physical representations are still an effective tool to use with students. Oymak and Ogan-Bekiroglu (2021) looked at the implementation of physical materials for a science lesson and the impact it had on the learning environment. Physical representations still have a large and positive impact on learning because of the conceptual and procedural knowledge students gather. "Both physical and virtual manipulatives can achieve similar objectives, such as exploring the nature of science, developing teamwork abilities, cultivating interest in science, promoting conceptual understanding, and developing inquiry skills" (Oymak & Ogan-Bekiroglu, 2021, p. 25). Their study showed this strategy works for science but can be adapted to all other content areas. They found that physical representations provide a quicker form of assessment as well. Oymak and Ogan-Bekiroglu (2021), noted that when a student uses physical manipulatives, they are actively involved in the lesson. Because of this, the teacher has new forms of assessment to eventually provide feedback and scaffolding if needed. Oymak and Ogan-Bekiroglu (2021) stated that, “by providing a learning environment where the students expressed themselves and worked as groups, the instructor observed them and used real-time assessment” (p. 35). This strategy is important to use because it provides students with differentiation in the classroom because of its modality. Research has noted that teachers should use multiple instructional strategies and modalities to accommodate all learners. Teachers should also keep that same mindset when it comes to planning and incorporating assessment strategies.

Understanding of Assessment Methods

Nonlinguistic Graphic Representations

Assessments are tasks that teachers use to evaluate where their students are and how they are progressing with understanding content. There are many research-based assessment strategies that teachers can implement into their instruction to assess student knowledge. One of those strategies is using nonlinguistic representations. Kelly (2020) defined a nonlinguistic representation as, “the imagery mode of representation, primarily taking the form of mental pictures, graphics or images, and physical feelings, sensations, or experiences” (p. 1). They help students process more information because they are actively participating and engaging in their learning (Kelly, 2020). There are many types of nonlinguistic representations that teachers can implement in the classroom to assess students. One way is through a graphic representation, which is a strategy where students create a graph to show and represent data. According to Ott

(2020), learner-generated graphic representations serve as an aid for problem-solving. Ott (2020) described how learner-generated graphic representations, “are more complete and more richly inscribed” (p. 96). Ott’s study focused on how graphic representations can aid with solving word problems. The study evidenced that graphic representations were effective because through creating and reading a graphic representation, students take in information directly to help them solve word problems. “In graphic representations, therefore, due to the position of the individual elements, relationships become directly apparent” (Ott, 2020, p. 94). This tool can be an assessment document to show the results of students' performance. Through the visual teachers can assess students’ understanding of creating a graphic representation to show data on a topic.

Nonlinguistic Graphic Organizers

Another type of nonlinguistic representation is graphic organizers. Graphic organizers are visual tools students can use to express knowledge and show relationships between concepts. Kwon et al., (2018) performed a study to see if students’ use of graphic organizers would increase their engagement with their schoolwork. The study proved that graphic organizers help facilitate higher levels of engagement and thinking. They also help students look at ideas other than their own. Graphic organizers help take students’ thoughts and put them in an organized chart so they can communicate clearly and think more critically about a subject.

According to Kwon et al. (2018), “A graphic organizer visualizes selected issues and their relations so that students can efficiently grab the relations of arguments, the contrasts of issues, and the flow of discussion” (p. 1480). They also present an opportunity for student choice in the classroom. When students are given the chance to create a student-generated graphic organizer, student motivation increases. “Graphic organizers, when students either received or generated, seemed to promote students’ consideration of alternative views” (Kwon et al., 2018,

p. 1496). This study showed that whether the graphic organizer was student-generated or teacher-created, engagement was increased because of the overall impact a graphic organizer has on a student's education. Once they are completed, teachers can formally assess their work to see what they know. Graphic organizers are a piece of nonlinguistic representations as an assessment piece because they help students with higher levels of thinking, provide a physical tool to work with, and gets students actively involved in the classroom. Both nonlinguistic representations (graphic organizers and graphic representations) are assessment strategies that provide a visual of students' ideas and thoughts. The visual provides the teacher with feedback to see how the student is processing information.

Feedback

A second assessment strategy that is effective to use in the classroom is the use of feedback. Ion et al. (2019) studied the impact of feedback on students' learning. They found many benefits when feedback is given by a teacher as well as from their peers. "Peer feedback can be considered both a form of formative assessment, i.e., the counterpart of teacher feedback, and a form of collaborative learning" (Ion et al., 2019, p. 125). Whether feedback is given by the teacher, or their peers, students and teachers learn a lot during this assessment process. Teachers can assess students as they are having a feedback conversation with another student to see what each student knows. From there, the teacher can provide feedback to both of those students to clarify any misconceptions. According to Ion et al., (2019), "providing feedback is considered a key component of learning" (p. 127). Feedback is individualized for each student. Providing students with feedback is a strong assessment tool as the teacher's comments provide students feedback on how they are doing.

