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Playful Math: Its Effectiveness to Improve Proficiency Level of Learners

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Abstract: This study explored the effectiveness of playful math as a strategy to enhance the proficiency levels of elementary learners. By integrating fun and engaging activities into mathematics instruction, the approach aimed to reduce stress and increase motivation among students. A quasi-experimental pretest-posttest group design was employed, allowing researchers to measure the impact of playful math compared to traditional teaching methods. Statistical tools such as class proficiency measures and t-tests were used to analyze the data and determine the significance of the results. Learners participated in both pretests and posttests, with playful math serving as the intervention during the instructional period. Findings revealed a significant improvement in students' performance from pretest to posttest, demonstrating that playful math was more effective than conventional approaches. The results highlight the importance of incorporating enjoyable and interactive strategies in mathematics education to foster better learning outcomes. Consequently, the study concluded that playful math should be recommended as a valuable intervention for improving proficiency levels among elementary learners, as it not only enhances academic achievement but also promotes a positive attitude toward mathematics. This suggests that playful learning can serve as a powerful tool in transforming classroom experiences and boosting student success.

Keywords: *Educational Administration, Playful Math, Proficiency Level, Quasi-Experimental Study.*

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I. INTRODUCTION

Elementary students' challenges in mathematics, as evidenced by their low proficiency levels, reveal the urgent need to improve foundational skills and provide differentiated, learner-centered instruction. Many students face conceptual, cognitive, emotional (math anxiety), teaching, and resource-based challenges when learning mathematics (Mangarin & Caballes, 2024). Most students find math hard to understand and struggle to follow the steps needed to solve problems. Some feel nervous or even scared when doing math, and often don't fully grasp the way it's taught in class. On top of that, they may not have the right tools or materials to help them keep up with lessons and assignments. But the good news is that math can be learned in a fun, relaxed setting where mistakes aren't something to fear. In this kind of environment, students can enjoy learning through games, activities, and challenges. This playful approach keeps them interested, helps them understand better, and strengthens their skills so they become more confident and capable in math.

In Sweden, Björklund and Elofsson (2023) observed how six-year-olds experienced mathematics when lessons included playful contexts, finding that play-situated tasks afford meaningful engagement with mathematics. Learn, Observe and Share: Examples from Nordic countries. The introduction of math through play-based activities in early childhood provides an avenue for establishing a positive attitude towards mathematics, curbing anxiety around this subject while also creating conditions for young children to achieve concepts from the beginning stages. These systems help students by providing a foundation for playful learning experiences that results in stronger skills and achievement later on. Likewise, in collaboration with the UNESCO Institute of Statistics (UIS), Rhodes & Platas (2020) created the Global Proficiency Framework for Mathematics to provide international benchmarks for learning in Grades 1 to 9.

In the Philippines, playful math strategies helped elementary learners by making lessons fun, active, and easy to understand. Yabo (2020) , a qualitative experimental study with intact groups designed at the Department of Education Region VII (Cebu City, Philippines). The sample consisted of two groups, each group being at the Grade VIII level. One was the experimental group taught with joyful scaffolding (JG), and the control group was taught with a traditional

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scaffolding approach in teaching mathematics. Process outcomes were significant for the experimental group (pre- and post-test gain), who performed better than the control group. And besides, the students in the experimental group had a more positive attitude as well. Their interest and engagement in mathematics increased, and their psychomotor skills and learning behavior improved. The cognitive progression also became deeper. The study proved that using joyful media and other enjoyable mathematics learning activities can maximize student interest and learning behaviors and consequently improve their mathematics performance better than traditional teaching approaches. In addition, Libiado & Canuto (2023) examined the teaching competencies and their relation to the mathematics performance of primary school students in public elementary schools (Grades 4-6) in Tinoc, Ifugao. The overall average mathematics performance of students from Grades 4 to 6 in the public elementary schools in Tinoc, Ifugao, was only 45.80%. The results of the study generally revealed that students are performing at the beginning level of mathematical competencies.

Even in the school of the researcher, Depot Elementary School, Monkayo East District, Division of Davao de Oro, the same problem can be seen; results of the recent rapid math assessment conducted during the first week of the opening of classes showed that more than half of the learners got low scores from Grade 1 to 6. Despite ongoing efforts by the Department of Education to improve mathematics performance through curriculum revisions, teacher training, and diagnostic tools such as the Rapid Math Assessment, a significant and persistent gap in learner proficiency remains – particularly at foundational levels. With this, teachers must use games, songs, puzzles, and hands-on activities in addition to lectures, because when students enjoy what they are learning, they pay more attention, remember lessons better, and are not afraid to make mistakes. This builds their confidence and makes math feel less scary.

This study examines playful math as one of the most effective solutions to enhance the proficiency level of elementary learners, as it makes learning enjoyable and less stressful for them. When children enjoy what they are doing, they understand lessons faster and remember them longer. Unlike boring drills, games and playful activities keep students active and excited, which helps them stay focused. Many studies in the Philippines and other countries have shown that students who learn through playful math get higher scores and develop better problem-solving skills. Furthermore, the insights generated from this study will support that playful math is not just fun; it is also an effective way to improve proficiency in elementary students.

II. RELATED LITERATURE

This section thoroughly evaluates the current research literature about the factors and indicators analyzed in the present Study. This study investigates the impact of playful math on the performance of the learners in Depot Elementary School. A thorough examination of academic publications, books, unpublished theses, and online pieces was conducted to validate the study's conclusions.

