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# THE EFFECT OF LEARNING BY GAMES AND STORYTELLING LEARNING METHODS ON MATHEMATICAL NUMERACY LITERACY SKILLS IN GRADE V ELEMENTARY SCHOOLS

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**ABSTRACT**

*This study investigates how learning through games and narrative affects Year 5 students' mathematical literacy and numeracy skills. The study's goal is to solve Indonesia's poor performance in international math literacy examinations by testing new teaching approaches. The study included three groups: one using games, one using narrative, and one combining the two modalities. Data were gathered through teacher interviews, observations, and validated numeracy literacy assessments. These results were examined utilizing quantitative quasi-experimental procedures, using pretest-posttest control groups. The findings show that games and storytelling greatly improve pupils' arithmetic literacy and numeracy when compared to traditional methods. The combined strategy yielded the best improvement, improving problem-solving and conceptual knowledge through interactive, contextualized learning, which increases motivation and critical thinking skills. The study concludes that incorporating games and storytelling effectively promotes mathematical comprehension, and teachers are encouraged to use these strategies to create more engaging and relevant math learning environments for primary school students, better preparing them for future academic challenges.*

## A. INTRODUCTION

Primary schools pupils' numeracy literacy is currently the main emphasis of 21st-century education development since it shows that they can comprehend, apply, and evaluate mathematical problems that are directly connected to daily life in addition to being able to count (Ekowati et al., 2019). International tests like PISA 2022, however, reveal that Indonesian kids' reading and math proficiency is still well below average, indicating the need for more creative teaching methods (Schleicher, 2023). The prevalence of closed-ended questions that do not require critical thinking and the absence of practice with contextual numeracy issues in the classroom are two factors contributing to inadequate numeracy literacy (Yustinaningrum, 2023).

Innovation in mathematics education is essential today. Through a more enjoyable and demanding learning environment, an interactive method that emphasizes a game-based learning model (Learning by Games/Game-Based Learning) is thought to be helpful in raising student motivation, engagement, and learning results (Isti Septianing et al., 2024; Kuswoyo et al., 2024). Empirical studies demonstrate that game-based learning improves motivation, critical thinking, and mathematical analysis because students actively participate in solving problems at different difficulty levels rather than merely memorizing numbers and formulae (Sindi et al., 2023; W. Wulandari & A.T. Widiansyah, 2023).

In addition to games, storytelling is a popular instructional technique that helps students better understand mathematical ideas by placing them in the context of personal stories. This activity encourages bravery and the voicing of ideas and questions while focusing the learning process and making it more tangible (Kustantina et al., 2022; Pebrianti et al., 2023). By presenting math problems in an engaging manner, this story-based learning strategy has been demonstrated to develop students'

imagination, creativity, and critical thinking abilities (Nurjanah, D., Astutik, F. Z., & Sulistyani, 2022b).

Numerous studies have demonstrated that using games and storytelling strategies to teach arithmetic can increase learning outcomes when employed independently (Anggraeni et al., 2024; Yustina & Yahfizham, 2023). Combining the two methodologies is considered to result in a more holistic learning environment, increased student motivation, and significantly improved literacy and numeracy skills (Alotaibi, 2024; Kusumaningsih, 2023). Combining these two approaches enables students to learn topics through contextual stories before applying them to arithmetic problems or games that test their problem-solving skills (Jayanti & Cesaria, 2024; Kustantina et al., 2022).

This study investigates how learning using games and storytelling strategies, either separately or in combination, can improve fifth-grade students' numeracy literacy skills as they study mathematics. The study's findings are expected to make a substantial contribution to the creation of innovative teaching methods, as well as act as a guide for educators, educational institutions, and basic education officials (Rahmi et al., 2025). This study employs a methodical and evidence-based approach to assess the effectiveness of integrating interactive and narrative methods in strengthening the literacy and numeracy skills of Indonesia's next generation of pupils (Hotimah et al., 2025).

