Master Capstone Project

The Impact of Math Games on Students Engagement and Attitudes Towards Mathematics for Students in First Grade
A Classroom Action Research Study

Kevin Graham

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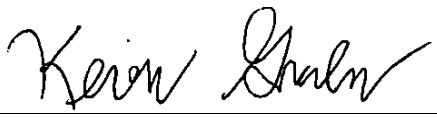
Submitted by		2-21-2025
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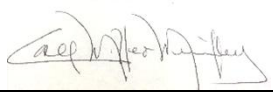
Approved by		2/22/2025
	Corll Miller Morrissey, M.Ed.	Date
Approved by		3/3/2025
	Vicki Butler, Ed.D.	Date

Abstract

This action research study explored the impact of gamification on first-grade students' engagement and attitudes toward math. Conducted in a classroom of 17 students in Washington, the study employed four action cycles. The first cycle established a baseline for student engagement and attitudes. Subsequent cycles introduced a new gamified math lesson each week, examining improvements in engagement and attitudes compared to traditional direct instruction lessons. Gamification was found to positively impact both. Validation of data included student surveys, teacher observations, math community circles, student interviews, mentor teacher discussions, and digital game reports.

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Introduction

It is not uncommon to hear from students that math is a scary and even an unenjoyable subject in school. However, as someone who has both loved math and loved games their entire life, I was inspired to see how melding the two, games and math, could turn the tide on student perception of this subject and bring joy back to learning a subject that can be daunting for some students. My hope was to inspire students, giving them a subject in school to look forward to. A bias of mine is that I like math and have a good relationship with the subject. I personally enjoy math games. As a teacher it is a subject I enjoy, am most passionate about and feel the most comfortable with.

Problem Statement

In my classroom, I have observed a pattern of decreased engagement and increased negative attitudes towards math among some students in my first-grade classroom. This manifests in behaviors like negative body language, reluctance to engage in classroom discussions, not engaging in assigned work, unfinished work, verbal expressions of difficulty, lack of enjoyment or dislike for math. These challenges present an obstacle for me as an educator striving to improve student outcomes in this subject.

Rationale

The foundation of my efforts to explore this educational challenge is rooted in my belief that classrooms should be vibrant and exciting learning environments where students are eager to learn. The big reason for this study is to increase engagement and attitudes towards mathematics. When students are engaged, they are interacting with the content, the teacher and fellow students. Each of these interactions gives the students an opportunity to learn and grow. When students are engaging with the content, they are retaining more knowledge and giving their

teacher the signs they need to adjust their teaching styles to meet the students' needs. In the first-grade classroom I conducted my study in, our longest portion of the day is math. I want students to look forward to this time of the day, be able to make strong connections to the content and have positive memories to look back on when thinking about math.

Question/s

Can the use of math games enhance engagement and attitudes towards mathematics among primary grade students in elementary schools?

- How can teachers effectively integrate math games into their primary mathematics curriculum?
- What is engagement and how is it measured in a primary classroom?
- What types of games are most effective in primary math education?

Literature Review

Student engagement has been a focus in education for decades. Dotter and Lowe (2011) and Fredricks et al. (2004) have identified engagement as a multifaceted construct encompassing behavioral, emotional, and cognitive dimensions. While these three forms of engagement may stand alone in certain contexts, Fredricks et al. (2004) highlighted how they are all interconnected. This literature review will delve into many aspects of engagement. It will define and describe the categories of student engagement, share different measurement strategies, and explore gamification through its connection to engagement.

Engagement

Categories of Engagement

Researchers and scholars have worked to define the various aspects of engagement. Skinner and Belmont (1993) described behavioral engagement as observable behaviors that

children display throughout learning activities where they initiate action, show persistence, exert prominent levels of effort and concentration while participating in learning activities. Similarly, Lei et al. (2018) explained it as the students' level of participation in the classroom learning environment. Emotional engagement refers to students' emotional reactions in the classroom towards teachers, students, and particular subject matters. This may also include their sense of belonging, value, and identity at school as well as their interest, boredom, happiness, sadness, and anxiety levels (Finn, 1989). Emotional engagement in students is shaped by their experiences and factors such as the quality of their relationships with teachers, the overall school climate, interactions with peers and the relevance of the curriculum to their lives. These play a role in determining whether students feel emotionally connected within an educational environment.

Cognitive engagement reveals what the learner is thinking about and how deeply they are engaging with the academic content (Goldspink & Foster, 2013). Cognitive engagement has two aspects: psychological investment and strategic learning (Fredricks et al., 2004). The students may be highly strategic and invested in their learning which can be formulated in multiple ways. For example, if the subject matter were of interest to the students they would be invested in the work, while in less appealing subjects they would take the strategic perspective, which may involve completing an assignment, engaging in discussions, but not thinking deeply about the content.

Motivation and Engagement

Data showed that when students are motivated, they are more engaged. Stohlman (2020) found this to be true when implemented an escape room style game (further explanation on page 11)with students. The motivation for the students was to earn a movie day for the class. The

results, as triangulated by both student interview and teacher observation, were an increased level of engagement with the content and high level of enjoyment in learning. The researchers noted that the students were motivated to solve the math problem that led them to an eventual escape. Hulse et al. (2019) conducted a study utilizing the math learning program From Here to There, the study had two groups, one where the students simply completed math problems and another where the students motivated to earn rewards as they progressed through the game. The study found that the students who completed the program with the motivational reward system, behaviorally and emotionally engaged with the content at a higher level. In a third study by Berrizbeitia (2024), the motivational factors were a race against the clock in a game called *Escape the Math Room* where if the students did not beat the clock, they would need to try again. The researcher observed elevated levels of engagement, in particular participation in the activity.

Evaluation strategies

Researchers have grappled with the complex task of developing reliable and valid measures for assessing student engagement in the classroom, given the multifaceted and complex nature of what engagement looks like within the living, breathing learning environment that is a classroom. Engagement is primarily measured through teacher observational practices and student surveys. Teacher ratings and student surveys have produced indicators related to conduct, participation, and work involvement (Fredricks et al., 2004). In both formats, scales were created to measure the level of engagement the students were displaying. Most of the studies that investigated tools for measuring engagement utilized a scale system, but they differed in many ways including the number of inputs and the types of engagement. Many studies utilized both observational and survey tactics to triangulate data.

Teacher observation and survey. In a study by Gremmen et al (2018), student engagement was measured through a teacher self-reporting questionnaire. The questionnaire asked the teachers to evaluate how well the students performed in ten distinct aspects of engagement, across all three levels of cognitive, emotional, and academic engagement. Capella et al. (2013) measured engagement through an observational process that categorized engagement into two categories, active and passive. Active was described as a student raising their hand, actively writing, or reading, while passive was listening to the teacher, showing positive body language or looking at a worksheet. The scores were added together and divided into 100 which produced a final engagement score placing the students at a particular level of engagement along a scale. Finn et al (1995), shared a comprehensive student participation questionnaire that was used in their study. The questionnaire included 24 questions and gave the teacher a scale of one to five to rate the student on. In this study, the survey was comprehensive and evaluated the engagement of the students over a two-to-three-month period.