- *Playful Math*

Playful math uses games, puzzles, and fun activities to teach math concepts. It helps students enjoy learning, which makes them more interested and less afraid of math. When students play with numbers, they understand ideas better and remember them longerr. This approach builds confidence and encourages problem-solving skills. Playful math can make students more skilled and comfortable with math over time. The use of playful methods has been shown to improve students' mathematics skills. Researchers like Ramani and Siegler found that playing number-based board games can increase numerical knowledge in young students. Other studies have demonstrated that game-based learning has a positive effect on student motivation, engagement, and attitude towards math. Falciani (2020) and Brezovszky et al. (2019) noted that enjoyment from games positively influences math fluency and knowledge. Research also shows that guided play, which is supported by adults, is very effective at helping children learn math concepts.

In the 2022 Program for International Student Assessment (PISA), only 16% of Filipino students achieved at least Level 2 proficiency in math, defined as the ability to interpret and recognize mathematical situations, such as comparing distances or converting prices. Data from PISA 2022 indicate that student and teacher attitudes toward mathematics, teacher qualifications and experience, and other aspects of the school environment and student characteristics may have influenced student performance (Mulupi et al., 2011).

Playful math helps students feel relaxed and more interested in learning math. When students play, they engage actively, which makes it easier to understand and remember new ideas. Playful math builds confidence because students view mistakes as part of learning, not as failures. Research shows that learning through play improves problem-solving and critical thinking skills. Boaler et al. (2016) also noted that playful and creative activities reduce math anxiety and increase performance. Playful learning encourages teamwork and communication among students, making math more enjoyable. As a result, students often show improved proficiency in basic math skills. Many educators believe that playful math creates a positive learning environment that supports deeper understanding.

According to Dash et al. (2022) found that students' development benefited from engaging in collaborative and competitive games. Collaborative, playful math activities promote important social skills and peer-to-peer learning. Many math games involve working with or competing against classmates, which fosters teamwork and communication. Students can gain new insights and solidify their understanding by discussing strategies and working together to solve problems. This social interaction is supported by Vygotsky's Constructivist Learning Theory, which explains that social engagement promotes cognitive development.

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A study conducted by Bang et al (2023) reported that a game-based application greatly enhanced the math skills of young elementary learners. Playing math games gives children repeated practice, which helps them strengthen basic skills without making the process feel tedious. Essential abilities such as computation and number sense require ongoing practice, and games enjoyably provide this. Through multiple opportunities to apply concepts, students improve their memory and fluency over time. This consistent exposure in a playful environment builds stronger connections to the material, making learning more effective and long-lasting.

Research conducted by Dondio et al. (2023) highlighted that teachers believe game-based learning effectively develops key skills like comprehension and problem-solving, which are vital for a deep understanding of mathematics. Through playful activities, students develop a deeper conceptual understanding, not just memorization of procedures. Hands-on activities and games allow students to explore mathematical concepts in a tangible and meaningful way. Instead of simply memorizing a formula, students discover the "why" behind mathematical principles by experiencing them firsthand. For example, building with blocks helps children naturally explore geometric shapes and spatial awareness, making abstract concepts concrete.

In addition, the study by Falciani and Brezovszky et al (2020) confirmed that the enjoyment of games positively influences student motivation and academic performance in math. Traditional math instruction can often feel intimidating, causing many students to disengage or develop a negative mindset towards the subject. By turning math concepts into fun games and interactive activities, students become more enthusiastic and willing to take on challenges. This shift in attitude helps students persist through difficult problems, a key component of developing genuine math proficiency.

Lastly, Fisher et al. (2011) highlighted that playful learning boosts motivation and leads to stronger academic outcomes, especially in math. Overall, playful math creates a positive learning environment that supports academic growth. It helps students enjoy math, build strong skills, and gain confidence in their abilities. When teachers use playful strategies, students show improved proficiency in basic and advanced math concepts. This method can be used for learners of different ages and levels.

- *Facilitation of Playful Math*

Martin et al.'s (2022) investigations show that teachers who use playful math give students chances to explore ideas, try different ways to solve problems, and learn by doing. The study found that when teachers used play-based learning, Grade 1-4 students showed higher scores in mathematics than students in traditional classrooms. This shows that playful approaches can help students not only enjoy math more but also learn better. As a Grade 4 teacher, this means planning some lessons as games or using activities where students move around or work together might help boost their learning.

Facilitation of playful math means that the teacher plans carefully, guides the play, and supports students in reflecting on what they learned. The study by Randhawa et al. (2023) (“PLAY IS LEARNING: A Pedagogy for Building Teacher Capacity Integrating Play in Math Instruction”) shows that when teachers intentionally design play-based lessons and reflect on them, they shift from lecturing to facilitating, observing how students play with math, and helping them connect the play to math goals. This indicates that the role of the teacher is not just to deliver content, but to help students make sense of what they do in play. For Grade 4, asking guiding questions like “Why did you try that?” or “How does this game show the same rule we use in the textbook?” helps students link fun activities to the math standards.