It is critical to note that integrating 'Learning by Games' and storytelling methods in mathematics education results in a more comprehensive and effective learning experience. Each strategy offers benefits that complement the other. Learning by Games motivates and engages students through enjoyable, engaging games, whereas storytelling provides a deeper, more relevant context for understanding mathematical concepts through narration. Combining these two approaches allows children to learn cognitively, emotionally, and socially, lowering anxiety about math and dramatically enhancing conceptual knowledge. As a result, combining these two approaches is predicted to overcome the limits of employing only one method, which is frequently insufficient to suit the different learning needs in the classroom. The purpose of this study is to examine the impact of Learning by Games and Storytelling on Year 5 students' numeracy skills at SD Negeri 2 Gundih.

## B. METHODS

This study used a quasi-experimental design with a one-group pretest-posttest to investigate the effects of game-based learning and narrative tactics on the mathematical numeracy literacy skills of fifth-grade elementary school children (Yuwanto, 2019). This strategy was chosen because it is best suited to the study challenge. It enables researchers to compare the learning outcomes of groups given one of two treatments: the Learning by Games approach or the storytelling method.

This study's demographic included fifth-grade pupils from one elementary school in Grobogan during the 2024/2025 school year. Purposive sampling was used to choose the research sample based on the results of the initial numeracy literacy tests (Lenaini, 2021). This class acted as the experimental group, and they were taught using a combination of games and tales. There were no control groups. The data collection approach involved three tools: (1) An assessment of students' beginning and end mathematical literacy skills using stories (Nugraha et al., 2025; Wardani & Purwati, 2025); (2) Observation sheets assess student involvement and motivation throughout the learning process (Mustikasari, 2021); and (3) We conducted interviews with educators and students to acquire data that supports the educational process. The test instruments were created using appropriate numeracy and literacy indicators, and they were validated by specialists. The mathematical literacy test instrument consists of 20 questions. All of these questions were declared legitimate after an empirical validity examination revealed that the correlation value for each question was greater than the r table value at a 5% significance level. This demonstrates that the questions are appropriate for measuring student abilities. This validity is additionally reinforced by content and construct validity, which are assessed by experts using expert judgment. The Cronbach Alpha technique was employed to verify the instrument's reliability, which yielded a value greater than 0.60. This demonstrates that the tool is consistent and dependable in assessing students' mathematical literacy skills. As a result, this test equipment fulfills high quality criteria and is

appropriate for use in research. We verified the content validity of the observation sheets and interview instructions prior to their use in the study.

| | Kolmogorov-Smirnov | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Value | .159 | 72 | .000 | .923 | 72 | .000 |
| Code | .340 | 72 | .000 | .636 | 72 | .000 |

To gauge students' starting reading and numeracy abilities, a pretest was given at the start of the study. The four learning sessions were facilitated through games and storytelling. After finishing the course, the students completed a posttest using the same resources as the pretest to gauge their development in reading and numeracy. If a study's results are collected methodically and in a planned manner, other researchers will find it easier to access them.

We tested the data from the pre- and post-test findings using parametric statistical tests, specifically the paired sample t-test, to determine the significance of the difference in numeracy literacy skills before and after the intervention. Descriptive analysis was also employed to describe the shifts in student motivation and involvement based on the results of observations and interviews. The meticulous and systematic design of the research approach allows for the replication and testing of the effectiveness of integrating state-of-the-art teaching techniques in enhancing mathematical literacy in elementary schools.

## C. RESULT AND DISCUSSION

The aim of this study was to ascertain how fifth-grade elementary school students' mathematical numeracy literacy skills were impacted by the use of learning via games and narrative strategies. In this work, a pure experimental design was used to administer the pretest-posttest to a single group. The paired sample t-test was performed to test the data and determine whether there was a significant difference between the pretest and posttest scores.