Student Surveys and interviews. In addition to teacher observations, data revealed use of student surveys and interviews as a measuring tool for engagement. Goldspink and Foster (2013) investigated instruments for measuring student engagement. Through a process of four trials, they resulted in a self-reporting instrument that included 24 questions, measuring against seven different variables implicating students' level of engagement and feelings towards the subject area. The questionnaire was a mix of open-ended and multiple-choice questions, with the scale ranging from exceedingly high to very low. In another study, Deng et al (2020) measured engagement through interviews with students. In the study they interviewed students before and after the implementation of math games as mathematical instruction. The interview provided

qualitative data that indicated student engagement levels from boring and uninteresting to joyful, exciting and fun.

A study of 3rd to 6th grade students measured engagement through a self-reflection survey (Olivier et al 2020). The students were asked questions centered on engagement and were given a 1-5 scale to rate their level of engagement. In this study, the researchers used the data to establish a baseline average. Students' engagement was then measured in relation to this, they were either below at or above the average.

The research has shown many avenues that can be taken when surveying and interviewing students about their experiences and conducting teacher-led observations. While researchers have taken a variety of approaches, they have yielded results that have informed their studies about student engagement.

Community discussion circles. Evidence supported the use of community circles as an effective way for students to express their feelings about their experiences. Watchel (2016) shared that community circles give people the opportunity to speak and listen to one another in an atmosphere of safety, decorum, and equality. Silverman (2019) discussed using the community circle as a restorative practice in their middle school classroom. The community circle was focused on an upcoming talent show. It was their finding that the students felt comfortable and safe sharing their feelings in this environment. Furthermore, Silverman and Mee (2019) conducted a study in a middle school classroom, utilizing community circles for restorative justice. In their study, they discovered that community circles offered middle school students a safe and empowering space to express their feelings amongst their peers.

Gamification

Games in mathematics are described by Stohlman (2023) as tasks that involve a challenge against an opponent or oneself, that are governed by a set of rules, and have a clear ending point. They involve choice, strategy, and having a specific mathematical objective.

Gamification and Student Engagement

Data reflected a positive relationship between gamifying math instruction and an increase in student engagement. Al-Washami et al. (2021) conducted a case study on a group of thirty-one *year 5* students in the UK. In this study 86% of the students surveyed confirmed that math games helped them better engage and understand the content being learned in math. In another study Firadaus et al (2023) found positive impacts on student engagement using digital flip books. In the study of 222 second year students in an online learning environment in Indonesia, the researcher found that the students showed increased levels of participation through gamification, while interacting and engaging in the digital flip book. A third study also confirms the positive relationship between gamification and student engagement. Mangram and Pope (2015) researched the effects of a digital math game *Wuzzit Trouble* on student engagement. The researcher observed increased engagement while playing the game through students showing improved persistence towards achieving a goal and challenging the students to solve problems as new situations arose.

Collaboration in gamification. Research showed collaboration in gamification increases student engagement. Nguyen et al (2016) found that the odds of being engaged are 3.4 times greater when students were interacting with other students and the teacher, compared to when they were by themselves. Stohlamn (2023) found in his research that gamification put students in a position to interact with others and collaborate surrounding their learning which in turn increased engagement. Al-Washami (2021), in a study thirty-one year five students in the UK,

discovered that there was a noticeable increase in engagement and enjoyment was present when students were participating in collaborative style games. One such game referenced in the study children took turns counting forwards and backwards by 10.

Interactivity in gamification. There is evidence that interactive features within gamification increase engagement. Firadaus et al (2023) conducted a study with 222 year 2 students in Indonesia. In the study of digital flip books, it was found that including features such as quizzes, videos and interactive images helped to increase the engagement levels of the class through levels of participation. Mangram and Pope (2015), in their study centered on the digital game *Wuzzit Trouble* discovered that the interactivity of the game helped to increase the engagement levels of the students. The game presented new situations and challenged the students to use different types of math as the game went on, changing the outcomes of the game with each decision the student made; this interactivity displayed increased levels of student participation in the game. Berrizbeitia (2024) included interactivity in the game *Escape the Math Room*. In this game, if the students were not able to complete the tasks in the given time, they would be sent back to try it again. The results, as observed by the researcher, were increased levels of engagement in the learning by the students.

Types of games for increasing engagement

Digital Games. Digital games offered numerous benefits in the classroom, especially increased student engagement. Hulse et al. (2019) conducted a study with 185 second graders across three schools in Massachusetts utilizing the game based mathematic learning program *From Here to There*. The study had two groups, a gamified and non-gamified cluster, it found that the students in the gamified version engaged at a higher level resulting in larger cognitive increases as measured from a pre- to post--test. Pilon and Ruales (2024) conducted a study with

35 third grade students in the Philippines using a teacher made digital math game. In a pretest, 66% indicated low knowledge and understanding of the content, though after they engaged with the game, 100% of the students scored in the high-test range on the post test. They also demonstrated high levels of cognitive and behavioral engagement. In a third study, Deng et al. (2020) conducted a case study with 45 second grade students in a public school in Shanghai. The study found that prior to the introduction of digital gamification, the students described this classroom environment as boring, unmotivating, and uninteresting. When digital gamification of mathematical instruction was introduced, the students were observed to be more engaged in classroom learning activities and the content as measured by student hand raising, understanding of content, and peer interaction. The classroom was observed to be filled with noise and excitement and the students were participating more in their learning. Students shared that they felt excited, happy, joyful and looked forward to their daily mathematics class.

Escape Room. Stohlman (2023) has described the activity of an escape room as a game that challenges teams to solve puzzles and riddles, using clues and strategic thinking to escape a locked room either real or hypothetical. They identified key principles to be used in designing an escape room including a back story, a theme, and hints to help the students solve the puzzle to escape. The students work in small groups to complete the challenge.

Research has shown that escape rooms are successful in both driving engagement and increasing students' attitudes toward learning. Stohlman (2020) referenced an escape room activity called *Michael's Movie Moves*. In this activity, it was observed by the researcher that the students were showing increased levels of engagement. Through student interviews they shared that the game created a challenge that was fun, and they found enjoyment in mathematical work that was embedded in a challenge. Berrizbeitia (2024) conducted a study based on an escape

room activity *Escape the Math Room.* They observed elevated levels of participation and engagement and described the scene as students working together to solve problems, having fun, and racing against the clock. The students shared feelings of accomplishment at the end of the activity, indicating improved attitudes. Cain (2019) found similar results of escape room style gamification improving student engagement. Their study was conducted on 141 pharmacy doctoral students at the University of Kentucky. In a survey given to the students at the conclusion of the activity, they found that 91% of respondents expressed they were more engaged in the activity and 89% said that they enjoyed the escape room more, when compared to a traditional learning environment.

Practice and Drill. Stohlman (2023) described this form of gamification as one where students solve problems symbolically while playing a game. There are many websites and companies dedicated to distributing and sharing information about the positive impact these types of games have on engagement and attitudes towards learning math. This format is used when teachers want to increase engagement and discussion surrounding problem solving. These types of games require less strategy and focus primarily on learning mathematical skills through a fun game. A website *Happy Numbers (2024)* shared several examples of these types of games including: addition and subtraction Bingo, dice and card games. Another website *We are Teachers (2024*) shared some additional examples that included kinesthetic learning opportunities through addition hopscotch, stacking objects to learn math facts and tossing a beach ball to practice math problems. Testimonials on both websites speak to the increased levels of engagement and increased levels of enjoyment because of the games.