Feedback can come in many forms. Chen et al., (2022) performed a study to see if the use of emojis had more of an impact than other forms of feedback. They looked at how the use of emojis for feedback impacted students, particularly students who are English Language Learners (ELLs). An emoji is a small image or icon that is digital to help express an emotion, thought, etc. Many students love using emojis for schoolwork because of their connection to technology. “The effectiveness of using emojis to facilitate communication between teachers and students has been confirmed” according to Chen et al. (2022) (p. 2).

Students who are ELLs may not positively respond to verbal or written feedback because they are still learning the language. However, researchers have found that when using emojis for feedback, ELLs responded well to emojis. According to Chen et al. (2022), “when people use emoji faces in computer-mediated communication, the receivers’ neural responses are similar to those in the situation of face-to-face communication” (p. 5).

Feedback is a simple, yet powerful tool for assessment because it helps a student get on the right progression path. Formative assessments, class activities, and instructional activities are starting to appear more on technology devices. Emojis are becoming more apparent in school, because of this. When used appropriately, all students can read feedback in the form of emojis. Regardless of which form of feedback teachers use, they are encouraged to find balance in giving feedback to their students. An element to providing effective feedback is to know the students and create a feedback plan that is best suited for individual students and the class.

As teachers provide feedback, they are looking at a completed assessment tool to determine what students know. Teachers also use assessment data as a conversation starter, whether verbal, written, or digital with emojis, to dig deeper into a student’s knowledge. Teachers should incorporate a variety of assessment tools and strategies to meet all their students' needs. Effective assessment modalities are key to assessing a student's present level of performance, where they are going, and how a teacher can modify and differentiate instruction to help all students.

Participants

The participants of this study were the 2nd-grade students at Birchcrest Elementary School. The class was comprised of nine boys and eight girls. 24% of the students were on an Individualized Education Plan (IEP). The four students had IEPs in the following categories: Student 1: reading and math, Student 2: reading and writing, Student 3: writing, and Student 4: speech and language. Of the seventeen students, 12% qualified as English Language Learners. 18% of the students were in the evaluation process to determine if they would qualify for the High Ability Learners enrichment program in math.

Methods and Materials

This unit connected to three Nebraska state standards.

- MA 2.3.3.b: Identify and write time to five-minute intervals using analog and digital clocks and both a.m. and p.m.
- MA 2.4.1.a: Create and represent a data set using pictographs and bar graphs to represent a data set with up to four categories.
- MA 2.4.2.a: Interpret data using bar graphs with up to four categories. Solve simple comparison problems using information from the graphs. (NE Department of Education, 2015, 10-11).

From these standards, I created objectives for the students to meet during instruction.

An eighteen-question pretest (Appendix A) was given to students on the first day. The pretest was administered to assist me in determining what background knowledge the students had about telling time, reading, and interpreting bar graphs, and more. The day I administered the pretest the students were encouraged to try their best. I also shared with the students that incorrect answers would not count against them. They did not receive any assistance from me or my cooperating teacher during the pretest. Following completion of the pretest I graded the tests and began planning my unit. After analyzing the pretest data, I created differentiated math groups. I created three groups: a high group, a middle group, and a low group. The three groups would be utilized in daily instruction to provide the most appropriate instruction for students.

After the pretest, ten days of instruction began. Each day had a similar flow and pattern. I utilized three math stations the students would rotate through during the math block. In station one the students worked with me. This station focused on the day's content and the students would receive direct instruction. I walked them through the gradual release model to teach them the new topics.

Station two was labeled as "activity". Depending on the day or lesson, students would complete an activity with my cooperating teacher or complete an activity with a partner. The activities were either extra practice with that day's content or extensions of previously taught concepts. These were provided to help with higher retention and mastery of the basic skills. On day one of instruction the students reviewed counting by 5s. This review was integrated into the lesson because when it comes to telling time on an analog clock by 5 minutes, the strategy taught to students was to count by 5s. The goal was that through practicing this skill the students could review background knowledge and prepare for the independent work ahead. Appendix D provides an independent activity students completed after instruction of telling time to 5 minutes and review of counting by 5s. The student work samples provided me with information that assisted me in determining if the students could successfully use the strategy of counting by 5s to tell time by 5 minutes on an analog clock.

The third station students rotated through was called “at your seat”. In station three, students would work independently at their seats on the independent piece of the gradual release. The students were tasked to either finish their workbook pages or a SeeSaw (educational app assignment). See Appendix C for an example of an independent work task. If they finished early in station three, they were given several options of what to do (e.g., free choice math app, telling time app, or an individual math activity).

The students would move stations with their differentiated math groups. Each group received the same instruction with minor adjustments. For example, the higher group may have been offered some more extension activities, and the lower group may have been provided with more modeling and explicit instruction. I planned each station rotation to ensure instruction was appropriate for every learner.

Based on the pretest data, most days of instruction were spent practicing telling and writing time on an analog clock. This instruction lasted five days. The students then spent four days learning about graphs and interpreting the data. They worked with bar graphs, pictographs, and line plots. The final day of instruction included a whole class review on Nearpod (a review app on an iPad) to prepare for their post-test.

