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Abstract

This study aimed to determine the effectiveness of the MATHUSAYA: Physical Gamification Strategy in enhancing the academic performance in mathematical fraction sense among Grade 3 learners. "MATHUSAYA," derived from *"Mathematics Masaya*," means "happiness in Mathematics." The research employed a quasi-experimental method as the research method to effectively balance practical considerations with the need for rigor in educational settings. The researchers also used this design in order for them to include more conclusive results by means of having two different groups. With 58 learners, the implementation of this strategy covered a period of four weeks. The Grade 3 Sampaguita class was exposed to the MATHUSAYA: Physical Gamification Strategy, while the Grade 3 Zinnia class continued with the traditional instructional method. To assess the performance of the students who participated in the study, the researchers utilized a pre-test and post-test designed specifically for this study, along with weekly assessments validated by a master teacher. A paired T-test analysis was conducted to compare the significant differences between the pre-test and post-test scores of the control and experimental groups. The findings indicated that the academic performance in the mathematics fraction sense of the experimental group who experienced the strategy, improved significantly from "Fair" to "Excellent". The results of the pre-test and post-test analyses revealed that the MATHUSAYA: Physical Gamification Strategy is an effective method for enhancing the academic performance of Grade 3 learners in the mathematical fraction sense compared to traditional methods.

Keywords: *Academic Performance, Mathematical Fraction Sense, MATHUSAYA, Physical Gamification, Quasi-Experimental*

Introduction

Teaching Mathematics in elementary learners is a crucial stage for every elementary teacher; it involves developing knowledge and enhancing numerical skills, as well as cultivating the curiosity and creativity of the learners. Besides, teachers are there to create a learning environment in which all learners feel comfortable and safe while acquiring and adapting new skills that will contribute to making their lives better. Therefore, for a teacher to impart knowledge, one must seek a strategy suitable for learners with different backgrounds, meeting their various needs and filling knowledge gaps. This means that a strategy is not only beneficial for the teacher by making things easier, but it also makes the learners more motivated and engaged throughout the learning process.

Mathematics is more than just a subject in elementary school; it is a vital tool that shapes children's cognitive, emotional, and social growth (Cevikbas & Kaiser, 2020). Through math, young

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learners cultivate critical thinking and logical reasoning, gaining a clearer understanding of the world around them (Papadakis, Kalogiannakis & Zaranis, 2021). However, teachers face significant challenges in delivering math content, as they must possess a strong grasp of the material to tailor their instruction effectively. Many educators feel hesitant due to the complexity and breadth of math, which can lead to misconceptions if not taught carefully. Therefore, it is essential for teachers to fully understand their lessons and choose effective teaching methods to ensure a successful and impactful learning experience for their students (Rashidov, 2020).

In the ever-evolving world of elementary education, developing foundational math skills is crucial for shaping a child's academic journey (Lavidas, Apostolou, & Papadakis, 2022). One important area is the understanding of fractions, which extends beyond basic number manipulation and helps develop a deeper, intuitive understanding of mathematical reasoning. Mastering fractions is a significant milestone in a learner's path, as it allows them to transition from whole numbers to exploring complex part-whole relationships (Perera & John, 2020). This "fraction sense" is essential not only for building numerical fluency and problem-solving abilities but also for laying the groundwork for more advanced math concepts. Ultimately, a solid understanding of fractions equips students with the skills necessary for real-world problem-solving and enhances their overall mathematical literacy.

Grade 3 learners at San Miguel Elementary School have been struggling with understanding and retaining fractions, a key concept in math. Teachers noted that the standard approach to teaching is often repetitive and dull, making it harder for students to stay engaged. To address this, "MATHUSAYA: Physical Gamification Strategy," a game-based method designed to make learning fractions more fun and interactive was developed. Backed by research showing that gamification boosts both retention and motivation, the researchers planned to implement this strategy over four weeks to see if it improves students' grasp of fractions and makes math more enjoyable.

This research aimed to fill a notable gap by exploring the unique features of the Physical Gamification Strategy in Mathematics that set it apart from earlier studies. While past research has shown that physical gamification boosts engagement and learning outcomes, this study delved deeper by incorporating personalized feedback and adaptive challenges tailored to each student's needs, enhancing their overall experience. It also looked at the long-term impact of this strategy by examining how well students retain what they learn over time, rather than just focusing on immediate results. Additionally, while many previous studies focused on traditional classroom settings, this research investigated various environments, including outdoor spaces, to see how different contexts impact effectiveness of the strategy. Although past studies have shown the strategy works, it is important to keep researching so it can keep up with the changing educational landscape and find better ways to support all types of learners. By doing so, researchers can ensure that math education remains engaging and effective for all students.