Theory of Change

The theory of change for this study is that the use of math games will demonstrate increased engagement in learning tasks and improved student attitudes toward mathematics.

Methodology

Context

The study took place one to two times a week during the math part of the day, from 12:15PM-1:05PM. It studied the effects on engagement and attitudes towards math through the weekly integration of math games into instruction over a four-week period. There were 17 students involved in the study, six girls and eleven boys. Seven of the students were part of the multilingual program.

The study's intention was to evaluate student engagement and attitudes toward mathematics mainly through student application. Data were collected predominantly through a teacher observation journal and triangulated with insights with a mentor teacher, community math circles, student surveys, student work samples, student interviews and quantitative data from digital games. The study focused on the entire class.

Actions

Action Cycle 1: 1/6/2025-1/10/2025

In action cycle one, baseline data were collected through observation, student surveys, student interviews and fellow teacher discussion. I observed levels of engagement by students in traditional math instruction. This involved 5-10 minutes of instructions, or an activity followed by 15 to 20 minutes to work individually through a curriculum-based worksheet or activity. This was integrated into one of the existing lessons and for this week my mentor teacher taught the lesson, and I observed the student’s interactions.

The focus of the observation was primarily on the student's mathematic application when working independently after the teacher gave instructions. The observation and subsequent triangulation all happened within the first week. Immediately following the math lesson, the students were engaged in the first version of the researcher-created survey (Appendix B). The students participated in the survey individually at their desks with privacy screens to ensure the answers were their own. I read and explained the questions to the students to account for the varying levels of literacy and language skills in the classroom. After the students went home for the day, I engaged my mentor teacher in a triangulation conversation about the students' engagement, and attitudes towards math. After analyzing the data in the observation journal and the notes from my mentor teacher and the surveys, I set up two to three individuals interviews with students to learn more about their experience and feelings toward math. I was able to pull students for these interviews during quiet portions of the day such as silent reading time, choice time and first thing in the morning.

Action Cycle 2: 1/13/2025-1/17/2025

In action cycle two, data were collected through observation, written student surveys, informal verbal questioning, student interviews and mentor teacher triangulation discussion. I observed the students in gamified math instruction looking for evidence of engagement and improved attitude towards mathematics. The game used for this week's action cycle was a practice and drill style game called *Tens and Ones Race* (Appendix D). The game was played in groupings of two. Each student took turns rolling the dice and moving their piece along the leaves. Whichever number they landed on, they had to display an understanding of that number through place value blocks, building out how many tens and ones were represented in the given number. After their partner confirmed they were correct, it was the other person's turn. The first

one to finish won the game. The lesson included an 8-minute introduction, set up, modeling, and partner assigning, followed by two seven-minute game sessions, which allowed for the students to switch partners one time.

Immediately following the lesson, the students were engaged in an informal verbal question and answer activity. After this, they cleaned up the game and engaged in the written survey I created (Appendix C). This survey was updated and adapted from the cycle one survey (Appendix B) based on student responses and usefulness of the data to explore student attitudes specifically and more narrowly about mathematics. While the students took the survey, they were at their desks with privacy screens to ensure their answers were their own. After the students left for the day, I met with my mentor teacher and engaged in a triangulation discussion about the students' engagement and attitudes towards math. I spent time in this cycle analyzing the observational journal, triangulation discussion with my mentor teacher and verbal and written survey results. Based on this data, I set up some individual interviews with students to learn more about their experiences. The interviews happened with students during quieter portions of the day first thing in the morning, during snack time and quiet reading time. This action cycle lasted one week.

Action Cycle 3: 1/20/2025-1/24/2025

Data collection changed significantly from cycles one and two. In action cycle three, data were collected through observation, multiple math community circles, informal verbal questioning, and mentor teacher triangulation discussion. I conducted two observations within this cycle, one based on traditional instruction, and one based on gamified instruction. Both observations focused on the application portion of the lesson. After each observation I engaged in a triangulation discussion with my mentor teacher to discuss and confirm findings about the

students' attitudes and engagement within the lesson. The traditional lesson was observed and conducted on Tuesday and the gamified lesson was done on Thursday.

The game used for this action cycle was a digital trivia style game called *Kahoot!*. The game was played by the whole class. Each student sat at their own desk with their laptop. Prior to beginning the game, the students each typed their names and chose an avatar to represent them. When the game started, a question appeared on the screen with four potential answers that each had a color and shape associated with it. On the student screens, they saw those same answer options and must select which one they think is correct. There is a time limit of 20-30 seconds per question. I read the question aloud to the whole class, then the group was given 20-30 seconds to choose the correct answer, as the answers were displayed, I also read these options to the class. Each question would earn the students a particular number of points depending on the answer, accuracy, and speed. In between each question the game would show the top five scores and highlight other accomplishments such as *high climbers* and *correct answer streaks.* I highlighted and celebrated these names as they came up and encouraged those whose names were not on the screen. As a class we played two rounds of the game, the first was 10 questions and focused on 10 stick groupings and the second was 13 questions focused on doubles.

After the gamified lesson on Thursday, the students engaged in a community math circle with me at the end of the day, more than an hour after the conclusion of the game. The community circle was set up in a way that I asked a single question, and each student went around the circle sharing their response (Appendix E). On Friday, after a week full of math lessons, including two observed lessons, I engaged the students in a second community math circle (Appendix F), which focused both on engagement and attitudes towards math. The second community circle was recorded and analyzed further after the students went home. I triangulated

the data this week by analyzing the observational journal, discussions with my mentor teacher, multiple math community circles and quantitative data produced from *Kahoot!* (Appendix A). This cycle lasted one week.

Action Cycle 4- 1/27/2025-1/31/2025

In action cycle four, similar to three, data were collected through observation, multiple math community circles at the end of the week, informal verbal questioning, student work samples and mentor teacher triangulation discussion. I conducted two observations within this cycle, one based on traditional-gamified hybrid lesson, and one based on gamified instruction. After each lesson, I conducted a math community circle, I analyzed and reviewed my observation notes, student work and engaged in a triangulation conversation with my mentor teacher about how the students engaged and their attitudes towards math.

In the first observation, the lesson was a hybrid that included both gamification and a traditional teacher led math portions of the lesson. The first part of the lesson, the students engaged in a game called *Ants at a Picnic.* Each student had a whiteboard with the number of squares around the edge going up to 120. The students took turns coming up and pulling a number out of a bag, everyone would then make a mark on the whiteboard by that number. I would say "___ ants came to a picnic", another student would come to the front to pull a number and say "then ____ more came", together we would make the mark on the whiteboard. This continued for several rounds, each time we made a 10, the students were supposed to draw a line through the blocks making a 10 stick. At the conclusion of the rounds, the students needed to know how many ants would come to the picnic. This was followed by a traditional math lesson application as a curriculum-based worksheet. Finally, when the students finished, they moved on to a self-paced individually gamified digital program called *I-Ready*. This program took students

through lessons, allowing them to earn coins and points along the way as they master the content. This was done individually at their desks on the laptops with headphones. For this week again, the focus was on the student application of math.