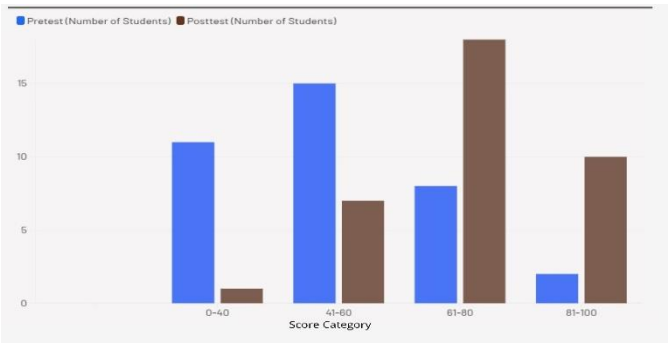


**Figure 1**. Results of the Numeracy Literacy Skills Pretest and Posttest

Learning through games and stories has been shown to dramatically improve pupils' numeracy and literacy abilities. On average, pupils' pretest scores rose from 30 to 75.42 on the posttest. This enhancement includes the ability to convert fractions to decimals, conduct decimal and fraction operations, understand graphs, and solve contextual word problems. The Wilcoxon test had a significance level of 0.001, indicating a statistically significant improvement. Learning by Games is an interactive learning strategy that improves student motivation, interest, and activity. Structured educational games enable students to study mathematics in a fun and engaging manner, allowing them to build a deeper and more critical knowledge of ideas. Kuswoyo et al. (2024) and Isti Septianing et al. (2024) support the efficacy of Game-Based Learning in enhancing learning results, notably in mathematics.

The interactive learning method known as Learning by Games boosts student motivation, interest, and activity. Structured educational games help students learn mathematics in a fun and engaging way, promoting a deeper and more critical grasp of subjects. Kuswoyo et al. (2024) and Isti Septianing et al. (2024) found that Game-Based Learning improves learning results, notably in mathematics. Storytelling helps students grasp mathematical topics in real-world contexts by presenting fascinating, contextualized stories. This boosts pupils' enthusiasm and confidence in completing math story problems. Research by Nurjanah et al. (2022) and Kusumaningsih (2023) confirms that storytelling can broaden students' knowledge and hone their critical thinking abilities.

The data in the previous table has a two-tailed Sig value of 0.000, which indicates that it is not regularly distributed. Combining two learning approaches, games and storytelling, results in a more thorough and participatory learning experience. Integrating engaging gaming elements and meaningful stories can help kids improve cognitive, emotional, and social skills. This motivates students to actively participate in conversations, ask questions, and work in groups, promoting healthy collaborative and competitive learning (Alotaibi, 2024; Kuswoyo et al., 2024; Pebrianti et al., 2023).

As a result, this study advises that schools and teachers use this strategy more broadly. To effectively adopt this unique strategy, teachers require training and support in the use of game-based and storytelling learning resources. Parental support is also critical to ensuring that learning continues at home. Students who have used this method claim that it has made studying more interesting and understandable, as well as increased their confidence, particularly in grasping tough story problems. This study is also pertinent to the 2022 PISA results, which demonstrate that Indonesian pupils' mathematical literacy is lower than that of students in OECD nations. This interactive and contextual method is thought to address these issues by developing numeracy abilities from a young age (Schleicher, 2023).

Furthermore, Piaget and Vygotsky's constructivist theories (Harefa et al., 2024), as cited in the file, emphasize that direct experience and social interaction are useful and relevant ways to increase students' knowledge. Bruner and Mayer (Wahyuddin et al., 2024) also propose using storytelling as a learning approach to improve conceptual knowledge through structured, multimodal narratives.

Deci and Ryan's Self-Determination Theory (Wijaya et al., 2024), which is also mentioned in the file, claims that storytelling can boost students' intrinsic motivation by meeting their basic psychological needs like autonomy and social connectivity. This supports the discovery of significant gains in numeracy skills.

According to Table 3, the majority of children had low numeracy skills before to the intervention, with scores falling primarily into the 41-60 (41.7%) and 0-40 (30.6%) groups. After implementing a learning strategy that combined games and storytelling, there was a considerable shift toward higher score categories: 81-100 (27.8%) and 61-80 (50.0%). This indicates how effective this strategy is in helping kids improve their reading and numeracy skills.

The observation results, when combined with the quantitative data, demonstrate that students are more engaged and motivated throughout the learning process. Students are more engaged in group conversations and more willing to play educational activities. They also have an easier time understanding math story problems. The results of the interviews supported these conclusions; most educators and learners said that learning became more enjoyable and easier to comprehend (Nurjanah, D., Astutik, F. Z., & Sulistyani, 2022b). The study's overall conclusions imply that grade V primary school pupils' mathematical literacy can be raised through the application of game-based learning and storytelling strategies.

