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Movement in Math: A Look at Integrating Movement-Based Activities into a Kindergarten Math Classroom

Abstract

The purpose of this study was to examine what happens when movement-based mathematical activities are introduced into a kindergarten math curriculum and its implications on how kindergarteners engage during math time. Using surveys, observational and reflective data, and semi-structured interviews of students and my cooperating teacher, this study aimed to examine student and teacher perceptions of incorporating movement-activities. The movement activities served as form of play-based learning and relied on thorough planning and preparation. Through the constant-comparative method, I generated 12 level 1 and three level 2 codes from key themes and analyzed descriptive statistics for numerical data from my surveys. This study also strived to understand teachers' feelings about incorporating movement-based activities into their regular math lessons.

Introduction

It is math time in kindergarten. As my students lumber to the carpet to begin our lesson, a student shouts out, "Is it recess time now?" As I respond with a cheerful, "Not yet, it is math time!" I notice shoulders slump, and the tired groans sound as if on cue. We have already colored in our poetry notebooks and written stories at our seats. We have listened to a picture book on the carpet and finished two cut-and-paste worksheets about letters. My students are tuckered out by the time we get to our math block.

Seeing their expressions, my cooperating teacher asks the students to stand up in their carpet squares for "whole-body exercises," which alerts them to stand up and shoot their hands in the air. Everyone yearns to be the student who chooses the exercise the whole class will do as we

count to 20. My students love this part of our math block, as they laugh loudly and try to do the silliest exercise and movement possible.

As we labored through another math lesson, I wonder – h ow can I integrate movement, something my students love, into math – something they do not love as much? Is it possible to improve our whole-body exercises and bring movement activities beyond simple counting? Are feasible, in-depth movement activities feasible for me to incorporate into the classroom?

Purpose

This study took place while I was a graduate student in a year-long clinical teaching placement during the 2021-2022 school at Coulson Elementary (all names are pseudonyms to provide privacy and confidentiality) which serves about 600 kindergarten through fifth grade students. The purpose of this study was to examine what happens when movement-based activities were introduced into a math curriculum, and its implications on how kindergarteners engage in math content. This study also strived to understand how teachers feel about incorporating movement-based activities into their regular math lessons. The questions for this research included the following:

- What is the influence of implementing gross-motor activities in kindergarten math instruction?
    - What is the influence of implementing these practices on student motivation and engagement?
    - What were the teachers' perceptions of the movement-based activities?

Literature Review

In early childhood and kindergarten classrooms, tactile-kinesthetic activities promoted academic achievement and the development of crucial motor skills and brain development

(Macdonald et al., 2020; Vujičić et al., 2020). Despite the research on the benefits of movement-based activities in early childhood, few studies exist about gross-motor integrated activities in early childhood classrooms (Macdonald et al., 2020; Skoumpourdi, 2010; Vazou et al., 2021). One of the few studies about gross-motor activities in early childhood classrooms came from Vazou et al. (2020), who sought to understand classroom engagement and academic performance by implementing a content-based online movement program. The most significant results came from the kindergarten classes in the study, which recorded some of the highest engagement rates out of all the grades in the study (Vazou et al., 2020).

Although integrated physical activities and programs lend themselves to all content areas, they are commonly used in language arts curriculums across different grade levels. Gross motor movements are not a typical classroom activity integrated into mathematics (Macdonald et al., 2020; Padial-Ruz et al., 2019; Haugland & Derby, 2020). A popular approach in early childhood mathematics focuses on fine motor skills, such as handwriting, cutting and gluing, and manipulatives (Macdonald et al., 2020). The study supported the idea that fine motor skills contributed to academic performance at a greater rate than gross motor skills. However, Skoumpourdi (2010) found that manipulatives were only successful if the children connected the material to the math concepts taught. Many students with weaker fine motor development struggled with math proficiency (Macdonald et al., 2020). Very few studies exist that focus on gross-motor activities for mathematics.

Unlike the majority of the studies which looked at increased academic achievement in language arts using movement-based activities (Snyder et al., 2017; Vazou et al., 2021), my study focused on overall student engagement with mathematical concepts, with the hope that

engagement in the activities would ultimately lead to an increase in academic achievement over time.