The game used for this week's action cycle on Thursday was an escape room style game focused on students making the connection between numbers and place value representation in the form of 10 sticks and 1's. This game was a partner game. There were 24 cards set up around the room, each card had a letter (A-X) and words on it that said "_____ tens and _____ones". The students had to then write the numerical representation of the number and the ten sticks and ones. Once all the boxes were filled in, they brough it to me to be checked for accuracy, if all were correct then they were asked to highlight the two boxes that matched (Appendix H). The students had only 25 minutes to complete this challenge, once they completed it they would earn a prize, which at the beginning was unknown, but would eventually be revealed as a mandarin orange.

At the end of the week (Appendix F), the students engaged in a math community circle. The math community circle was more in depth and focused on student reflection on the entirety of the week's math, for the purpose of analysis I recorded this community circle. I triangulated the data this week by analyzing my observational journal, engaging in discussions with mentor teacher, multiple math community circles, and student work samples (Appendix H) from the escape room style game. This cycle lasted one week.

Data Gathering Instruments/Assessments

Data were gathered in many ways. Engagement and attitudes towards math were measured primarily through a teacher observational journal and triangulated by student

interviews, student work, digital game reports, mentor teacher discussions and math community circles.

Assessment #1: Teacher Observation Journal

An observation journal was the primary tool to measure and evaluate student engagement and attitudes towards mathematics throughout the four-week study. The journal documented observations of student behavior during both gamified and traditional instruction, notes from triangulation discussion with the mentor teacher, records from the math community circles, scheduling and planning information, emerging trends, limitations, and recommendations for future research. Organized by action cycle, each week had a dedicated section in the journal.

Assessment #2: Student Survey

A student survey was conducted among students over the first two weeks of the study. In week one, the survey (Appendix B) was used to establish baseline data and was collected immediately following a traditional math lesson. Participants were asked to reflect on their feelings towards the math of the day through an emoji scale. The rationale for this is first graders often do not have the skill to express their emotions through written words, but they are able to make a connection between the facial expression of the emoji and how they feel. The students took these surveys individually at their desks with privacy screens, utilizing paper and pencil. Due to the varying achievement levels of readers in a first-grade class, the questions were read and explained to the students. After collecting the data from week one, a few adjustments were made, and a new survey was created (Appendix C) to make the survey more concise and focused more specifically on learning about the student's feelings towards math. The results of the survey are shown in (Appendix G).

Assessment #3: Student Interviews

In the first two weeks of the study, student interviews were conducted after the weekly survey. These interviews triangulated observational data and provided deeper insights into student survey responses. The interviews were focused in response to the student surveys on feelings towards math. Since the survey used emojis and drawings, the interviews offered a richer understanding of student experiences. The questions varied depending on the student, their survey's results and what the hopeful outcome was from the interview. They were recorded onto a digital spreadsheet.

Assessment #4: Verbal Questioning

Before and after each gamified math lesson, students engaged in an informal formative verbal assessment. Prior to the lesson, they were asked about their excitement or anticipation. Afterward, they were asked about their enjoyment and whether they wanted similar lessons in the future. The rationale was to collect raw data for how the students were feeling in the moments leading up to and immediately following the excitement of gamification. This information aided in triangulating and supporting findings throughout other assessments.

Assessment #5: Digital Game Reports

During week three, students used the digital game *Kahoot!* for their gamified math lesson. *Kahoot!* generated quantitative reports (Appendix A) detailing student participation and accuracy, including the numbers of questions answered and the percentage answered correctly. These reports were used to assess student engagement, indicating both participation levels and successful learning outcomes.

Assessment #6: Community Circles

Math community circles (Appendix E & F) were held in weeks three and four to assess student engagement and attitudes toward math. Engagement was measured by students' ability to recall, discuss, and explain learned concepts. Attitudes were assessed through questions about their favorite lesson, what brings them joy in math, and their opinions on what activities we should engage in throughout our math class time. These recorded sessions were analyzed in detail after the discussions concluded. These circles were conducted verbally at the end of the school day.

Assessment #7- Student Work

Throughout the study, student work samples were collected to assess engagement and content mastery. Specifically, during the week four escape room activity (Appendix H), student work was collected to evaluate participation, effort, and accuracy. These factors served as indicators of student engagement with the gamified lesson.

Results

Action Cycle 1

In action cycle 1, baseline data were collected from 14 first-grade students through observation, discussions with mentor teacher, surveying, and interviews. In the traditional math lesson, students were observed to be engaged during instruction, exhibiting positive body language and eagerness to participate. However, during the application portion, emotional engagement, perseverance, and effort were low. Specifically, 41% of students repeatedly sought help instead of problem-solving independently, indicating low perseverance. Additionally, students did not appear to experience enjoyment in the application work. The observations were confirmed and supported through a discussion with the mentor teacher.

The survey (Appendix B) was conducted with 14 students, which provided baseline data about their feelings towards math. The results (Appendix G) for question one reported that 71.4% of students shared math makes them feel happy, 7.14% described their feelings as neutral, while 21.43% described their feelings about math as sad or disliking math. Question two asked if students enjoy math, 42.86% said yes, 35.71% felt neutral or unsure and 21.43% shared that they did not enjoy math. In question three, 35.71% of the students expressed that they looked forward to math, 21.43% responded as neutral or unsure and 42.86% shared that they did not look forward to math. In question four, 100% of the students view themselves as being good at math. Question five explored engagement through asking the students to reflect on how much effort they put into math. The survey found that 71.43% expressed putting a high level of effort in, 14.29% responded neutrally or unsure, while 14.29% said they put in very low effort.

Two students were interviewed to explore their feelings about math, with questions tailored to their individual survey and observation results. Student one explained their dislike of math due to its perceived difficulty. When asked what would improve their enjoyment, they suggested partner work, computer-based math, and math games, specifically mentioning the appeal of immediate feedback in programs like *I-Ready*. Student two expressed a lack of enjoyment due to feeling unchallenged and not learning new material. They cited science as their favorite subject because of its constant stream of new information. To make math more enjoyable, student two also suggested partner work, math games, and learning new math concepts.

This data established a baseline for the study. Observations, surveys, and interviews provided both quantitative and qualitative data to inform the next action cycle. This cycle's baseline data revealed potential for improving students' attitudes toward math. Observations

identified areas of low engagement during application, while interviews highlighted the complexity of the issue. For some students, the content was too challenging, while for others it was too easy. Analyzing the baseline data showed that gamification may offer a way to bridge this gap, potentially improving both engagement and attitudes.

Action Cycle 2

During this action cycle, data were collected on 12 students participating in a gamified math lesson. Data collection included the same methods as cycle one plus verbal questioning. Student attendance was inconsistent between weeks one and two due to illness and other absences. In the gamified lesson, students engaged in the game *Tens and Ones Race* (Appendix D).

It was observed that students demonstrated high engagement, exhibiting perseverance in problem-solving, strong effort, adherence to directions, effective collaboration, and full participation. Only one hand was raised throughout the entire game, and that was to clarify a game rule and ensure proper use of materials. All students remained on task and required no redirection. The lesson also fostered positive attitudes, happiness, and enjoyment of math. During the game, 100% of the students smiled, laughed, and appeared to be enjoying themselves. This enjoyment occurred even though the game's core concept—decomposing two-digit numbers into tens and ones—was new and challenging for them. The classroom environment could be described as joyful but controlled. Students worked together to play the game, engaged in the content, had fun, and learned math. Immediately following the gamified lesson, students were asked verbally if they enjoyed the game. A resounding 92% responded affirmatively. When asked if they would like to play more math games like this, 92% again responded yes.