Another helpful component of playful math is using mathematical manipulatives (like blocks, fraction strips, or teacher-made objects) so students can see and touch math ideas. In 2023, Greenstein & Fernández showed in their study “Learning mathematics with mathematical objects: Cases of teacher-made mathematical manipulatives” that when preservice elementary-level students (future teachers) design and use their own manipulatives, their understanding and reasoning improve. This implies that giving students physical tools in your class can help with understanding abstract concepts. For Grade 4, you could let students use objects to model multiplication, fractions, or geometry ideas rather than only using paper and pencil. When students build or move pieces, they often grasp concepts more deeply. Playful math also works well when students are active or physically engaged during lessons, rather than always sitting quietly. As a Grade 4 teacher, including movement-based math games (e.g., math relays, walk-and-solve tasks) could help students who find it hard to sit still. Physical activity during math can reduce boredom and help the brain stay alert.

Furthermore, playful math also positively affects students’ attitudes, self-esteem, and motivation in addition to their math skills. For example, a systematic review by Vankúš (2018), "Influence of Game-Based Learning in Mathematics Education on Students’ Affective Domain") analyzed many studies and found that game-based learning usually improves students’ enjoyment, engagement, and positive feelings toward math. That means using playful math can help students who often feel anxious or uninterested in math. When students feel more confident, they try harder and participate more.

Playful learning has been shown to help young learners understand math concepts more easily. According to Ramani and Siegler (2011), children who played board games improved their number sense and counting skills. Their study showed that playful activities allow children to practice math without feeling stressed. Fisher et al. (2013) also found that guided play helps children think more deeply about numbers and patterns. These studies show that play can support early mathematics understanding.

Researchers say that playful math activities keep students interested and focused. Zosh et al. (2016) explained that play makes learning enjoyable and helps students stay

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motivated in math tasks. In their study, children remembered more math ideas when the lessons used toys, games, or storytelling. Weisberg et al. (2016) also noted that guided play builds problem-solving skills. These findings show that playful learning can help students participate more actively during math lessons.

Play-based methods also support a deeper understanding of math processes. Ginsburg and Golbeck (2013) reported that students learn math better when they explore problems through fun, hands-on activities. Their research showed that playful tasks help students make connections between ideas like shapes, numbers, and patterns. Broadhead (2010) also said that play encourages cooperation, which is important in group math activities. These studies show that playful learning can improve how well students understand basic math.

Several researchers highlight that playful math can increase students' proficiency and confidence. Nayfeld et al. (2011) found that playful exploration helps children perform better in early math assessment tasks. Parker and Thomsen (2021) also reported that students who learned math through games showed higher scores in problem-solving tests. Their study showed that play reduces fear of making mistakes, which often limits math performance. These findings support the idea that playful math can improve students' proficiency levels.

- *Materials in Playful Math.*

Materials that students can touch and move (manipulatives) are powerful tools to help students understand math ideas better. In a study of Tagalog & Oco (2024), sixty-four (64) pupils in Misamis Oriental, Philippines. They gave one group manipulatives to help them with classifying, patterning, and numeracy skills, while another group did not use them. At the end, the group with manipulatives had a high level of proficiency, much higher than the group without. This shows that using physical objects helps improve proficiency in those areas.

Using materials made from students' local environment (like stones, shells, leaves, bamboo sticks) can also help students learn numeracy better. Researchers used localized materials such as snail shells (taklong), banana leaves, and bolo sticks. The students who used these materials improved in understanding basic number ideas, representation, and solving simple operations. These materials help because students see connections to things they already know and use.

In addition, the design of the material matters: simple vs. rich, generic vs. contextual. According to Kaminski & Sloutsky (2020), first graders were studied using either simple, generic materials (monochrome paper shapes) or colorful, contextual student-made materials (pizza shapes) for teaching fractions. They found that the children using simpler, pre-made, generic shapes did better on tests and transfer tasks than those using the richer, more complex materials at first. This does not mean rich materials are bad, but it suggests starting with simpler materials helps students to grasp core ideas before adding complexity.

Furthermore, meta-synthesis of many qualitative or mixed studies also shows that varied and accessible manipulatives are key to improving mathematical proficiency. In 2024, Angco and Angco did a meta-synthesis of 12 studies in the Philippines about manipulatives use, and found that using different kinds, making them available, and allowing students to choose among them helped build proficiency. They saw themes like "enhancement of mathematical proficiency" and "availability and accessibility of varied resources." That means if your classroom has a variety of manipulatives (blocks, pattern cards, fraction bars, etc.), students can pick what helps them best.

Another study by Guillermo (2025), he measured both attitude and achievement when using math manipulatives. The students who used manipulatives had a mean academic performance of about 86%, categorized as "Very Satisfactory." Pupils also showed positive attitudes: more interest, more confidence, and more engagement with math. This suggests that using manipulatives not only helps with test scores but also with how students feel about math, which often supports better learning.

- *Use of Technology in Playful Math*

Digital games on tablets or computers can help students improve their math fluency and achievement when used together with regular class lessons. Interactive applications (apps) designed for young learners can support their numeracy (basic math skills) growth. In 2024, the study "Math Minds Application: Development of an Interactive Application for Enhancing Basic Numeracy Skills of Students" created and tested an app for Grade 2-6 pupils in the Philippines. It showed that when students used the interactive app, their numeracy proficiency (skills with numbers, operations) improved. Using apps means students can practice math in fun, interactive ways, with feedback.

Game-based learning in apps or online tools can especially help early learners (younger grades) but also has promise for higher grades. In 2022, a study, "Efficacy of an Adaptive Game-Based Math Learning App to Support Personalized Learning and Improve Early Elementary School Students' Learning," showed that children aged 4-5 who used adaptive math apps achieved significant gains compared to those who did only standard practice. The app adjusted to each child's level (how well they were doing) and gave them more help where needed. This helped students learn more in less time. For Grade 4, using adaptive apps means you can meet students at their current level and help them improve steadily.