Methods

This action research study incorporated movement-based activities into mathematics, which was not previously occurring in the classroom. It investigated how gross motor skills and whole-body movement practices align with kindergarten mathematics classroom. I then collected data to assess the implications on student engagement, motivation, and academic proficiency using movement-based math activities.

Participant Selection

This study occurred during the spring semester of a year-long clinical teaching placement. The participants of this study included a single, self-contained classroom of 12 students. My participants included nine boys and three girls. According to school records, six of our students were White, three were African American, two were Hispanic, and one was considered two or more races. One of the participants received speech therapy during the school day. Two of the participants qualified as gifted and talented. I sent home a parent permission form, and the students were asked to sign an assent form to participate in the study. I also received permission from the participants and their families to include any artifacts and images generated from the study to be included in the publication. In addition to my student participants, I had my cooperating teacher as an adult participant. She was a White, middle-class female who had taught kindergarten for 13 years. All names in the study have been replaced with pseudonyms to protect the participants' privacy.

Intervention - “The Math Games”

During the intervention period, students engaged in teacher-created movement-based activities that correlated to the unit of study. Each activity was designed to fit the specific mathematical content studied that week. I decided to call my intervention "The Math Games." Taking safety and educational needs into consideration, my cooperating teacher and I put students into two groups by academic level, with each group serving about eight to nine students. Using a rotation, one group participated in a movement activity with me on the carpet, while the other group independently engaged in related math activities using class iPads at their seats. After approximately fifteen to twenty minutes, the groups would switch, allowing each student to participate in the movement activity on the carpet. Table 1 briefly describes each movement activity, its specific content objective, and corresponding gross-motor movements.

Table 1

Movement Activities

Activity Name	Content Objective	Description	Gross Motor movements used
Snowball Addition	Students will add numbers up to 10.	Students are put into groups and the first student draws a number card (either 1 to 10). He or she tosses that number of Styrofoam balls into a bucket. The next student draws a different card and tosses that number into the bucket. Students then count the total number of balls in their bucket.	Throwing, tossing, walking, standing, kneeling
Bowling Graph	Students will collect data and organize data into a graph.	Students will take turns rolling a ball and to hit bowling pins. Students will count how many pins they knock them and then color that number of pins on a graph on the whiteboard.	Rolling, kneeling, standing
Exercise Graph	Students will collect data and organize data into a graph.	Students will take turns rolling a dice. Together as a class, they will complete the exercise it lands on 5 times. (Ex: The student rolls: Jumps; the whole class	Standing, jumping, squatting, lunging, jogging, spinning

		does 5 jumps). The student who rolled comes and plots the graph.	
Find the Shape	Students will be able to identify 2D shapes and their attributes.	Teacher will use the tapes to create different 2D shapes on the carpet squares. After a brief minilesson introducing the shapes and their attributes, students will be asked to find the shape that matches the description – (Ex: Find the shape with 3 vertices. Students find a triangle and stand on it)	Walking, hopping, crawling, leaping

Data Collection

Data collection took place over three weeks during the spring semester. My students completed a Likert scale survey using picture cues and oral responses. At the end of the intervention, the students completed the survey again, and I looked to see if their perceptions changed or stayed the same after the intervention.

Student-generated artifacts were also collected as we implemented movement during regular classroom instruction. For my observations, I wrote journal entries before and after the activities. I observed for student attitudes and indications of engagement and their willingness to participate in the activities. Within 24 hours of the activities, I collected field notes and wrote down any data from those observations in a reflective journal, including student quotes about the activities (Hendricks, 2017). My journal allowed me to collect and organize my data thoroughly.

To gather information on student opinions of the activities, I interviewed six students about their perceptions of the movement-based activities (Hendricks, 2017). To gain insight into the teacher's perceptions of movement-based activities, I coded my reflective journal and interviewed my cooperating teacher, Mrs. Scarlett, using a semi-structured interview approach (Hendricks, 2017). This interview lasted 45-60 minutes long and took place after school at the end of the intervention.