In a discussion with the mentor teacher, these findings were confirmed. They shared they were equally impressed by the students' high level of engagement, perseverance, participation, positive teamwork, and on-task behavior. The mentor teacher also corroborated the observation of positive student attitudes, such as visible enjoyment and smiles, throughout the lesson.

A survey (Appendix C) explored how 12 students' feelings about math changed after experiencing gamified learning compared to traditional methods. Question one (Appendix G) revealed that 75% of respondents felt happy about math, a 3.6% increase from week one. The percentage of students expressing negative feelings about math decreased by 4.76% to 16.67% (Appendix G). Regarding enjoyment of math in question two, positive responses increased by 23.84% to 66.7% (Appendix G), while negative responses increased slightly by 3.57% to 25% (Appendix G). When asked if they were looking forward to math, positive responses climbed 14.29% to 50% (Appendix G), while negative responses fell by 26.01% to 16.67%(Appendix G). Notably, the number of students who were unsure or neutral about looking forward to math increased by 11.9% to 33.33% (Appendix G). Finally, concerning effort, positive correlations were also realized. The percentage of students who reported high effort increased by 20.57% to 92%, while those reporting low effort decreased by 14.29% to 0% (Appendix G).

This action cycle's data demonstrated improved engagement and attitudes toward math when using gamified lessons compared to traditional instruction. These findings were supported by teacher observations, student surveys, mentor teacher discussions, and verbal questioning. While interviews were conducted, they proved challenging to schedule, and when completed, the students appeared nervous, potentially providing answers they believed were expected rather than their true feelings.

Quantitatively, attitudes showed increases in enjoyment, positive feelings, and anticipation of math. Engagement was marked by a significant increase in students' self-perceived effort. Qualitatively, engagement levels were observed to be much higher. An additional finding discussed with the mentor teacher concerned the role of collaboration in engagement. When students collaborated to play a game, the game's success depended on both students' engagement; if one was disengaged, the game was impossible to play. When students worked individually, they were only accountable to themselves or the next activity and did not feel a sense of responsibility to the class.

Several significant changes were implemented for action cycle three based on the findings from action cycle two. After working with students to better understand their feelings and engagement levels, it was determined that more effective methods could be used. Consequently, for cycle three, the survey and interviews were replaced with math community circles. These circles combined elements of both surveys and interviews, allowing students to share their feelings while also providing more detailed examples and explanations. The students found these circles to be a safe and comforting environment to share.

Action Cycle 3

In this action cycle, data were collected on 17 students, over two math lessons, one traditional and one gamified. Data were collected through teacher observation, mentor teacher discussion, quantitative *Kahoot!* data and math community circles. The gamified lesson this week was engaging the students in the digital trivia style game *Kahoot!*.

In the traditional lesson, the students were observed to be showing some signs of engagement, many of them were focused on their work, showed positive body language and during instruction listened to instructions. However, similar to action cycle one, throughout the

application process, it was observed that the students had a low threshold for perseverance. Even after directions were delivered and models were done as a class, 47% continued to show low signs of perseverance in problem solving. This manifested through stopping work when they reached a problem they were unsure how to solve or raised their hand repeatedly to ask questions on problems they were able to solve. This lack of perseverance is significant, because the math curriculum included in this lesson was the same content that we engaged in through gamification. An additional sign of disengagement was the number of students who did not complete the assigned work, in contrast to them making it through the entire gamified lesson.

Students enthusiastically participated in a gamified math lesson for action cycle three, using *Kahoot!*, an online trivia platform. Two rounds were played: one focused on 10 sticks and the other on doubles. Student engagement was evident from the start. Upon hearing they would be playing *Kahoot!* for math, many students cheered and pumped their fists, demonstrating both engagement and a positive attitude towards math learning. This enthusiasm continued throughout the game. Students remained focused on their screens, eager to answer questions and excited to see the rankings after each round. One student even exclaimed, "I am the highest climber!" with excitement, referring to an in-game recognition for the most improved ranking. Like the game in action cycle two, this game also had a collaborative aspect to it. While the students were each on their own computer, they were competing against one another, nearly demanding engagement from the students.

Kahoot! data provided further evidence of strong student engagement. The automatically generated reports (Appendix A) showed that in game one, students answered an average of 98% of the questions with 81% accuracy. Game two saw an average of 99% of questions answered and 90% accuracy (Appendix A). While the difference in accuracy likely reflects the varying

difficulty of the content, both sets of results demonstrate strong engagement with the game, the lesson, and the material. Four students, in game one and five in game two achieved perfect scores (100% accuracy; Appendix A).

Despite generally high engagement and positive attitudes, some instances of disengagement were observed. These typically occurred when students encountered technical difficulties (e.g., being logged out of the game) or when the content exceeded their current abilities. While these instances are noteworthy, they are consistent with student responses in traditional learning environments. Even students who struggled with the material in the gamified setting maintained higher engagement and more positive attitudes than were observed in the traditional lesson.

In a discussion with the mentor teacher, they corroborated these observations. The mentor teacher also noted high engagement, describing an exciting and eager learning environment, as well as strong content engagement reflected in student accuracy and competitiveness. They also acknowledged the few instances of disengagement due to technical issues and content difficulty, while agreeing that overall student engagement and attitudes were significantly improved compared to a traditional lesson. An additional point of discussion was the connection between perceived success and student enjoyment. It was observed by both the mentor teacher and the researcher, and later confirmed by the student that the student who won the game showed the most growth in their feelings towards the activity. This student initially expressed a lack of enthusiasm for the game, but, after participating and ultimately winning, stated that it was fun and enjoyable. Displaying signs of positive attitudes and emotional engagement.

Finally, at the end of cycle three, students participated in two math community circles. The first (Appendix E), held on the same day as the gamified lesson, focused on reflecting on

that day's math activities. The second (Appendix F), conducted at the end of the week after both observed lessons were completed, challenged students to reflect on the entire week's math learning. In both circles students demonstrated engagement through their ability to recall and describe what they had learned, as well as their positive attitudes toward math.

The first community circle discussion focused on student engagement, posing a single question: "What is one skill you learned, improved, or practiced during the math game?" Several students, unprompted, described the game, the content (10 sticks and doubles), and specific skills and strategies they used for success. They displayed signs of engagement and evidence that they were focused on the game, the content and more than an hour after the game the learnings were still instilled in their minds.

In the second community circle (Appendix F) students were asked to reflect on their week through four questions. When asked about their favorite math activity, *Kahoot!* was the overwhelming favorite, with six students explicitly stating this preference and others nonverbally agreeing. Student comments included, "*Kahoot* because I won twice and it was really fun," "*Kahoot*, 10 sticks in *Kahoot*. I liked it because it helped me learn more about 10's," and "*Kahoot*, I like math more when we play games." Beyond expressing positive attitudes toward math through gamification, students also demonstrated engagement by recalling and sharing their learning. Several students again mentioned learning about 10 sticks and doubles within the game, but did not discuss content from other, non-gamified lessons.