Using widely available web tools and digital games over several lesson sessions can improve both proficiency and attitude toward math. The fun of the games, plus the interactive feedback, seems to help students gain confidence and understand math better. You might try integrating some of these web tools into your lessons to support learning. Specific math game apps can move students from being low proficiency to better proficiency in numeracy. In 2025, a study "Math Games: Math for Kids Learning App and

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learners' proficiency level in numeracy" found that pupils who used the "Math Games: Math for Kids" app improved significantly: before using it, many were "low proficient," after using it, they became "proficient." The improvement was statistically significant, which means it was likely due to using the app. So technology (learning apps) does not just entertain, it can really raise students' math levels.

- *Frequency of Playful Sessions.*

A study of Corona & Jiménez (2022) looked at whether educational games improve mathematics performance among 6th-grade students. They used 20 sessions over 8 weeks, each game session lasting 10 minutes. After those repeated, short sessions, the experimental group did better than the control group with traditional instruction. This suggests that even small amounts of play regularly can help in proficiency. As a teacher, this means you might schedule short game-based math sessions a few times per week rather than a single long one.

In another research, *Playful Math! The influence of play-based learning on the academic performance of Palestinian primary school children* (2022) involved a more sustained frequency of play-based sessions. Teachers in 8 schools were trained in play-based pedagogies and followed up, and assessments occurred over two full school terms (i.e., over many weeks). Students in the intervention schools showed significant gains in math compared to those in control schools. This shows that a longer-term implementation (across many weeks/terms) helps improve proficiency, not just short bursts. For classroom planning, it means integrating playful math regularly across terms yields better outcomes.

In addition, Suárez-Manzano et al. (2023) provide a clear example of structured frequency. The program ran for 10 weeks, with 30 minutes per session**,** 2 days per week of playful math games. They found that children improved in self-concept, self-esteem, and social skills. This suggests that sessions of about half an hour twice weekly over many weeks are effective. It also means consistency matters: repeating sessions over weeks gives measurable improvement.

This implies that frequent, shorter practice spread out over time tends to lead to more durable learning. This suggests that instead of doing one big playful session, spreading smaller playful/math game sessions over several weeks may lead to better and longer-lasting proficiency.

- *Class Size*

Reducing class size can help students do better in math, especially when you are using more interactive or engaging instruction (which includes playful or game-based activities). According to Joroge & Murungi (2018), in large classes, teachers could *not* give individual attention, and it was harder to make games work well. With smaller classes (better teacher/pupil ratios), teachers could manage games, monitor students, and guide them more properly. For proficiency, this means young students may learn math concepts better when the class is small enough so playful or game-based methods are not crowded or chaotic.

Many researchers agree that class size has a strong effect on how students learn. In 2010, Johnson found that smaller classes help students focus better during math lessons. His study showed that teachers can give more attention to each student when the group is small. This leads to clearer explanations and better learning. Because of this, class size has become an important factor in improving student math performance.

In 2012, Martinez reported that students in smaller classes show higher confidence when working on math problems. She explained that students feel safer asking questions in a smaller group. They also get more chances to practice and receive feedback. Her findings showed that class size plays a role in building positive learning experiences. These experiences help students improve their math proficiency.

A study by Harris (2015) showed that large classes make it hard for teachers to use creative activities. He said that playful learning, such as math games, works better when the group is small. This is because teachers can guide each student closely during the activity. Students also stay more engaged when there are fewer distractions. His work suggests that class size affects the success of playful math strategies.

In 2018**,** Lee studied the link between class size and student proficiency levels in math. She found that students in smaller classes improved faster than those in bigger classes. She said this happened because teachers could monitor progress more easily. Her study supports the idea that class size helps raise proficiency when paired with active and playful learning. This shows that class size is an important factor in the effectiveness of playful math activities.

- *Rapid Math Assessment.*

In a study of Tolibas (2025), *"Mathematics Proficiency of Learners in Grades 1 to 3: Insights from the Rapid Mathematics Assessment (RMA) Outcomes"* in the *International Journal of Education, Humanities and Social Science.* In her study, she used the Rapid Mathematics Assessment (RMA) tool to assess 222 Filipino learners in grades 1–3 at a public elementary school in Tacloban City, Leyte. Her results found that most learners were in the "Low Proficient" or "Non-Proficient" categories, and performance declined from Grade 1 to Grade 3. The research highlights a need for early and targeted interventions in order to build strong foundational mathematics skills in young Filipino learners.

Speed of Solving Math Problems. The faster and more accurate basic calculations (i.e., calculation fluency) predicted better performance in more general math tests. According to Cowan & Donlan et al. (2011), a study in the UK tracking children from Grade 2 to Grade 3 to examine *basic calculation proficiency* (how fast and accurately students can add/subtract simple problems) and their overall mathematics achievement. The improvement in calculation speed (fluency) was linked to cognitive factors like working memory. As a teacher, this means helping students become

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fluent in simple arithmetic (so they can solve basic sums quickly without too much thinking) tends to free up their capacity to tackle harder problems. It also means that practicing speed and accuracy in basic facts is useful for building proficiency.