This study aimed to improve fraction sense among Grade 3 learners at San Miguel Elementary School through the MATHUSAYA: Physical Gamification Strategy.

Its specific goal is to provide answers to the following questions.

1. How may the pre-test result of the control and experimental groups be described?

2. How may the post-test result of the control and experimental groups be described?

3. Is there a significant difference in the fraction sense level of learners in the control and experimental groups before and after the strategy?

Materials and Methods

The study was a quantitative research that utilized quasi- experimental research that provides a structured approach to investigating the impact of the MATHUSAYA: Physical Gamification Strategy on learners' academic performance in Mathematics fraction sense while considering ethical considerations. According to Abraham and MacDonald (2011), quasi- experimental research is commonly used if random selection cannot be performed for control group. Thus, it compares groups with different situations to identify links.

The Grade 3 learners at San Miguel Elementary School served as the participants of the study. The participants are learners from two heterogeneous sections of Grade 3, totaling 58 learners. Grade 3 - Sampaguita comprised the experimental group, while Grade 3 - Zinnia comprised the control group.

The study utilized a total enumeration sampling, a type of purposive sampling technique where a set of respondents were chosen to be examined because of their suitability to the study (Sugiyono, 2019). Specifically in this study, the total enumerated respondents were Grade 3 students who already took the topic related to fraction sense. As supported by Lavrakas (2008), seeing information from this kind of sampling usually gives deeper insights into samples than partial ones. It may allow researchers to point-out a big picture on the results. It also eliminates bias in selecting samples that are usually encountered in random sampling.

The MATHUSAYA: Physical Gamification Strategy introduced innovative teaching methods and physical gamified strategy to improve learners' Mathematics fraction sense. According to Song and Kang (2020), this research examines the effects of gamification on student engagement and academic performance in elementary school mathematics education. The study demonstrates that gamification interventions enhance students' motivation and enthusiasm for learning mathematics, ultimately leading to improved academic outcomes and positive social interactions in the classroom. The strategy MATHUSAYA: Physical Gamification Strategy will help the learners become more engaged in learning and mastering fraction sense as it provides a fun, interactive, and convenient experience for them. It integrates their previous knowledge and fraction sense with the combination of games.

In this research, an interactive game-based approach that caters fraction sense through MATHUSAYA: Physical Gamification Strategy is used to help teachers improve the learners' Mathematics fraction sense. A pre-test and a post-test were given before and after the proposed strategy was implemented. To strengthen the study's rigor, it is essential to clarify the design of the pre-test, post-test, and weekly assessments. These tests were specifically created to measure key skills, such as understanding fractions and problem-solving abilities, closely aligned with curriculum goals. To ensure their effectiveness, the researchers involved mathematics educators and experts to review and refine the test items, and conducted pilot tests to adjust the components of the strategy based on student feedback. This careful validation process helps ensure that the assessments genuinely reflect student progress and the impact of the Physical Gamification Strategy.

The researchers prepared all necessary materials, double-checked for readiness, and obtained permission and consent from San Miguel Elementary School. A pretest was administered to the

respondents before the discussion began, with learners' identities kept confidential to protect their privacy.

The suggested strategy lasted for a month. The teacher's discussion of the lesson with the integration of the MATHUSAYA: Physical Gamification Strategy. The approach was divided into four weeks: Week 1, " Visualizing and Representing Fractions Equal to One and Greater Than One", Week 2, " Reading and Writing Fractions in Symbols and in Words", and Week 3, " Representing, Comparing and Arranging Dissimilar Fractions", Week 4 “Visualizing and Generating Equivalent Fractions”. Following the weekly discussion, the teacher conducted a weekly assessment to see whether the strategy utilized is beneficial to the learners' Mathematics fraction sense.

After the teacher discussed the lessons with MATHUSAYA: Physical Gamification Strategy incorporated, the teacher administered a post-test with the same items as the pre-test. The data for this study was collected from week one to week six, with the researchers keeping track of the student respondents' scores. The recorded results were based on pre-test scores from the first week as well as post-test scores from the last week.

The researcher utilized descriptive statistics. Mean and standard deviation were used to describe the learners’ fraction sense before and after the execution of the strategy. At the same time, a Paired Sample T-Test was employed to determine if a significant difference existed between the mean scores in pre-test and post-test. More so, paired T-test was used in this study to measure the significance of the difference in scores between the pre-test and post-test. This statistical method helped the researchers determine whether the changes in students' performance could be attributed to the Physical Gamification Strategy, providing clear evidence of its impact on learning outcomes.