When asked about something they learned that would stick with them, despite covering various topics, students consistently referenced their *Kahoot!* learning. One student shared "Doubles!" while another stated, "I like Kahoot, I learned how to focus and never give up!" When asked how they would engage their own students if they were the teacher, both responding

students suggested using games like *Kahoot!*, *Blooket*, *I-Ready*, and other math games, adding that these games made math more enjoyable. Finally, when asked what brought them joy in math, many students again mentioned math games. One student shared, "Math games, because they are fun," while another said, "I like *I-Ready* math because it is fun.” I learn a lot and it challenges me." These responses were again corroborated by head nods and other nonverbal cues of agreement.

Action cycle three yielded significant findings regarding student engagement and attitudes toward math learning. Observations, discussions with the mentor teacher, and math community circles all indicated that gamification improved both engagement and attitudes. Two changes were implemented in action cycle four. First, the math community circle was reduced to a single session at the end of the week, based on its demonstrated effectiveness in cycle three. Second, an additional gamified element was incorporated. A game was embedded within a lesson that was originally planned as a traditional activity, providing students with multiple opportunities for gamified learning that week.

Action Cycle 4

In this action cycle, data were collected on 17 students, over two math lessons, one traditional, with an imbedded game and one gamified. Data were collected through teacher observation, mentor teacher discussion, and math community circles. The gamified lesson this week was engaging the students in an escape room style game.

The first lesson, though planned as traditional, incorporated the game *Ants at a Picnic*. This whole-group activity helped students learn about grouping by tens and how this supports understanding larger numbers. After the game, students completed a worksheet and then used *I-Ready*, a gamified platform. Engagement and attitudes were higher during both gamified

segments than during the worksheet activity. Students expressed excitement during *Ants at a Picnic*, with comments like "This is so fun!" and "What if we made it to 100!", this in reference to seeing how many ants would be at the picnic. While students were engaged during the traditional portion, gamified activities elicited greater enthusiasm, particularly when students led the *Ants at a Picnic* chant.

The second lesson featured an escape room-style game (Appendix H), in which students were highly engaged. During the instructional phase, they listened attentively, asked clarifying questions, and demonstrated a clear understanding of the game before starting. Students exhibited signs of excitement and anticipation. Throughout the game, engagement and positive attitudes remained high. Working in partnerships, students demonstrated perseverance, collaboration, thoroughness, and cognitive accuracy. The 25-minute time limit, visualized by a candle timer, significantly contributed to engagement. Students frequently checked the timer and adjusted their strategies accordingly. They enjoyed the game, displayed positive attitudes, and encouraged each other. Toward the end, when only one group remained, other groups cheered them on. The prospect of a mysterious prize for completing the game boards (Appendix H) further motivated students. The prize—special mandarin oranges—elicited joy and positive attitudes, rewarding their efforts. Student work (Appendix H) reflects their high engagement, as evidenced by timely, collaborative, and accurate completion of the game challenges. At the conclusion of the game the students were verbally asked if they had fun playing the game, 90% of the students responded yes.

In a discussion with the mentor teacher, they confirmed these observations. The mentor highlighted the excitement and engagement of a typically less-engaged student, who was highly involved in the game. This student was heard saying "hurry, hurry" and "this one is 29!",

demonstrating both competitive spirit and cognitive engagement. The mentor teacher described the classroom environment as one of collaborative problem-solving, with students moving around the room and working together. Some students were so engaged that they were on their hands and knees searching for clues.

The end-of-week math community circle (Appendix F) again asked students to reflect on their math learning. When asked about their favorite activity, three students provided answers, with the rest of the class showing verbal and nonverbal agreement. Two students chose the escape room game, stating, "I liked the math game where we were going around the room looking for numbers. I liked writing 10 sticks, it was challenging but fun.", and "I liked the 10 sticks game we played; it was my favorite activity this week. It was very fun and there were partners." The third student referenced the *Ants at a Picnic* game. These responses demonstrated engagement and positive attitudes through student recall, descriptions of their learning, and expressing preferences.

The second question asked what they learned that would stick with them, students offered varied answers, all related to gamification. One student shared, "I learned how fast I could do math! I learned that I could do math faster than I ever thought," while another mentioned they learned about 10 sticks from the escape room. Notably, one student, while off-topic, shared their increased positivity towards math when they worked with partners. When asked how they would use math time if they were the teacher, responses included math games. One student mentioned *I-Ready* and *Xtra Math*, explaining that they were fun and helpful. Another mentioned *Kahoot!*, stating that it helped students learn.

Finally, when asked what brought them joy in math, students again focused on gamification. One shared "Partners and surprises," another expressed "10 sticks! They help me

better understand math," and one more stated, "I really like math games, they bring me joy in math!".

Data from action cycle four supported improved student engagement and attitudes toward math. Observations, mentor teacher discussions, and math circles all confirmed this. Students demonstrated strong engagement and recalled specific learning from the activities. Reflecting on positive experiences and feelings, the data strongly supported the use of gamification in math learning.

Conclusions

Through the four action cycles, I consistently observed the positive impact of gamification on my first-grade students' math engagement and attitudes. In action cycle one, baseline data revealed varied engagement in traditional lessons, with low perseverance during application. Interviews showed mixed math feelings, with some students finding it too hard, others not challenging enough. Action cycle two, the game *Tens and Ones Race* significantly improved engagement from cycle one, with increased perseverance, positive attitudes, and enjoyment, reflected in survey data. Action cycle three, the students showed increased engagement and attitudes towards math through the digital game *Kahoot!* further reinforced this, with enthusiastic participation. In this action cycle, I introduced community math circles, as I found them to be more effective for feedback than previous surveys and interviews. The students also seemed more comfortable and familiar with this process in comparison to surveys, in action cycle four the games *Ants at a Picnic* and the escape room activity continued the trend. Gamification consistently increased engagement, improved attitudes, and fostered greater math enjoyment, demonstrating its value in first-grade math learning.

Limitations

There are several limitations to consider in reflection of this study that may have affected the study, though were outside of the scope. Math happened at the same time each day of the study, 12:15PM-1:05PM. It may have impacted the results if the time was in the morning, as the students overall energy, excitement and focus would have been at a different level. Another limitation was how games affect those on the edges of the learning spectrum. The focus of the study was on the class, though the results may have been affected if smaller groups of students were studied independently. A third limitation that is directly related to the study but fell outside the scope was investigating the effect of partners in gamification. While it was shown throughout the study that students viewed partnerships through a positive lens, it poses the question if both partners engage and enjoy the game at the same level or is one more and the other less engaged.

Recommendations

I have several recommendations for future researchers. First, consider conducting the study at various times of day to determine if time influences student feelings or engagement. Second, extend the study from four to eight weeks to gather more comprehensive data. Third, in action cycle one, study both traditional and gamified lessons within the same week rather than stretching it over two. Fourth, explore diverse gamification styles to better understand their impact on engagement and attitudes. Finally, individualize the study further by examining how games affect both high- and low-performing students.

Reflections

One reflection that came out of this study is that gamification is a strong tool for culturally responsive teaching and meeting students where they are in their learning journey. For struggling learners, it offers a less intimidating math practice, improving attitudes and

engagement through enjoyment and game mechanics. For advanced learners, often bored or disengaged by first-grade math, gamification encourages deeper, more thoughtful engagement with the content, improving both understanding and attitudes. I will utilize what I have learned, applying it in my classroom to aid in bridging the gap.