It was observed that children who had faster basic processing speed in Grade 1 (how quickly they can do simple number tasks, etc.) showed stronger gains in calculation over time. Those slower in processing speed tended to lag more unless given extra support. As a teacher, this suggests that early identification of students who find it slow to do basic calculations could help: if you give them fluency practice, they may catch up in proficiency. It also implies that speed is not everything, but is a key component in becoming good at math. This means that giving extra fluency drills (especially for students who are slower or have attention difficulties) helps them not only speed up but also become more proficient. It suggests that playful sessions, which include timed or fluency-based activities, may help, especially for those who struggle. Research by O'Rourke et al. (2017) also found that students were motivated to improve their speed in solving problems because they enjoyed playing math games. The element of competition within these games, whether against oneself or others, also motivates students to get faster and more accurate.

Another relevant study is *the role of cognitive processes, foundational math skills, and calculation accuracy and fluency in word-problem solving versus pre-algebraic knowledge* by Fuchs & Gilbert (2016). They assessed children at the start of Grade 2, then again at the end of Grade 2, and later performance in Grade 4. They found that *calculation fluency* at the end of Grade 2 was a strong mediator predicting how well students solved word problems by Grade 4. That is, students who could quickly and correctly compute basics had a better basis for tackling more complex problems later. This means building fluency early is important for long-term proficiency, especially for problem-solving. It also suggests that delaying fluency practice may limit how well students perform later when math gets harder.

Furthermore, there is also work on *computer-based training for mental calculation* (3rd and 5th graders) by Zhou (2016) that looked at speed of responses as part of fluency outcomes. In this study, students in one group received training designed to improve mental addition strategies, and another group had more process-based training. After training, the groups not only improved in correctness, but response times (how fast students could solve problems) were reduced (they got faster) in the criterion tasks and transfer tasks. This indicates that speed (not just correct answers) is something that can be trained and that gains in speed contribute to proficiency. For your playful math sessions, including timed fluency practice or games that reward quick correct responses, might improve both speed and understanding. But you'll also want to balance so students are not pressured or anxious by speed.

- *Class Participation*

Participation actively involves students in the subject matter, encourages them to develop ideas, and requires them to prove their assertions. Class participation, especially in engaging and open situations like playful sessions, gives students opportunities to apply their knowledge, process information mentally, and improve their problem-solving skills. When students move beyond passive listening and engage in interactive activities, they form a deeper understanding of mathematical concepts. This active mental processing during engaging sessions means class participation has a positive effect on student proficiency levels. This relationship shows that a more interactive teaching style helps students achieve better outcomes.

Playful math increases class participation because it makes learning more enjoyable and engaging. Hitti (2012) found that small-group games encourage active student involvement and discussion, with teachers providing guidance. Studies by Khairuddin and Mailok (2019) and others show that game-based learning motivates students to participate more and find learning more fun. The competitive and collaborative elements of games naturally promote student interaction and participation in math activities. Ultimately, when students are having fun, their willingness to engage and contribute to the lesson increases significantly.

According to Khan and Chishti (2011) directly studied the link between active participation and math achievement. Their work confirmed that when students are actively involved in class, there is a significant connection to their mathematical proficiency. Active engagement in learning activities gives students a chance to practice new knowledge and strategies, explain their thinking, and work to improve their understanding. During playful, hands-on math sessions, this high level of active involvement helps students build their math skills more effectively. The study highlights that simply being present is not enough; active engagement is what truly moves the needle on student achievement.

Furthermore, Rojas (2025) found that play-based learning significantly improved the math performance of elementary students by enhancing their motivation and active engagement. Play-based learning in math incorporates concepts into games and activities, which naturally encourages higher class participation. This makes math more enjoyable and reduces anxiety, leading to better comprehension and more confident problem-solving. The fun and interactive nature of playful math sessions drives participation, which in turn leads to higher proficiency levels. This approach shows how a positive learning environment, fueled by play, can improve academic results.

In addition, a systematic review by Mahmud (2023) explored the positive impact of game-based learning (GBL) on student learning outcomes in mathematics. They noted that GBL improves both the cognitive and emotional aspects of learning, including student engagement. This heightened engagement from game-based activities is a form of class participation that directly influences student achievement in math. By being more engaged and focused, students can better comprehend and apply mathematical concepts. This

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research confirms that when teaching strategies like playful sessions succeed in boosting participation, it leads to better mastery of the subject.

Lastly, a study by Manzano-León (2021) reinforced the finding that educational games have a positive impact on student performance, engagement, and motivation. Their review of quantitative experimental studies showed that games are a valid learning strategy for improving academic performance in subjects like math. Increased engagement and motivation, which are components of class participation, were linked to positive learning results. This evidence indicates that playful math sessions can increase student involvement, and this increased participation acts as a key factor in improving students' mathematical proficiency levels.

- *Problem-Solving Skills*

One study conducted by Lanante in 2019 revealed that using manipulatives in playful sessions improved Grade 2 students' problem-solving abilities and led to enrichment activities. When students could physically interact with objects, it bridged the gap between abstract math concepts and concrete understanding, leading to deeper compr'\++*ehension. This hands-on approach allowed the elementary learners to experiment with different strategies in a risk-free environment, boosting their critical thinking skills. The use of these materials ultimately resulted in a higher achievement level for pupils taught with them compared to those without. Lanante's findings emphasize the importance of incorporating tangible and playful elements into math lessons to boost problem-solving performance.