Data Analysis

Data was analyzed using the constant comparative method (Hubbard & Power, 2003). To generate concise findings, I looked through the earliest data from the first Math Game and pre-intervention surveys. I complied a list of repeating words, phrases, and ideas, also known as my Level 1 codes. (Tracy, 2013). I synthesized these Level 1 codes with my remaining data to find a central them, or a Level 2 code, that allowed me to interpret the data even further (Tracy, 2013). Table 2 displays my codes that I collected: three level 2 codes and 12 level 1 codes.

Repeated Concept & Phrases (Level 1 codes)	Overall Theme (Level 2 Codes) generated from Level 1 code
Play-based learning*	**Play-Based Learning**
Learning	
Playtime	
Working in Groups	
Collaboration	
Teaching Kindergarten	
Excitement*	**Excitement**
Exercise	
Feelings about the movement	
Activity Implementation	**Activity Implementation**
Differentiation	
Setting the Expectations	
Mini Lesson	
Challenges	
Flexibility	

Findings

After data collection and analysis, three level 2 codes emerged: play-based learning, excitement for the movement, and activity implementation.

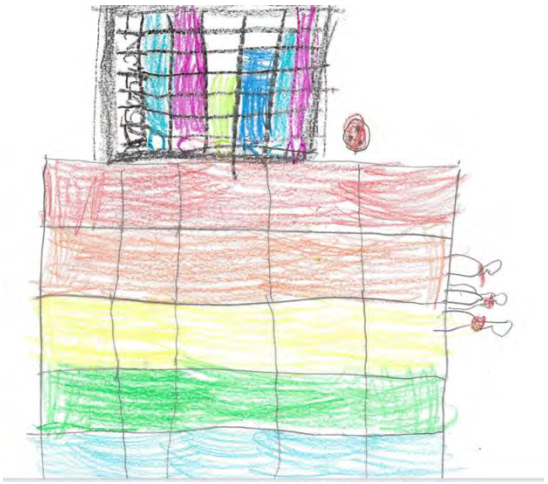
Play-Based Learning

When the movement was integrated into the math classroom, it was associated with play. The play aspect appeared more often in student interviews as they reflected on their experiences "playing" the Math Games. The students participated in a kind of play tied to a specific learning goal and focus.

Play-based learning, or guided play, is the mixture "between direct instruction and free play, presenting a learning goal, and scaffolding the environment while allowing children to maintain a large degree of control of their learning" (Weisberg et al., 2013, p. 104). Through the Math Games, students actively participated in the movement while practicing the specific math concept. Clint mentioned how the activities "help[s] our minds get better at math." In Figure 1, Peggy drew a picture of the bowling activity and added the graph we made on the whiteboard. When asked about her graph inclusion, she shared, "Because we were learning how to graph."

Figure 1

Peggy's Drawing of Her Favorite Math Game



In the interview with my teacher, Mrs. Scarlett, she mentioned how the Math Games appealed to the students' love for playing. She opened up about the need for play in kindergarten classrooms and how finding opportunities to integrate play into the classroom is challenging. The Math Games allowed for both content and playtime to coincide together.

More importantly, the movement made the students feel successful in their learning. In the surveys, students disliked working on worksheets at their desks because they did not like messing up and making mistakes. Natasha told me that math makes her shy and nervous because she does not want to get problems wrong. Steve went as far as to describe how his head would hurt and feel itchy when he started to feel nervous when doing math. However, both students reflected on how this nervousness and anxiety went away during the Math Games and felt happy and excited.

When students were assessed after the snowball activity, we found that most students started to answer questions more automatically. Mrs. Scarlett shared how she saw differences in the students' addition skills, "To see them be so successful and feel so successful when they're counting out their two groups of snowballs that they just added together in the bucket. 'You have three, and I have two.' I feel like their addition skills were strengthened with that activity." Through the Math Games, students showed more confidence and proficiency in their content knowledge.

Excitement

Almost every student expressed positive emotions about the Math Games in their post-surveys. Table 3 shows how the students reacted to their post-surveys of the Math Games and whether they preferred the iPad or the movement activity. When the movement was integrated into lessons or play, students were more engaged and focused on learning.