The results of this study clearly show that adopting learning approaches incorporating games and storytelling techniques, either alone or in combination, greatly enhances Year 5 students' mathematical literacy skills. Learning by Games, Storytelling, and the combination technique dramatically increase these kids' mathematical literacy skills. Learning by Games is beneficial on its own, enhancing motivation, engagement, and knowledge of mathematical subjects through engaging and enjoyable exercises. This helps pupils better understand mathematical story problems (Hadihabibi et al., 2023). Meanwhile, the storytelling method is successful in helping students put mathematical concepts in context by using narratives from their daily lives, improving their enthusiasm and confidence in learning (Nurjanah, D., Astutik, F. Z., & Sulistyani, 2022a; Pebrianti et al., 2023). However, combining these two strategies produces the most dominant and ideal outcomes since the combination between the game's interactive aspects and the narrative backdrop of storytelling generates a more meaningful learning environment. This boosts pupils' critical thinking, motivation, and social abilities (Alotaibi, 2024; Kuswoyo et al., 2024). As a result, integrating these two strategies is suggested as a holistic learning strategy for improving numeracy literacy in elementary school kids. It has a major impact on the development of mathematics and numeracy literacy abilities in fifth-grade elementary school children. A comparison of average and recapitulated results revealed a significant rise in average numeracy literacy levels following the training.

The Learning with Games technique has been shown to motivate students and create an interesting learning environment. Instructional games like Snakes and Ladders make math more fascinating and less boring (Isti Septianing et al., 2024). The game is not only entertaining, but it also gradually develops pupils' numeracy skills through several stages and activities that include narrative challenges (Yustina & Yahfizham, 2023). The results of this study align with

the advantages of GBL, including increased motivation, improved problem-solving abilities, and enhanced cognitive creativity (W. Wulandari & A.T. Widiansyah, 2023).

Additionally, the storytelling style considerably contributes to the development of numeracy literacy. Students obtain a more contextualized, real-world understanding of arithmetic issues, especially while working on story problems (Mulyati et al., 2024). According to studies, integrating math comics with compelling narrative and interactive conversation improves students' comprehension and passion for studying (Kustantina et al., 2022). This strategy also promotes critical thinking and increases students' education in numerous math disciplines, such as congruence (Sulistiawati & Fiangga, 2024). Storytelling has also been demonstrated to help youngsters improve their numeracy abilities, encourage curiosity, and reduce the stress of studying (Kusumaningsih, 2023).

Combining storytelling with play-based learning creates a more thorough learning experience. This combination greatly improves students' mastery of numeracy and literacy by enabling them to comprehend ideas through pertinent stories and then apply them in gaming challenges (Alotaibi, 2024). This is also consistent with the suggestion that narrative problems or storytelling that promotes the simultaneous application of math and reading skills be used to foster numeracy literacy from a young age (Jayanti & Cesaria, 2024).

All things considered, these results highlight how innovative approaches to mathematics education are necessary to solve pupils' poor numeracy literacy, a significant issue in Indonesia (Susetyawati & Kintoko, 2023). It is anticipated that students' preparedness to handle the problems of the twenty-first century will be enhanced by the engaging and contextualized learning provided by the combination of Learning by Games and storytelling.

## D. CONCLUSION AND SUGGESTIONS

This study found that using game-based learning strategies greatly improved Year 5 pupils' numeracy skills. This technique increases students' enthusiasm and participation in the learning process, as evidenced by an increase in the average numeracy literacy score following the intervention. Furthermore, storytelling has been proved to be an excellent teaching approach for improving students' mathematical comprehension and assisting them in applying mathematical principles to real-world problems. Combining these two approaches enhances numeracy abilities and fosters an engaged, enjoyable learning environment that promotes critical thinking and teamwork. As a result, it is advised that educators and educational institutions incorporate these two strategies into the curriculum to address deficient numeracy abilities in elementary school and improve learning results.

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