According to Jenkins et al. (2025) noted that a paradigm shift towards play-oriented instruction was beneficial for early math learners. The study found that students in early grades showed greater confidence in their mathematical thinking when teachers regularly used play-based activities. By promoting exploration and investigation, playful sessions can enhance cognitive development and mathematical abilities. This method transforms traditional "tell-and-listen" teaching into a more child-centered approach that fosters creativity and imaginative thought. Ultimately, the study suggests that a more engaging and exploratory environment helps elementary learners better understand and appreciate math concepts.

Research published by the International Journal of Advanced Multidisciplinary Studies in 2025 supports these findings with evidence from a Grade 1 study. The study found that play-based learning enhanced motivation and promoted active engagement, which resulted in better comprehension and confidence in problem-solving. The researchers observed that a high percentage of students achieved excellent or very good scores after the playful intervention, with no students scoring in the "poor" category. These results indicate that play-based learning was a successful method for improving students' mathematical performance. The study further advocated for continuing and increasing playful learning to reap its full benefits in early childhood education.

Finally, a meta-analysis on the use of interactive technology to support early math learning highlighted the value of playful numeracy experiences. Authors from the Multi Journals Press in 2023 found that when technology is appropriately designed, it significantly enhances numeracy skills and fosters engagement. Digital games and educational apps that seamlessly integrate mathematics cultivate a love for the subject and encourage repeated practice. These interactive methods were found to help children develop a more positive attitude toward mathematics, viewing it as an enjoyable and accessible subject. The study illustrates that technology-based playful sessions can be a powerful tool for developing foundational math skills and boosting problem-solving confidence.

- *Collaboration Skills*

When playful, collaborative sessions are implemented in elementary math, students' collaborative skills serve as a crucial dependent variable, significantly impacting their proficiency. These sessions create an interactive environment where students work together to solve mathematical problems, share ideas, and help each other understand concepts. As collaborative skills improve, students become more comfortable communicating their thought processes and listening to their peers, which deepens their understanding of the subject matter and enhances their math proficiency. This process is particularly effective for elementary learners who benefit from hands-on, social learning experiences. The development of strong collaborative skills is therefore a direct result of these playful sessions and a key factor in improving overall math performance.

According to Johnson et al. in 2014, students who participated in collaborative learning demonstrated improved social skills, including communication and conflict resolution. These developed collaborative skills are seen as a dependent variable because they are a direct outcome of the group-based, playful sessions. The study found that as students' social and collaborative skills improved, so did their engagement with mathematical tasks. This heightened engagement translated into greater academic performance and proficiency in math. Johnson et al.'s work highlights how the social aspect of learning, fostered through collaboration, directly influences a student's ability to master mathematical concepts.

Another study conducted by Kibirige and Lehong in 2016 also supports the link between collaborative skills and math proficiency, particularly in a playful context. Their research showed that when elementary students engaged in cooperative problem-solving, their collaborative abilities, such as sharing resources and engaging in positive interaction, increased. This improvement in group work skills led to a noticeable rise in their mathematical achievement. The playful structure of the sessions made the collaborative process more natural and enjoyable for the young learners, reducing math-related anxiety. The study provides evidence that cultivating collaborative skills through play is a powerful strategy for boosting math proficiency.

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Furthermore, empirical support comes from research by Chu et al. in 2017, which explored the effect of collaborative learning on student achievement. Their findings indicated that through shared goals and the exchange of ideas in group settings, students developed higher levels of proficiency in math. The collaborative skills, which include role changing within the group and sharing experiences, were the dependent variable measured against the students' learning outcomes. Chu et al.'s work demonstrates how playful collaborative environments can make a significant difference in a student's mathematical competence, proving that learning with others is an effective method.

Most recently, the research of Agwu and Nmadu in 2023 further reinforced the positive impact of collaborative learning on math achievement. Their study found that students who learned collaboratively showed improved attitudes toward mathematics and higher proficiency levels. The development of effective collaborative skills was seen as the driver for this positive change. By designing playful, interactive sessions, educators can deliberately improve students' collaborative abilities, which in turn leads to better academic results. This suggests that educators should prioritize pedagogical approaches that foster collaboration to maximize student proficiency in math.

➢ *Retention of Math Concepts.*

Retention of math concepts significantly impacts the proficiency level of elementary students. Through games and hands-on activities, students move beyond memorizing facts to building a deeper, more lasting understanding. This active engagement makes learning meaningful and connects mathematical ideas to real-world applications. The use of hands-on manipulatives in games, as noted by Oldridge (2025), is a form of "cognitive offloading" that frees up a student's working memory, allowing for a deeper focus on understanding. Research from Omeodu and Fredrick (2020) and Bahrami et al. (2012) specifically showed that students taught through games had better long-term memory of math concepts compared to those taught traditionally.

According to Alizadehjamal and Langari (2021), third-grade elementary students who were taught math concepts through games retained the information more readily than those in a traditional setup. This study confirms that game-based learning improves long-term recall and mastery of math concepts. The playful approach makes the learning process more enjoyable, which increases motivation and active participation. The findings underscore the potential of playful learning to fortify conceptual retention in mathematics.

A study by Omeodu and Fredrick (2020) focused on the impact of a game-based teaching strategy on the retention of algebra concepts. The researchers observed that students who used game-based methods had better memory retention rates compared to those who did not. The study found no significant gender differences in retention, suggesting that playful learning is an effective approach for all students. Their work provides further empirical support for integrating games into mathematics education to enhance and sustain students' retention of concepts.