I utilized multiple research-based instructional and assessment strategies throughout my unit to set students up for success. I incorporated think-pair-shares to help students critically think about topics that were presented. I found this to be a great tool to enhance cooperative learning. I implemented the think-pair-share strategy when I addressed the difference between A.M. and P.M. Students were paired up to discuss the difference between A.M. and P.M. and what activities happen in those time periods. I found this strategy was effective because students produced higher-quality responses and learned the big, important difference between the two.

Another instructional strategy I integrated repeatedly throughout this unit was using physical models/manipulatives. Students created their own paper clocks to help them practice telling time (Appendix B). The clocks were used at the very beginning of the unit and were slowly taken away to help students start to remember the strategy for telling time by 5 minutes. Students also used small clocks without flaps to practice showing times.

Another physical model students used was a ruler to practice measuring lengths and then turning that data into a line plot. I had students practice with manipulatives. They were provided with small clocks to move the clock hands as well as some M&M candy to create a bar graph. This activity assisted students in seeing the relationship between the data (M&M) to understand and answer analysis questions.

An assessment strategy that I used multiple times throughout the unit was nonlinguistic representations. For example, an end-of-day formative assessment students completed a T-chart to help them master the difference between A.M. and P.M. (Appendix E). Another nonlinguistic representation students used was the use of bar graphs. Bar graphs are categorized as a nonlinguistic representation. Because of a bar graphs visual attributes, the graph helps students visualize and take in information and relationships between data directly. The students created a bar graph that served as a great tool to help them answer simple analysis and interpretation questions quickly (Appendix F).

I also used feedback multiple times as an assessment tool. I gave students verbal or written feedback on several of their small group and seatwork assignments. From observing their work, I could identify which strategies they used to complete the assignment. As I interacted with the students, I promptly provided feedback. I found that the quicker I provided the feedback, the quicker the students clarified any misconceptions they may have had. The immediate feedback also provided students with confirmation that their new understandings were on the right track. Throughout the unit I also engaged the students in giving feedback to one another.

During our Nearpod review before the post-test, I would pick one student to share their answer. The student would explain their thinking and how they got that answer. Then, I would have the class participate in a math talk. The student whose answer I chose would pick a friend who was raising their hand. The student who was chosen would either say they agreed or disagreed and had to explain why. The student would explain how they got their answer and why it was a similar process to the first student. This activity provided additional feedback because the second student was helping the first student clarify if their answer was correct. The second student would provide another strategy to solve a problem which provided another tool to the first student, as well as the whole class.

The last day of instruction I administered the post-test. (Appendix A). The post-test had eighteen questions and it was the same test as the pretest. I graded the tests immediately and recorded the data. I compared the data from the pre and post-test to determine if student test scores had improved. If there was an improvement from the pre/post-test, I could use the data to determine if the instructional and assessment strategies I planned and implemented throughout the unit were successful.

Results/Data Analysis

Pre-Assessment

Table 1: The table below shows the pretest question/student correct answer ratio. On the horizontal axis is each student. In the last row, there is the overall pretest score for each student. The vertical axis shows the question number and the number of points that were attached to each question. The final column shows the number of students who got each question correct. This table assisted me in planning for instruction because it showed which questions students struggled with and which questions students were able to answer correctly based on prior knowledge.

Q: Question—S: Student—2p: 2 points possible—8p: 8 points possible—39p: 39 points possible for the whole test—-TCQ: Total Correct for Each Question—TS: Total Score for the Test

Q#	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	TCQ
#1 (2p)		1	2	1			1	1		1	1		1			1		1
#2 (2p)		1	2	1		1	2	1	1	1	1	2	1	1	2	2	1	5
#3 (2p)			2			1	1			1	1		1			2		2
#4 (2p)		1	2	2	1	1	2	1		2	2	2	1		2	2	1	8
#5 (2p)		1	2	1	1		2			2	1	1	1		1	2		4
#6 (2p)			2	2	1		1	1		1	1	1	1		1	1	1	2
#7			1		1					1	1	1	1		1			7
#8			1		1				1	1	1		1		1			7
#9		1	1	1		1		1		1			1					7
#10			1												1			2
#11		1	1												1			3
#12			1															1
#13			1	1							1							3
#14											1				1			2
#15		1	1							1	1				1			5
#16 (8p)	4	6	4	3	4	2		4	2	7	4	2	2	7	2	7	3	0
#17 (8p)	7	1	8	7	3	7	1	7	1	3	2	6	7	1	7	8	2	2
#18 (2p)	1		1				1			1				1	1	1		0
TS (39p)	12	14	33	19	12	13	11	16	5	23	18	15	18	10	22	26	8	