To calculate the data that the researchers gathered, Microsoft Excel and IBM SPSS Statistics were used as statistical software that analyzed these quantitative data. At the same time, figures were created to show whether the student gains knowledge that leads to improved fraction sense in Mathematics after the proposed strategy.

Results and Discussion

Pre-test Results of the Control Group and Experimental Group

Table 1

Pre-test Results of the Control Group and Experimental Group

	Control Group		Experimental Group	
Range	**Frequency**	**Percentage**	**Frequency**	**Percentage**
17-20	0	0.00%	0	0.00%
13-16	5	17.24%	3	10.34%
9-12	13	44.83%	13	44.83%
5-8	10	34.48%	12	41.38%
0-4	1	3.45%	1	3.45%
Standard Deviation	3.088		2.989	
Mean	9.410		8.690	
Verbal Interpretation	Fair		Fair	

Legend: 0-4 “Poor”, 5-8“Fair”, 9-12, “Good”, 13-16 “Very Good”, 17-20 “Excellent”

Table 1 presents the pre-test results for both the control group and the experimental group, providing a baseline comparison of students' understanding of fractions before the implementation of the MATHUSAYA: Physical Gamification Strategy. The control group's mean score is 9.41, and the experimental group's mean score is 8.69, indicating that the difference between the two groups is not substantial. This showed that both teaching methods produced comparable results in terms of average performance.

The standard deviations are 3.088 for the control group and 2.989 for the experimental group, showing similar variability in scores around the mean for both groups. The slightly lower standard deviation in the experimental group suggests that its scores are a bit more concentrated around the mean compared to the control group. Further, both groups have been rated as "Fair" based on their mean scores, suggesting that the overall performance level of participants in both groups is generally moderate.

The control group's mean score is a bit higher, which suggests they performed slightly better on average since they had already discussed some topics before taking the pre-test. However, the similar standard deviations indicate comparable consistency in performance within each group. The "Fair" rating for both groups suggests that participants' performance in both contexts is moderately acceptable, with no significant difference in the overall ability or achievement between the groups.

Post-test Results of the Control Group and Experimental Group

The table below displays the post-test results for the control group and the experimental group, highlighting the differences in students' understanding of fractions following the implementation of the MATHUSAYA: Physical Gamification Strategy. The control group's mean score is 11.24, lower than the experimental group's mean score of 19.20, indicating better performance in the experimental group.

Table 2

Post-test Results of the Control Group and Experimental Group

	Control Group		Experimental Group	
Range	**Frequency**	**Percentage**	**Frequency**	**Percentage**
17-20	2	6.90%	28	96.55%
13-16	8	27.59%	1	3.39%
9-12	14	48.28%	0	0%
5-8	5	17.24%	0	0%
Standard Deviation	3.192		1.236	
Mean	11.240		19.200	
Verbal Interpretation	Fair		Fair	

Legend: 0-4 "Poor", 5-8"Fair", 9-12, "Good", 13-16 "Very Good", 17-20 "Excellent"

The standard deviation is 3.192 for the control group and 1.236 for the experimental group, showing wider variability in scores around the mean for the control group. The lower standard deviation in the experimental group suggests that its scores are more concentrated around the mean compared to the control group. Further, the control group's verbal interpretation stayed on "Fair" based on their mean scores, while the experimental group's verbal interpretation went higher from "Fair" to "Excellent",

suggesting that the fraction sense of participants in the experimental group was improved by the MATHUSAYA: Physical Gamification Strategy.

The experimental group's mean score is higher than the mean of the control group's mean, signifying a better fraction sense of learners. This implies that the MATHUSAYA: Physical Gamification Strategy has impact on learner's Mathematics fraction sense. Post-test results suggest that implementing the aforementioned strategy resulted in a higher mean than the pre-test.

Significant Difference in Pre-test Results of the Control Group (Grade 3- Zinnia) and Experimental Group (Grade 3-Sampaguita)

The table below outlines the significant differences in pre-test results between the control group (Grade 3-Zinnia) and the experimental group (Grade 3-Sampaguita). The significant difference on the pre-test between control and experimental groups resulted to a p-value of 0.35, which is greater than the level of significance at 0.05. Therefore, the null hypothesis was not rejected. There is no significant difference between the pre-test of the control and experimental group.