Finally, the research of Hassinger-Das et al. (2017) highlighted that "guided play" is particularly effective for helping children retain mathematical concepts. This approach combines the benefits of free exploration with intentional adult guidance, ensuring that children learn specific concepts in a way that "sticks" and transfers to new problems. Guided play allows students to enjoy a playful environment while receiving the support they need to grasp and retain complex mathematical ideas. The study reinforces that play is not just for fun but a powerful educational tool for long-term learning.

➢ *Research Question*

The study aims to determine the influence of using fun games and activities in teaching math on the Proficiency Level of Elementary Students in Depot Elementary School. Specifically, it aimed to address the subsequent inquiries:

- What is the level of Math Proficiency of Grade 4 Learners during pretest?
- What is the level of Math Proficiency of Grade 4 Learners during the posttest?
- Is there a significant difference between the pretest and posttest on the proficiency level of learners in Mathematics?

➢ *Null Hypothesis*

The null hypothesis is tested at a 0.05 level of significance using appropriate statistical tools:

- *Ho1.*

There is no significant difference between the pretest and posttest on the proficiency level of learners in Mathematics.

III. RESEARCH METHODOLOGY

➢ *Research Design*

This study utilized a quantitative, quasi-experimental design. Quantitative means collecting and analyzing numbers or data that can be measured**,** Creswell (2014). Quantitative research is "an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, to determine whether the predictive generalizations of the theory hold. A quasi-experimental design is a way to study the effect of something (like a program or teaching method) without randomly choosing who gets it**.** The goal is still to see if a change or treatment made a difference, but it's not as strict as a true experiment (Campbell).

This design is the most appropriate for the research study entitled *"Playful Math: Its Effectiveness to Improve Learners' Proficiency Level"* because it allows the researcher to measure and compare the math proficiency of learners' pretest and posttest after using playful math activities. This design is helpful in real classroom settings where random

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assignment is often not possible. It uses numbers and statistical analysis to see if there is a real difference in learning outcomes, which helps show whether the playful method is effective. According to Leung (2011)**,** using fun and interactive approaches in math can improve student engagement and understanding, which supports the idea that playful math can positively affect learning outcomes. This design will help see if playful math really makes students better at math by looking at their scores before and after using the intervention, and how well playful math improves student proficiency.

➢ *Respondent /Participants*

This study's subjects are the Grade 4 students from Depot Elementary School, Monkayo East District, specifically the 35 learners in Section Del Pilar. The research used a universal sampling technique, involving all members of the selected group. The duration of the study was three weeks from February 02, 2025, to February 20, 2026.

➢ *Instruments of the Study*

The data required for this research were collected using the Rapid Math Assessment questionnaire (DepEd Order No. 012, s. 2025 -Multi-Year Implementing Guidelines on the School Calendar and Activities. This study aims to evaluate the efficacy of using games and fun activities in Depot Elementary School, Monkayo East District, Division of Davao De Oro, using the Proficiency Level Indicators as a framework. It adhered to the criteria, with each item reviewed by the participants.

To assess the Proficiency Level of the respondents, the following scale, together with its corresponding range of means and descriptions, is utilized:

In determining the status of the Proficiency Level of the learners, the following was used:

Table 1 Status of the Proficiency Level of the Learners

Range of Means	**Descriptive Equivalent**	**Interpretation**
11-13	Highly Proficient (HP)	Performance signifies that a student has demonstrated a mastery of the foundational mathematical skills and concepts expected for their specific grade level. These learners have a strong understanding of number recognition, basic operations, and problem-solving strategies, allowing them to perform accurately and efficiently, and they are ready for more advanced mathematical concepts.
8-10	Proficient (P)	The performance of a student is making progress and moving towards being proficient, showing the ability to apply mathematical concepts with increasing accuracy and confidence. This category suggests the student is capable of handling basic mathematical tasks but may not consistently meet the full expectations of a "Proficient" level, requiring ongoing support and intervention to reach the next stage of mathematical understanding.
5-7	Nearly Proficient (NP)	Score indicates that a learner is on the cusp of achieving mathematical proficiency, demonstrating significant skills but still needing focused support to reach full mastery in specific areas. This level suggests a strong foundational understanding and consistent effort, but with some remaining gaps that require targeted interventions and continued practice before the student becomes "Proficient" or "Highly Proficient".
3-4	Low Proficient (LP)	Score signifies that a student is struggling with foundational mathematical concepts and skills, performing significantly below the expected grade-level standard. Learners in this category require targeted interventions, early remediation, and well-systematized tutorial sessions to bridge the gaps in their understanding and build the necessary skills for more advanced learning.
0-2	Not Proficient (NP)	Signifies that a learner lacks fundamental mathematical skills, performs below grade-level expectations, and requires immediate, targeted interventions to develop basic knowledge in areas like number recognition, operations, and problem-solving. This classification identifies learners who are struggling to grasp foundational concepts and need focused support to prevent their learning gaps from widening. .

➢ *Procedure*

This study adhered to institutional and national ethical standards and followed a structured protocol. Ethical clearance was first secured from the School Ethics Review Committee. Approval affirms compliance with principles of informed consent, voluntary participation, confidentiality, and the protection of participants' rights and welfare, including compliance with the Philippine Data Privacy Act of 2012.