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Appendix A

Kahoot! Data

Ten Groupings

Player	# of questions	Correct Answers	Incorrect Answers	Unanswered	% Correct	% answered
1	10	10	0	0	100%	100%
2	10	10	0	0	100%	100%
3	10	10	0	0	100%	100%
4	10	10	0	0	100%	100%
5	10	9	1	0	90%	100%
6	10	9	1	0	90%	100%
7	10	9	0	1	90%	90%
8	10	9	1	0	90%	100%
9	10	9	1	0	90%	100%
10	10	9	1	0	90%	100%
11	10	8	2	0	80%	100%
12	10	8	2	0	80%	100%
13	10	7	3	0	70%	100%
14	10	6	4	0	60%	100%
15	10	6	3	1	60%	90%
16	10	5	3	2	50%	80%
17	10	4	6	0	40%	100%
Average	**10**	**8.12**	**1.65**	**0.24**	**81%**	**98%**

Adding Doubles

Player	# of questions	Correct Answers	Incorrect Answers	Unanswered	% correct	% Answered
1	13	13	0	0	100%	100%
2	13	13	0	0	100%	100%
3	13	13	0	0	100%	100%
4	13	13	0	0	100%	100%
5	13	13	0	0	100%	100%
6	13	12	1	0	92%	100%
7	13	12	1	0	92%	100%
8	13	12	1	0	92%	100%
9	13	12	1	0	92%	100%
10	13	11	2	0	85%	100%
11	13	12	1	0	92%	100%
12	13	11	0	2	85%	85%
13	13	11	2	0	85%	100%
14	13	10	3	0	77%	100%
15	13	10	3	0	77%	100%
16	13	11	2	0	85%	100%
17	13	10	3	0	77%	100%
Average	13.0	11.7	1.2	0.1	90.05%	99.12%

Note: The above two tables show automatically produced data from *Kahoot!*. The report is created immediately after the conclusion of the game.

Appendix B

Student Survey

Name Date:

Key

= Happy, Exited, Agree, Like, Enjoyment, Eager

= Neutral, unsure of feelings,

= Sad, Dislike, Disagree, Unenjoyable, Dread

1. Describe how math makes you feel.

2. Do you enjoy math?

3. Do you look forward to the math portion of the day?

4. Do you consider yourself good at math?

5. Describe how much **effort** you put int the math portion of the day?

6. Illustrate a feeling you have about math today.

Appendix C

Student Survey

Name Date:

Key

= Happy, Exited, Agree, Like, Enjoyment, Eager

= Neutral, unsure of feelings,

= Sad, Dislike, Disagree, Unenjoyable, Dread

1. Describe how math makes you feel.

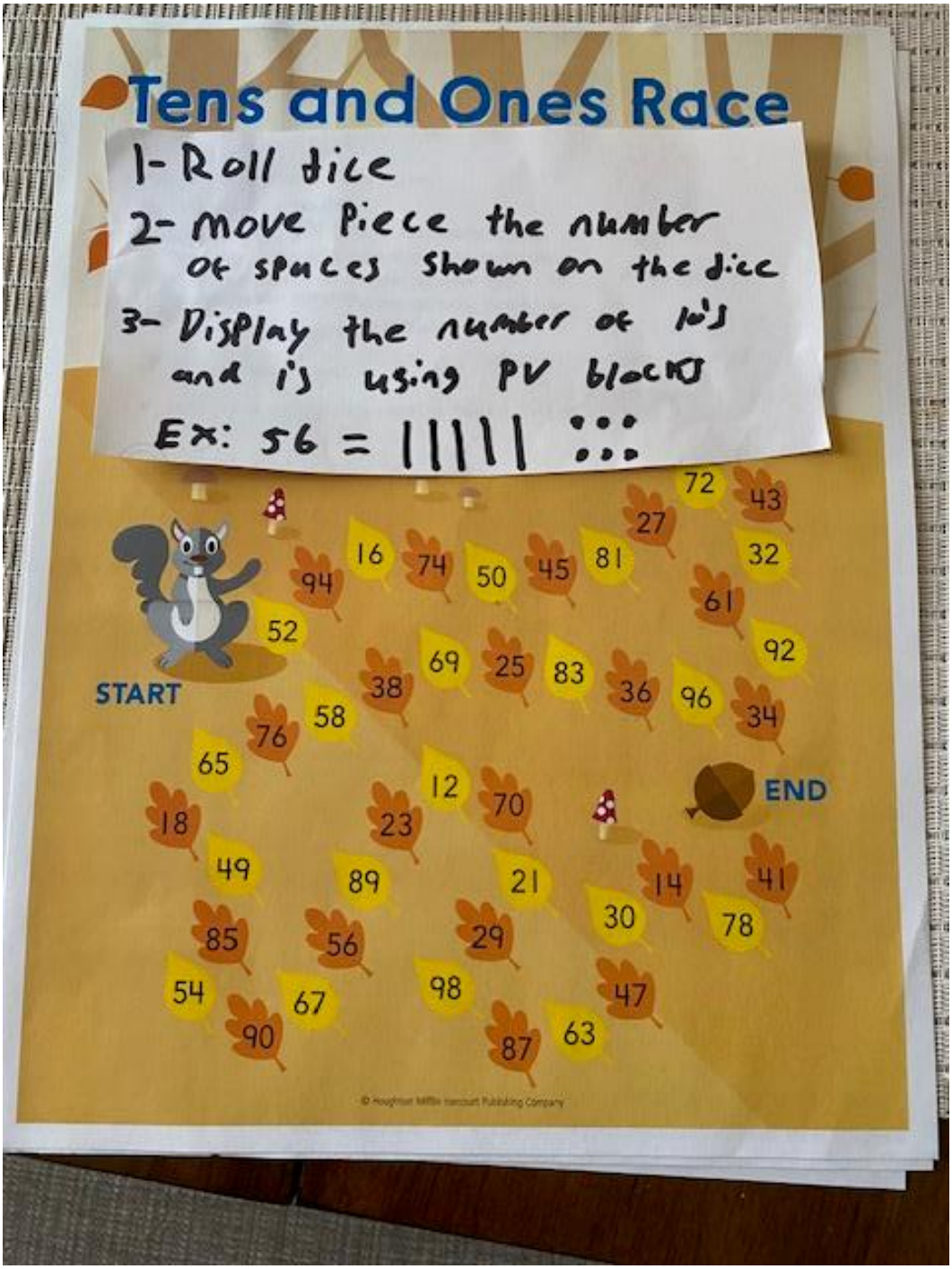
2. Do you enjoy math?

3. Do you look forward to the math portion of the day?

4. Describe how much **effort** you put int the math portion of the day?

5. Illustrate a feeling you have about math today.

Appendix D


Tens and Ones Race
1- Roll dice
2- move Piece the number of spaces shown on the dice
3- Display the number of 10's and 1's using PV blocks
Ex: 56 = |||||
START
END
72
43
27
16
74
50
45
81
32
94
61
52
92
69
25
83
36
96
38
34
58
76
65
12
70
18
23
49
89
21
14
41
30
78
85
56
29
54
67
98
47
90
87
63

Appendix E

Math Community Circle- Thursday Week 3

I asked below question to students. They went around the circle answering the question and engaging in a discussion.