Post-Assessment

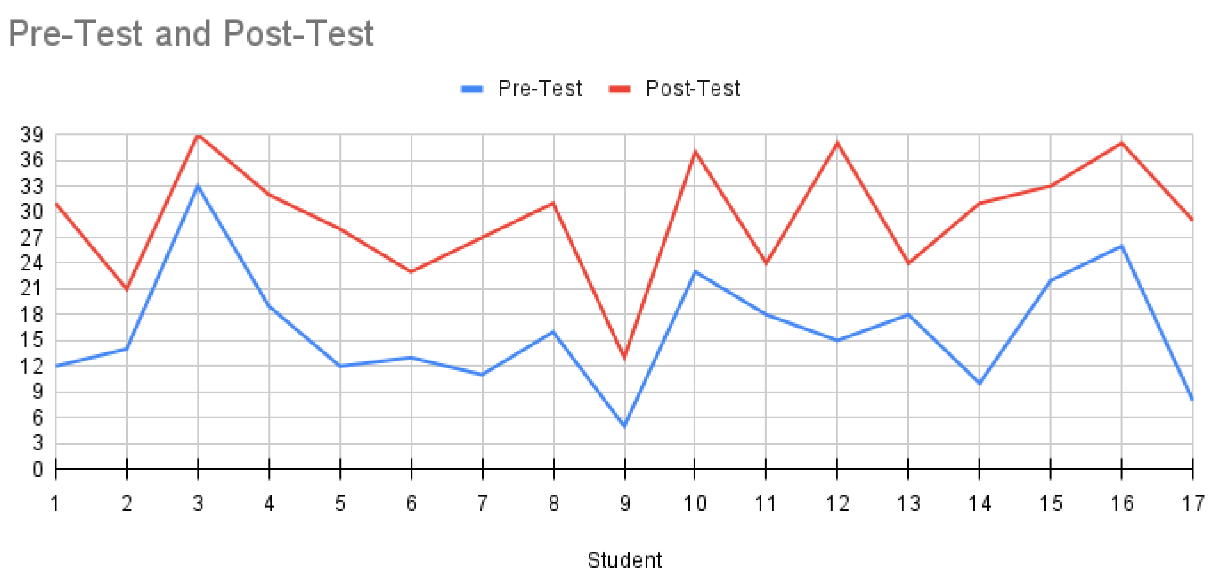
Table 2: The table below shows the post-test question/student correct answer ratio. On the horizontal axis is each student. In the last row, there is the overall post-test score for each student. The vertical axis shows the question number and the number of points that were attached to each question. The final column shows the number of students who got each question correct. This table showed progress from the pretest to the post-test. The data helped me see which content areas students came to understand and what new knowledge they acquired through this "show me what you know" assessment.

Q: Question—S: Student—2p: 2 points possible—8p: 8 points possible—39p: 39 points possible for the whole test—-TCQ: Total Correct for Each Question—TS: Total Score for the Test

Q#	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	TCQ
#1 (2p)	2	1	2	1	2	1	2	2	1	2	2	2	2	2	2	2	2	13
#2 (2p)	2	2	2	1	2	1	2	2	1	2	2	2	1	1	2	2	2	12
#3 (2p)	2	1	2	1	2	2	1	2	1	2	2	2	1	1	2	2	1	10
#4 (2p)	2	1	2	2	2	2	2	2	1	2	1	2	1	2	2	2	2	13
#5 (2p)	2	1	2	2	2	1	2	2		2	2	2	1	2	2	2	2	14
#6 (2p)	1	2	2	2	2	1	2	2	1	2	1	2		2	2	2	2	12
#7	1		1	1	1				1	1	1	1	1			1	1	11
#8	1		1	1	1				1	1	1	1	1			1	1	11
#9		1	1		1	1				1	1	1				1		8
#10	1	1	1		1		1	1			1	1	1	1	1	1		12
#11			1	1	1			1	1	1	1	1		1	1	1	1	12
#12	1	1	1		1	1	1	1		1	1	1	1	1	1	1	1	15
#13	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	16
#14	1		1		1	1	1	1		1	1	1		1	1	1	1	13
#15	1	1	1		1		1	1	1	1	1	1		1	1	1	1	14
#16 (8p)	4	7	8	7	8	3	3	4	3	7	4	8	6	7	7	7	7	3
#17 (8p)	8		8	8	8	7	7	8	1	8	1	7	6	7	7	8	2	7
#18 (2p)	1	1	2		2	1	1	1		2		2	1	1	1	2	2	6
TS (39p)	31	21	39	28	39	23	27	31	13	37	24	38	24	31	33	38	29	

Pre vs Post Test

Table 3: The table below represents students' overall improvement for the unit that was taught. The horizontal axis notes the seventeen students who participated in this unit. The vertical axis represents what score each student got. The highest number on that axis is 39 (number of points possible for the test). The blue line represents the pretest scores. Based on the data, students had a baseline understanding of the content they were about to interact with. The highest score was 33, and the lowest score was 5. After ten days of lessons and instruction, I administered the post-test (red line). The highest score was 39, and the lowest score was 13. At first glance, the data shows that all students improved from pre to post-test and gained more knowledge and understanding of the content taught.