Table 3

Significant Difference in Pre-test Results of the Control Group (Grade 3- Zinnia) and Experimental Group (Grade 3-Sampaguita)

	Mean	P-Value	Decision	Verbal Interpretation
Control Group	9.41			There is no significant
Experimental Group	8.69	0.35	Accepted Ho	difference

Legend:<0.05

This implies that the learners' fraction sense had the same level before the strategy was utilized in the teaching and learning process. Consequently, this implies that the result may have significant implication for education, particularly in improving mathematical literacy. By focusing on a core skill like understanding fractions, the strategy addresses a foundational area of math education that is often a stumbling block for students.

This result is aligned with the meta-analysis study of Hamari, Koivisto, and Sarsa (2024) that justified gamification can create a more stimulating and enjoyable learning environment and its elements such as points, badges, and leaderboards can significantly boost students' intrinsic motivation. Moreover, a study by Su and Cheng (2015) found that students who participated in a gamified Mathematics course performed better in problem-solving tasks and exhibited higher levels of critical thinking compared to those in traditional settings. These improvements from several studies are attributed to the interactive and immersive nature of gamified learning, which encourages active participation and persistence.

Significant Difference on Post-test Results of the Control Group (Grade 3- Zinnia) and Experimental Group (Grade 3-Sampaguita)

This table presents the significant differences in post-test results between the control group (Grade 3-Zinnia) and the experimental group (Grade 3-Sampaguita). The significant difference in post-test scores between the control and experimental groups—evidenced by a p-value of 0.00, well below

the 0.05 threshold—shows that the MATHUSAYA: Physical Gamification Strategy had a real and positive impact on students' understanding of fractions. By rejecting the null hypothesis, it can confidently say that the improvements observed in the experimental group were not random; they were a direct result of this engaging approach.

Table 4

Significant Difference on Post-test Results of the Control Group (Grade 3- Zinnia) and Experimental Group (Grade 3-Sampaguita)

	Mean	P-Value	Decision	Verbal Interpretation
Control Group	11.24			There is significant
Experimental Group	19.20	0.00	Rejected Ho	difference

Legend:<0.05

With a mean difference of 7.96 between the two groups, it is clear that students who participated in the physical gamification strategy experienced a more enriching learning environment, helping them grasp mathematical concepts better. This finding highlights the power of hands-on learning, especially in subjects like math, which can be tough for young learners.

The results align well with previous studies that support innovative teaching methods, showing that gamification and active learning really boost student engagement and understanding. By connecting the findings to this broader research, the researchers reinforce the value of the MATHUSAYA strategy and encourage educators to adopt such approach in their classrooms to improve learning outcomes. The novelty of this study lies in its introduction of innovative, hands-on approach to learning. By combining physical activities with gamified learning strategies, the approach not only departs from traditional lecture-based methods but also engages learners in a more interactive and enjoyable way. This is particularly important for mathematics, a subject that many students find challenging and abstract, such as in fractions. Gamifying this process makes the concepts more tangible, and the integration of physical movements likely enhances cognitive processing and retention, making the strategy novel in its interactive, kinesthetic approach.

Through this result, it can be noted that gamification also supports the development of crucial 21st-century skills such as collaboration, communication, and technological literacy as it highlights educational platforms often include collaborative challenges and problem-solving activities that require students to work together, communicate effectively, and use digital tools proficiently (Dicheva, et. al, 2015). Additionally, a study by Hung et al. (2018) backs up our findings, showing that using games offers immediate feedback and gradually increases challenges. This approach helps students build confidence and overcome their fear of failure. These skills are crucial for success in today's workforce and can be nurtured effectively through gamified learning experiences.

Conclusion

Given the significant findings from this study, the study concluded that the MATHUSAYA: Physical Gamification Strategy is both effective and valuable for improving Grade 3 learners' understanding of fractions. This approach not only boosts engagement but also deepens their mathematical comprehension. The results revealed that teachers must embrace this strategy in their

classrooms, as it has the potential to enhance students' overall math skills and make learning more enjoyable.

Recommendations

In light of the findings and conclusions of the study, the researchers recommend to uplift the academic performance of the students in Mathematics through MATHUSAYA Physical Gamification Strategy as it could serve as a model for curriculum development and instructional design that balances physical activity with learning, potentially impacting policy recommendations for teaching Mathematics. The researchers likewise suggest the essence of rewards to make the strategy more interesting and engaging for learners. Moreover, the researchers suggest the broader adoption of gamification in classrooms and inspire further studies into how physical engagement can improve cognitive skills, making it an important contribution to both educational theory and pedagogical practices.

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