1- What is one math skill you learned, improved or practiced during the math game?

Appendix F

Math Community Circle- Week 3 Friday and Week 4 Thursday

Engagement and Attitudes toward math

In this version of the math community circle, students are asked a series of questions about their experiences in math, focused on engagement and attitudes. In this version a *talking object* is used and participation is voluntary. Each question is answered by 2-4 students, allowing for maximum participation, data collection and engagement. This survey used inclusive language such as we, us and our to signify that we are all one community.

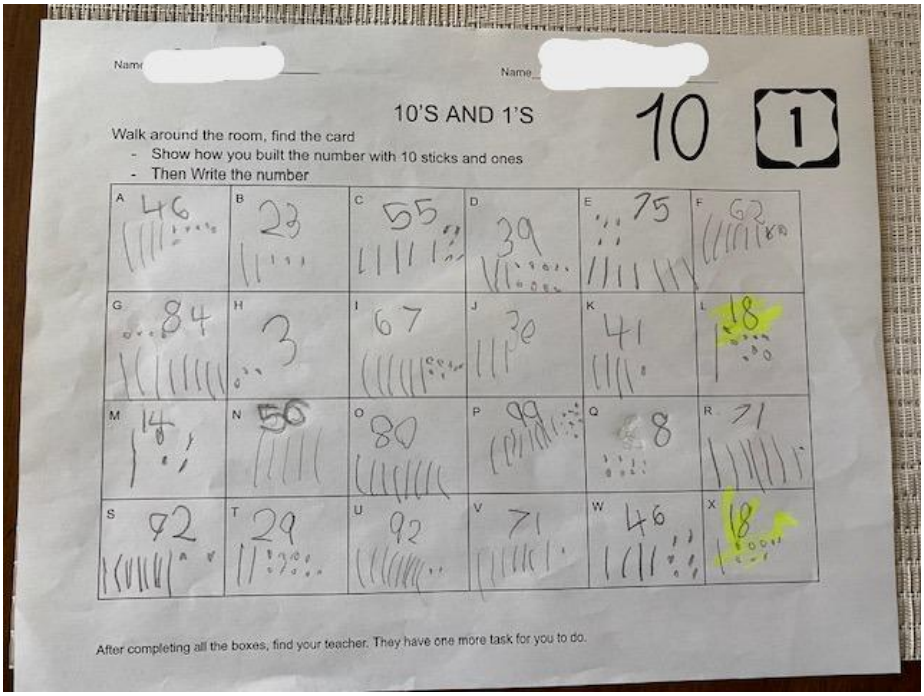
1- What was our favorite activity we did in math this week?

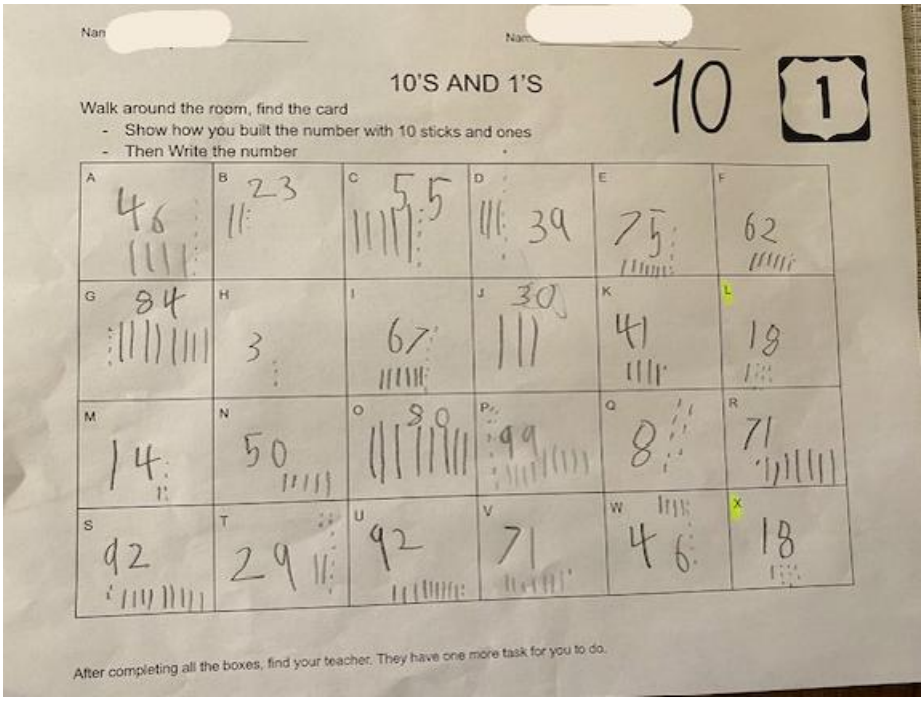
2- What was something we learned this week that's going to stick with us?

3- If any of us could be the teacher how do we think our math time should be spent?

4- What brings us joy in math?

Appendix H


Name
Name
10'S AND 1'S
10
1
Walk around the room, find the card
- Show how you built the number with 10 sticks and ones
- Then Write the number
A 46
B 23
C 55
D 39
E 75
F 62
G 84
H 3
I 67
J 30
K 41
L 18
M 14
N 50
O 80
P 99
Q 8
R 71
S 92
T 29
U 92
V 71
W 46
X 18
After completing all the boxes, find your teacher. They have one more task for you to do.


Nan
Nam
10'S AND 1'S
10
1
Walk around the room, find the card
- Show how you built the number with 10 sticks and ones
- Then Write the number
A 46
B 23
C 55
D 39
E 75
F 62
G 84
H 3
I 67
J 30
K 41
L 18
M 14
N 50
O 80
P 99
Q 8
R 71
S 92
T 29
U 92
V 71
W 46
X 18
After completing all the boxes, find your teacher. They have one more task for you to do.

Appendix G

Student Survey Data

Table 1

Student Survey Results (Questions 1-5)

Question	Score	Week 1 14 Students	Week 2 12 Students	% change
#1 - Feels	Happy/Agree- 3	71.4%	75%	+3.6%
	Neutral/unsure- 2	7.14%	8.33%	+1.14%
	Sad/disagree- 1	21.43	16.67%	-4.76%
#2- Enjoy	Happy/Agree- 3	42.86%	66.7%	+23.84%
	Neutral/unsure- 2	35.71%	8.33%	-27.38%
	Sad/disagree- 1	21.43%	25.0%	+3.57%
#3- Looking Forward	Happy/Agree- 3	35.71%	50.00%	+14.29%
	Neutral/unsure- 2	21.43%	33.33%	+11.9%
	Sad/disagree- 1	42.86%	16.67%	-26.01%
#4- Good at math	Happy/Agree- 3	100%	NA	NA
	Neutral/unsure- 2	0%	NA	NA
	Sad/disagree- 1	0%	NA	NA
#5- Effort	Happy/Agree- 3	71.43%	92%	+20.57%
	Neutral/unsure- 2	14.29%	8.33%	-5.96%
	Sad/disagree- 1	14.29%	0.00%	-14.29%

Note: This table shows responses to the student survey for weeks one and two, the survey was administered immediately following the math lesson. In week one there were 14 participants and in week two there were 12. Question 4 was removed from the survey for week 2.

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