Discussions and Conclusions

When starting to plan instruction and looking at the pretest scores, I created differentiated math small groups to guide instruction. Each group included 5-6 students. The high group consisted of students who had the highest scores and students who had a strong base in math. The high group students were Students 3, 4, 5, 7, 8, and 16. Although Students 5, 7, and 8 did not have some of the highest scores, yet I placed them in the high/extension group. Following a conversation with my cooperating teacher about the data, we believed the scores of students 5, 7, and 8 may have been due to anxiety over the pretest. Prior to the math pretest, students had never participated in a pretest. During instruction with the high group, I made sure to still go over the day's content that I did with the other groups. For each lesson I had an extension activity planned on the topic to challenge this group more. The extension activities were to help them have a deeper understanding of that day's instruction and keep them challenged. For example, I worked with these students on creating graphs that had a scale different than 1 or starting to practice telling time to the minute.

The students who struggled with the pretest were placed in my low group. The low group, students 1, 9, 13, 14, and 15, I created a combination of students who had low scores and had less math success. I made this decision with approval from my cooperating teacher. We created this group as we felt this group would need additional instruction. This group received more direct and explicit instruction during daily instruction. I included more modeling and think-alouds in comparison to the other groups to assist them in understanding the content.

The middle group included students 2, 6, 10, 11, 12, and 17. These students received grade level direct instruction. Depending on how this group did each day, I would also offer a little extension or reteaching if they struggled with the content. All the groups all showed great progress in understanding the content.

For each group, I used instructional strategies to teach them new ways to solve math problems. I observed students using the strategies immediately following instruction. With practice, the students began to use the strategies in their independent work as well as their post-test. More teaching and reteaching were planned for all students during the activity station of the math rotations. Some days the activity would revolve around the topic, and the students would either complete the activity with a partner or be guided by my cooperating teacher.

When I compared the pre and post data I noted that the instructional strategies I used during the unit were effective as all the students' scores improved. Some strategies that I know were effective was my use of think-pair-shares. I used this strategy during one of my lessons to help promote a better understanding of AM vs PM. I specifically planned this because the question scores data showed those questions had a lower correct number of answers. When looking at Appendix A, Questions 1-6 had students telling time and then answering a question related to AM and PM. Each student answered six questions with this format. There was a total of 102 questions and, after looking at the data, only 22 questions were answered correctly, which is 22%. When looking at the post-test data, a significantly higher number of students answered those questions correctly shown in the data. The percentage of correct answers increased to 73% (74/102 questions). I believe this changed because students received more time to process the concept of AM and PM. During think-pair-share the students discussed the words associated (morning, evening, night) with AM and PM, and what activities happen during those times.

I also found the integration of student-to-student feedback was effective. During the test review, students participated in math talk. The post-test scores evidenced that students used different strategies discussed during feedback time to solve the problems. I believe this led the students to the correct answers. As I reviewed Questions 16 and 17, I believe the higher scores on the post-test were a result of the students answering the analysis and interpretation questions correctly. For these questions the students demonstrated the use of the strategies learned throughout the unit. Some from feedback or others explicitly taught. Although the overall bar graph question scores may not look improved, when I analyzed the student's individual tests (pre and post) side by side, many students made improvements and scored higher when it came to the interpretation questions.

Based on how the curriculum guide outlined the unit, most of the instructional time was spent working with clocks and telling time. Following review of the pretest data, if the curriculum had been outlined differently, I would've spent more instruction time on telling time. Most of the test was students telling time from an analog clock. To set them up for success, I made sure to teach and implement multiple practice opportunities and teaching opportunities to help students master this content. Reading an analog clock is a skill students need to master to assist them in their future grades.

The data on the pretest evidenced that students did not know how to tell time on an analog clock. In review of Questions 10-15 (Appendix A) these two questions specifically asked questions about the analog clock. Only 16 out of 102 (6 questions times 17 students) questions were answered correctly, which is 16%. The responses to these questions noted a significant gap. The gap guided my planning. I implemented a variety of strategies (e.g., physical models/manipulatives, think-alouds, think-pair-shares, review games, and exit tickets) to improve student scores. The post-test data evidenced that implementation of the strategies was successful as 82 out of 102 questions were answered correctly, which increased the scores to 80%.

After administering the unit, analyzing data, and reflecting on my practices as a teacher, I found that the strategies I used and the instruction I implemented were effective processes. The data visually demonstrates the growth students made. Implementing a variety of instructional and assessment strategies sets the students up for success.

Research has noted that when students are given multiple ways to solve a problem and information is presented to them in different forms (different strategies), they are more engaged in their learning that leads them to success. All the students' scores improved from pre to post-test. I found that I had to teach topics explicitly and intentionally to students in ways that kept them actively engaged. When I, and other teachers, can set students up for success, we are helping the student see their potential and all the ways they can grow to reach their goals. I believe student success starts with me being intentional and passionate in my instruction. I found a simple way to do this was to create a fun, positive, safe, and welcoming learning environment for all learners and keeping their learning styles in mind.