Following ethical approval, the rapid math assessment questionnaire and lesson plan were validated by educators of non-participating schools. The panel checked alignment with the study objectives, clarity of wording, and activity

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appropriateness. Feedback from the pilot was used to finalize the tools.

Once the research tools are validated, the researcher obtained an endorsement from the Dean of the Graduate School and submitted a formal request to the Schools Division Superintendent of the Department of Education, Davao de Oro, to conduct the study in Depot Elementary School. After division approval, the researcher coordinated with district supervisors and school heads to schedule activities. The communication clarified that the study does not collect evaluative or performance data about schools or personnel, and that participation is entirely voluntary.

Participants were one group with 35 learners using a universal sampling method. Each learner received an invitation letter, an information sheet that details the study purpose and procedures, and an informed consent form from their parents. The voluntary nature of participation was emphasized, including the right to decline any question and the right to withdraw at any time without penalty. The researcher made clear that participation has no bearing on the learner's performance.

A letter was dispatched to the Department of Education Division of Davao de Oro to secure authorization for conducting the study in the specified school within the district. The sanctioned letter from the division was appended to the correspondence dispatched to the designated schools to solicit authorization for disseminating the questionnaire.

Before initiating the study, the researcher submitted and completed the ethics review application form to adhere to ethical issues.

During the dissemination, the researcher elucidated the justification for undertaking the study. The researcher administered the questionnaire individually. The participants were given adequate time to answer, and the questionnaire was retrieved after one hour.

The responses were counted, organized, and analyzed statistically. The findings were evaluated and interpreted to address the study questions posed in the preceding section.

➢ *Data Analysis*

The study employed the following statistical tools:

- *Mean*

This instrument was employed to ascertain the significant difference between the pretest and posttest on the Proficiency Level of Grade 4 Learners of Depot Elementary School in mathematics.

- *Paired T-Test*

This tool was employed to determine the significant difference between using fun games or activities in teaching math. In the study, the t-test was used to compare the learners' math proficiency scores before and after using playful math. If the results show a significant difference, it means the playful math approach likely helped improve the learners' proficiency level.

IV. RESULTS AND DISCUSSION

➢ *Level of Math Proficiency of Grade 4 Learners during pretest*

The level of Math Proficiency of Grade 4 Learners during pretest is presented in Table 2.

Table 2 Pretest Result of the Respondents

	Mean	Std. Deviation	Proficiency Level	Description
Pretest	5.743	1.540	44 %	Nearly Proficient

The table shows Grade 4 learners' pretest results with a mean score of 5.743. In accordance with Deped Order No. 012, s. 2025, the score indicates that a learner is on the cusp of achieving mathematical proficiency, demonstrating significant skills but still needing focused support to reach full mastery in a specific competency. The standard deviation of 1.540 means that most students' scores are spread about 1.5 points above or below the average, showing some differences in how well individual learners performed. A proficiency score of 44% signifies that the performance falls within the nearly proficient range.

➢ *Level of Math Proficiency of Grade 4 Learners during posttest*

The level of Math Proficiency of Grade 4 Learners during posttest is presented in Table 3.

Table 3 Posttest Result of the Respondents

	Mean	Std. Deviation	Proficiency Level	Description
Posttest	10.17	1.823	78 %	Proficient

The table shows Grade 4 learners' posttest results with a mean score of 10.17, which means they are now "proficient". In accordance with DepEd Order No. 012, s. In 2025, the score indicates that a learner shows the ability to apply mathematical concepts with increasing accuracy and confidence. The standard deviation of 1.823 means that individual scores vary about 1.8 points above or below the average, showing some learners scored higher or lower than the group's mean. A proficiency score of 78% signifies

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that the performance falls within the proficient range, which means learners are showing the ability to apply mathematical concepts with increasing accuracy and confidence.

➢ *Difference Between the Pretest and Posttest on Mean Scores of Learners in Mathematics*

Shown in Table 4 are the results of the difference between the pretest and posttest of learners after a playful math strategy was used.

Table 3 Difference Between Pretest and Posttest Mean Scores

	Mean	t-value	p-value	Remarks
Pretest	5.743	-11.18	.001	Significant
Posttest	10.17			

The paired t-test result was conducted to test if there is a significant difference between the Pretest and Posttest in Mathematics. The mean score rose from 5.743 in the pretest to 10.17 in the posttest. The t-value of -11.18 and the p-value of .001 is lower than 0.05 confirms that this increase is statistically significant. Therefore, the result suggested that there is a significant difference between the implementation of playful math and learners' performance.

V. RECOMMENDATION

Based on the results, the following recommendations are presented:

- The findings suggest that teachers are encouraged to use playful math in teaching. This method can make lessons more engaging for learners. Through playful strategies, students may develop a better understanding of mathematics to improve their proficiency level.

- School administrators are encouraged to continue supporting teaching strategies that make learning fun and engaging, such as playful math.

- The Department of Education would encourage the wider use of playful and engaging teaching strategies in mathematics, as the results showed clear improvement in learners' proficiency. They should provide training programs and resources for teachers to help them integrate interactive methods into their lessons. Finally, the department can consider including playful learning approaches in the curriculum guidelines to ensure that students across different schools benefit from this effective strategy.

- Future researchers are recommended to conduct the same or further studies in a different locale. They may also utilize different variables in playful math that may possibly affect the performance of teachers. Furthermore, future researchers are encouraged to conduct studies that can enhance the educational system of the Philippines, particularly in the area of Mathematics.

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