Table 3

Perceptions on the Math Games

	Math Games	iPad vs Movement
Peter	3	Movement
Sam	4	iPad
Peggy	4	Movement
Steve	4	Movement
Clint	4	iPad
Howard	4	Movement
Natasha	4	Movement
Harry	4	Movement
Jane	3	Movement
Nick	4	iPad
James	1	iPad
	4 - I loved it!	
	3 - I liked it.	
	2 - I didn't like it.	
	1 - I really didn't like it!	

Every student participated in the movement activity while completing math lessons on an iPad. The table shows the students' perceptions of the intervention and which option the students enjoyed the most. When students were asked about using the iPad, Clint said he liked working on it because "it's totally quiet." Other students had reservations about the iPads, like Peggy, who talked about how she would get tired and bored on the iPad and started watching what was going on the carpet.

Movement activities also allowed students to collaborate and compete against each other. The bowling activity was a favorite of the students for this reason. Because we utilized a graph, students could see who had knocked down the most pins. James looked the most excited to participate in the bowling activity; I watched him as he smiled when it was his turn and anxiously watched his classmates bowl. At the end of the game, I asked the class if they enjoyed

our bowling game. To my surprise, James put both his thumbs down. Figure 2 describes our interaction afterward when I talked with him privately.

Figure 2

My Conversation with James

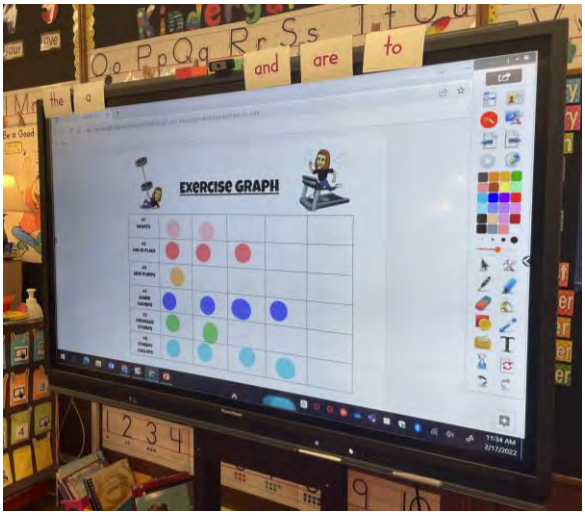
Me: James, you didn't like bowling?
James: I like winning.
Me: Oh, but did you still have fun?
James: Yes.

Coincidentally, James was the only student to express strong dislike in the Math Games. When I asked specifically about the Math Games, he said he only liked the bowling activity because he was good at it and liked to win.

When I designed the movement activities, I wanted to try to integrate the students' love of exercising but tie it to a content standard. Therefore, I created the Exercise Graph to practice collecting and graphing data (see Figure 3). To my surprise, out of all the movement activities, this was the least favorite among the students. It could have been that we did this Math Game as a group, and everyone took a turn rolling the dice. We plotted on our graph each time we rolled the dice and completed the exercise. With 17 students, that was 17 exercises that we had to do! "You can get very tired and start sweating… And then you start smelling gross!" Steve said about the Exercise Graph activity.

Figure 3

The Exercise Graph



Activity Implementation

All movement activities took place on our classroom carpet, providing enough space for small groups to do the movements safely. Figure 4 shows how I utilized our carpet's design by taping different shapes into the squares of the carpet for our Find the Shape activity. As for materials, I tried to use available items in our classroom, so I did not need to go out and buy many of the items. All electronic materials (like the graphs on the board or the Slides presentations) were created using Google Slides and Google Docs. Since I did not have any bowling pins for the bowling activity, I asked our PE teacher if I could borrow them, and she generously brought them to my class the day before.

Figure 4

The Carpet During "Find the Shape"

Ironically, the most challenging part of the Math Games was ensuring students knew what they were doing on their iPads. We chose the iPad because it provided students with an independent practice tailored to their ability levels about our current math concept. Similarly, because students were wearing headphones on the iPads, it allowed them to stay on task while the other group did the movement activity.

The movement activities worked the best when I conducted a mini lesson about the math concept whole-group before splitting into the Math Games. I found that the mini lesson not only explained what we were learning in math, but it helped make the connection to the movement activity and iPad lessons. Because we did a mini lesson whole group, when we split into smaller groups, it gave me more time to explicitly model the how to do the activity and give the students a chance to practice. Incorporating a "practice round" for these movements allowed the students to get comfortable with the movement I was asking them to before we started to play. Because I implemented a practice round, students were more proficient with their movement and the math concept.