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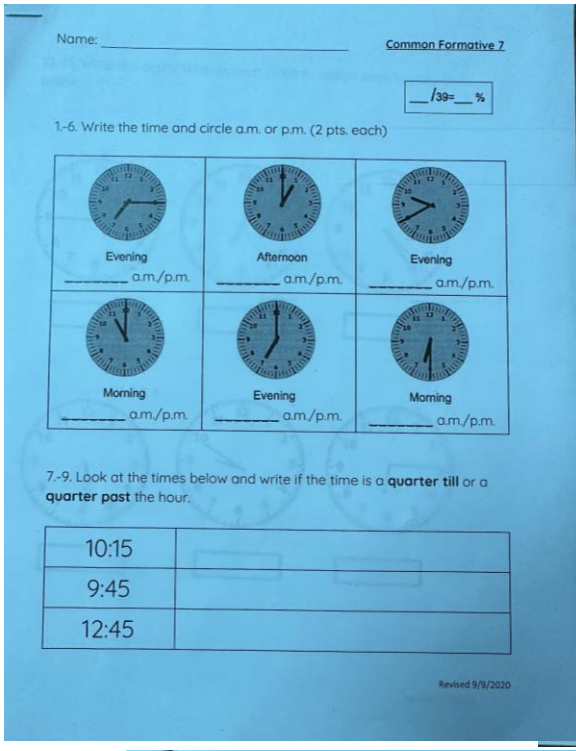
Appendixes

<u>Appendix A:</u> Below are pictures of the pre and post test that was given to students.


Name: ______________ Common Formative 7

___/39= ___%

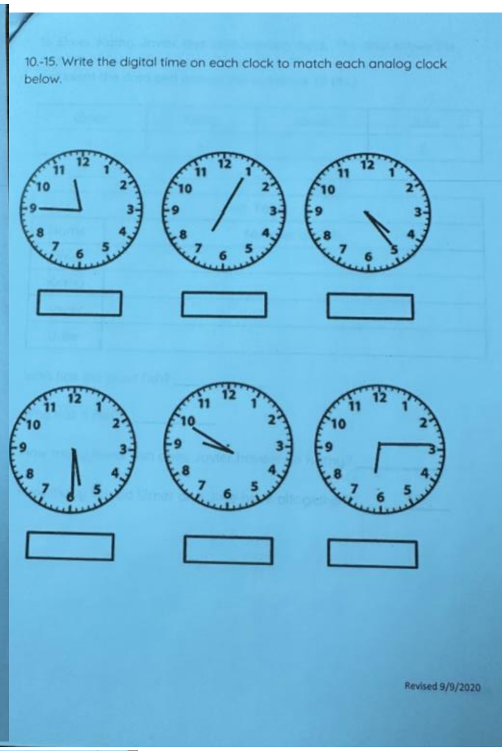
1.-6. Write the time and circle a.m. or p.m. (2 pts. each)

Evening _______ a.m./p.m.	Afternoon _______ a.m./p.m.	Evening _______ a.m./p.m.
Morning _______ a.m./p.m.	Evening _______ a.m./p.m.	Morning _______ a.m./p.m.

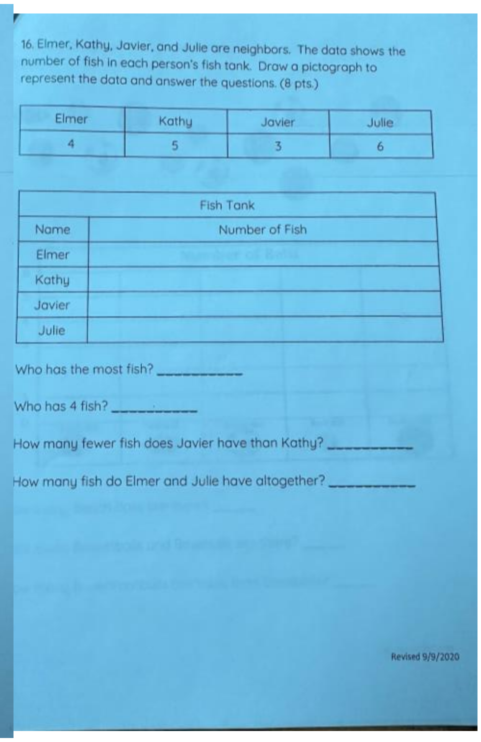
7.-9. Look at the times below and write if the time is a **quarter till** or a **quarter past** the hour.

10:15	
9:45	
12:45	

Revised 9/9/2020


10.-15. Write the digital time on each clock to match each analog clock below.

Revised 9/9/2020


16. Elmer, Kathy, Javier, and Julie are neighbors. The data shows the number of fish in each person's fish tank. Draw a pictograph to represent the data and answer the questions. (8 pts.)

Elmer	Kathy	Javier	Julie
4	5	3	6

Fish Tank	
Name	Number of Fish
Elmer	
Kathy	
Javier	
Julie	

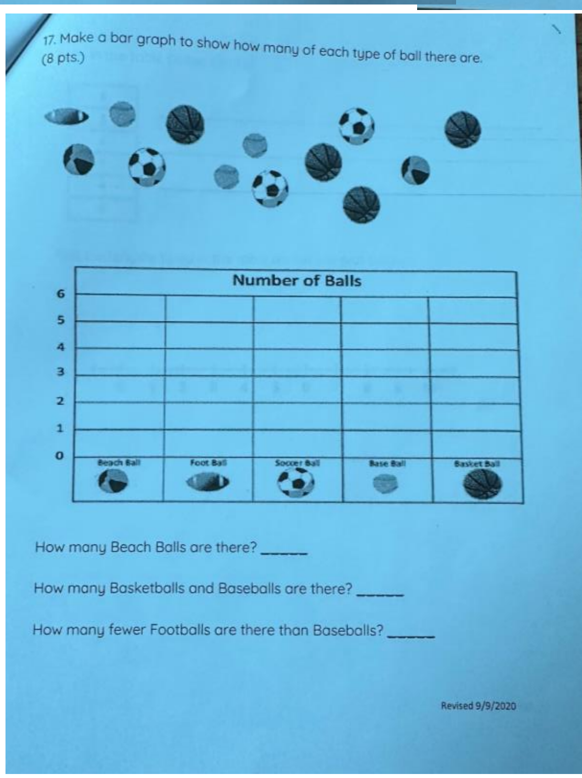
Who has the most fish? __________

Who has 4 fish? __________

How many fewer fish does Javier have than Kathy? __________

How many fish do Elmer and Julie have altogether? __________

Revised 9/9/2020

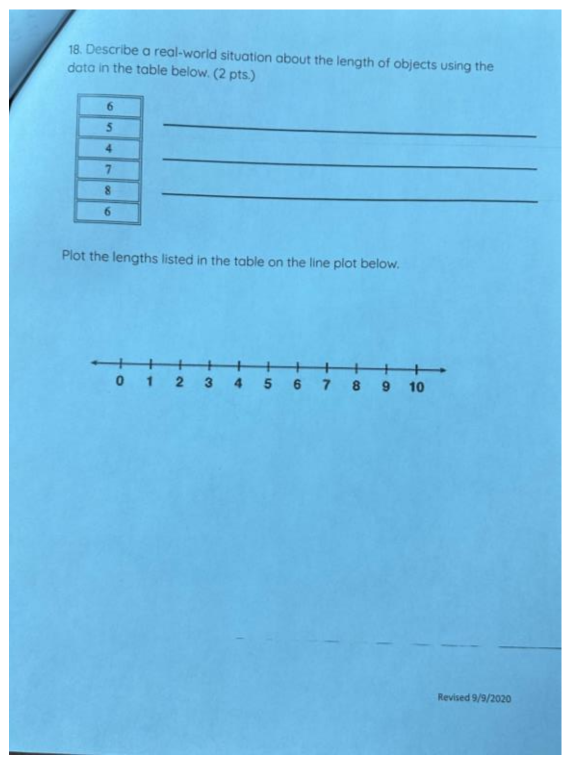

17. Make a bar graph to show how many of each type of ball there are. (8 pts.)

How many Beach Balls are there? _____

How many Basketballs and Baseballs are there? _____

How many fewer Footballs are there than Baseballs? _____

Revised 9/9/2020

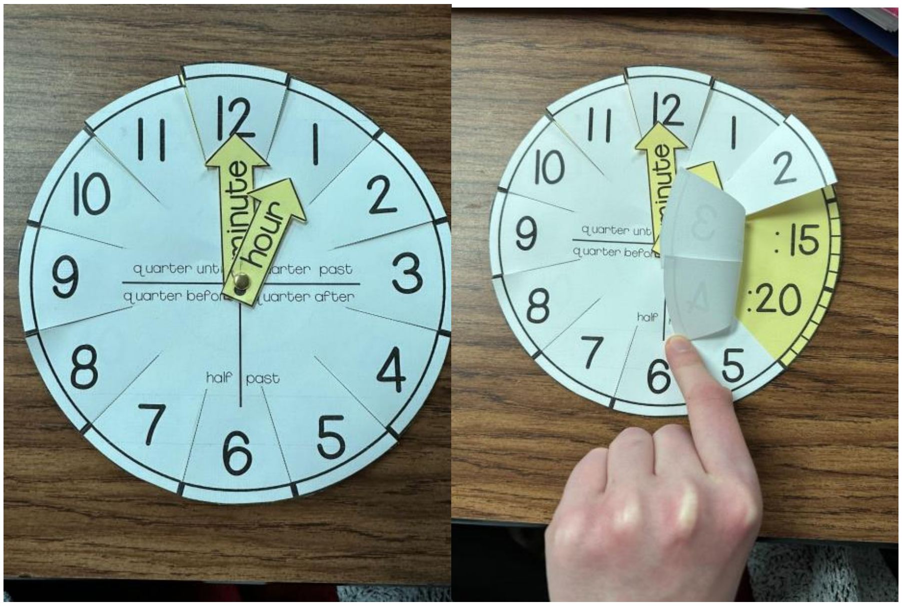

18. Describe a real-world situation about the length of objects using the data in the table below. (2 pts.)

6
5
4
7
8
6

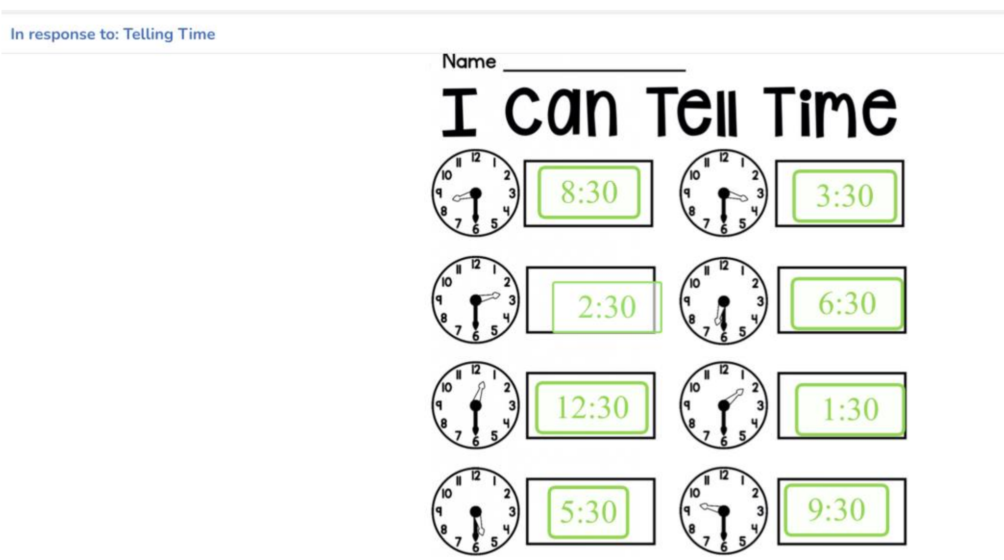