Many kindergarteners lacked the coordination to accurately toss balls into a bucket or roll a ball to hit some pins. As I was modeling during the bowling activity, I rolled the ball toward the pins and didn't knock down any pins, which garnered some laughs from my students. After that, we went down the line of students, and each took a practice round. I noticed that even when they didn't knock down any pins, they didn't get upset or sad because they had seen me fail the first time and then try again. If they still struggled to roll the ball, they knew I was there to help them (see Figure 5). Even though this was a small moment in the activity, I still feel it made a difference in my students' attitudes and perceptions about themselves and their ability to participate and succeed in the activities.

Figure 5

Jane and I During the Bowling Activity

Discussion

My research sought to observe the influence of implementing gross-motor activities on student motivation and engagement during kindergarten math instruction. Through my investigation, I was encouraged by the difference in my students' attitudes and engagement in math when I said it was a "Math Game" day. Students were intent on listening and cooperating during mini-lessons and then practicing and demonstrating the gross-motor movements involved

in the activity. Before implementing the Math Games, movement existed in only brain break videos and transitions between activities from their carpet to their desks. In addition to the lack of movement opportunities, play infrequently appeared, usually only during indoor recess. During the Math Games, the students played a kind of play tied to a specific learning goal and focus. I noticed that students were excited about the Math Games because they differed from the usual classroom routine, which helped generate that excitement.

The excitement and engagement of my students shaped my understanding of teacher perceptions of implementing movement-based activities for mathematical content. Mrs. Scarlett shared her feelings about the Math Games, "I love that you've incorporated movement because it involves them more. It involves them physically, and they [the students] just love it." For me, one of the significant benefits was the joy on my students' faces as I demonstrated and helped them during the activities. The students loved seeing me knock over pins, toss snowballs in a bucket, or do silly exercises with them. As the teacher, I enjoyed taking a break from worksheets and lecture-style lessons to enjoy movement while still learning essential content standards. While the preparation took some time, I could get everything readily available when I needed it, and I utilized a lot of materials we already had in the classroom.

Limitations

One of the most significant limitations of my study was that it took place in a co-teaching setting rather than a typical single-teacher classroom. Because of my cooperating teacher's experience in her classroom, she had many materials and resources already available that I used for the activities. Other teachers may have to go and buy or create certain items that can take up time and money. In addition to the resources, a two-teacher classroom served our 17 students by splitting them into two groups. Utilizing fewer groups in a one teacher classroom would be

beneficial so fewer students would move simultaneously. In small groups, students had more room to move around and focused more on the objective. Alternatively, when doing the movement activity, the students must have something they can do independently, like using the iPad or a separate assignment.

Implementing these activities in the second semester setting or as part of a spiral review was essential. When we implemented the Math Games, the students were familiar with the content enough to explore and actively engage with the movement part of the activity. These activities were versatile for different ability and maturity levels but implementing these activities would be more challenging without the basic content knowledge first. Students were able to solidify their understanding of the concept, or they were able to extend their learning.

Implications

After seeing the success of implementing movement activities into our math curriculum, I encourage teachers to try movement in their classrooms for any subject. Movement-based learning activities help to teach content and provide practice that is both engaging and motivating. The research supports implementing movement throughout the school day, and it is up to teachers to determine what they feel comfortable using in their classrooms. Teachers may start with implementing brain breaks that get students up and moving for non-academic purposes, then begin to integrate more content-related movement videos or other movement programs, and then eventually incorporate more specific movement-based learning activities.

Conclusion

In her interview, Mrs. Scarlet shared that “reading and writing is something [the students] can physically do. Math isn’t so much an action.” After implementing gross-motor activities in kindergarten math instruction, I noticed more of my students enjoyed participating, learning and

even looking forward to math time each day. Because of the success I saw from my students, I would try to implement movement-based activities as much as I could in my classroom. I hope that gross-motor movements are continued to be explored in mathematics in kindergarten and upper elementary grades. Maybe one day "mathing" will become its own thing!

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