Plot the lengths listed in the table on the line plot below.

Revised 9/9/2020

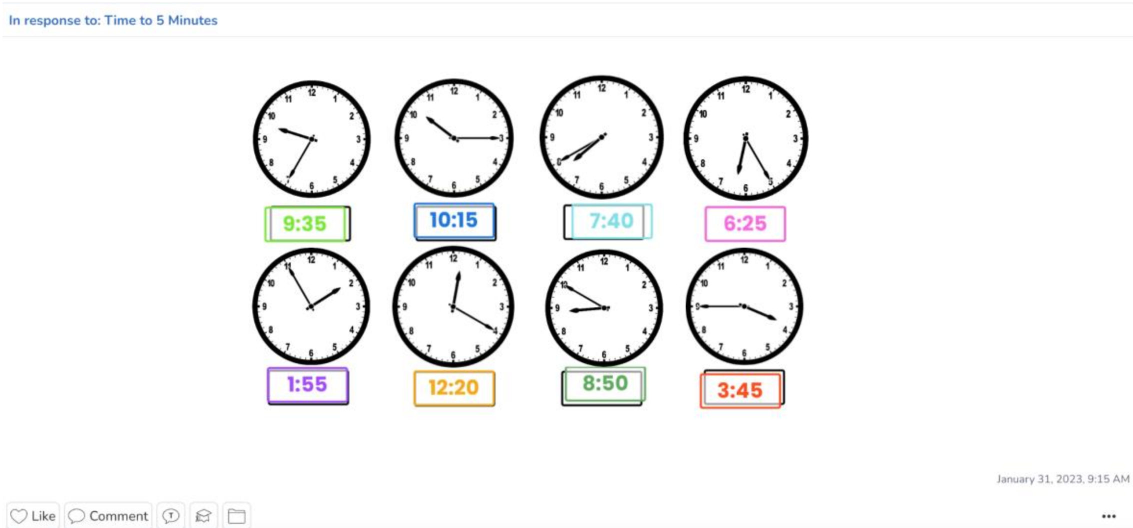
Appendix B: *Student Work Sample* Paper clocks (physical manipulatives/models) to practice telling time to 5 minutes used at the very beginning of the unit.



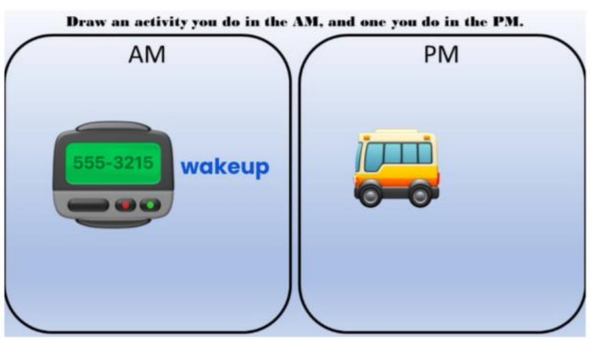
Appendix C: *Student Work Sample* Exit ticket for quick review of telling time to the half hour.



Appendix D *Student Work Sample* Formative Assessment for Telling Time to 5 Minutes (Technology tool for formative assessment)



<u>Appendix E: *Student Work Sample* </u>Graphic organizer (t-chart) used as a formative assessment for students to show the relationship between A.M. and P.M.



<u>Appendix F: *Student Work Sample* </u>Created bar graph to help students show the data visually and eventually answer interpretation questions.