

Exploring the Use of Arithmetic Operation Games to Develop Mathematical Literacy and Numeracy in Elementary Schools

Miftakhul Jannah¹[0000-0002-9710-4206], Lady Agustina^{2*}[0000-0003-1639-0333], Rohmad Wahid Rhomdani³[0000-0001-8755-0539]

Universitas Muhammadiyah Jember, Jember, Indonesia
Corresponding Author: ladyagustina@unmuhjember.ac.id

Abstract. This study explores using arithmetic operation games in mathematics learning to improve the literacy and numeracy of grade 3 elementary school students. This study uses a qualitative approach with data collection techniques through interviews, observations, and analysis of LKPD used in the learning process. The study results indicate that arithmetic operation games can increase student motivation and involvement in mathematics learning. Students find standing basic arithmetic operation concepts such as addition and subtraction through fun and interactive activities. In addition, this game also helps students develop critical thinking and problem-solving skills. However, using this game requires proper time management, and teacher skills in facilitating learning activities by learning objectives.

Keywords: Arithmetic Operation Game, Mathematical Literacy, Numeracy, LKPD, Grade 3 Students

1 Introduction

Education is an effort to develop the skills and understanding needed for a person to adapt and thrive in social life. In the context of education, mathematics has a very important role. In addition to helping solve various problems, mathematics also trains a person to think logically and critically [1]. Therefore, a good understanding of mathematics is very necessary for every student. The core problem in this study focuses on the difficulties of elementary school students in understanding basic mathematical concepts, especially simple arithmetic operations such as addition and subtraction. These difficulties are caused by monotonous learning methods, lack of active student engagement, and low relevance of learning to real-life contexts. As a result, students' mathematical literacy and numeracy skills are still far from expectations. Based on data from the Ministry of Education, Culture, Research, and Technology, the numeracy scores of elementary school students in Indonesia only reach 18%, showing weak logical thinking and mathematical problem-solving skills from an early age. Therefore, this study specifically aims to develop and evaluate the effectiveness of learning media based on arithmetic operation games on improving the literacy and numeracy skills of grade III elementary school students. This goal is measured through measurable indicators such as increased student engagement, ability to complete basic arithmetic operations, and

improved critical thinking and problem-solving skills after the implementation of the learning media.

The potential of innovative teaching methods for literacy & numeracy. Prominent approaches are game-based learning and the use of contextualized LKPDs: both approaches increase engagement, facilitate collaborative discussions, and help students see the relevance of mathematics in everyday activities thus supporting the development of numerical concepts and problem-solving skills. In addition, models such as problem-based learning (PBL), contextual learning (CTL), ZPD-compliant scaffolding, and digital media integration (e.g. e-LKPD, educational game applications or VR for structured exercises) have the potential to accelerate the automation of arithmetic skills while developing HOTS, when accompanied by differentiation and teacher training. The document shows field evidence that guessing games and LKPD increase motivation and understanding, but also note the need for teachers' time management and skills as a condition of success indicating that positive effects depend on the quality of implementation.

However, in reality, many students face difficulties in learning mathematics. Some of the contributing factors include less interesting teaching methods, low student interest in learning, and also limited facilities at school. Learning mathematics becomes boring and irrelevant to everyday life, which in turn reduces students' enthusiasm for learning [2].

Currently, improving students' literacy and numeracy skills at primary school level is a major concern in the world of education. These two things are a very important basis for learning at a higher level. Mathematical literacy involves the ability to understand numbers and symbols, while numeracy is the skill of using numbers to solve everyday problems [3]. However, there are still many students who have difficulty with basic arithmetic operations, which should be the initial foundation in learning mathematics.

The existing facts show that the academic achievement of Indonesian students in mathematics is still relatively low. Data from the Ministry of Education and Culture, Research and Technology in 2021 showed the results of a national assessment that revealed the importance of special attention to elementary school students [4]. Numeracy scores at primary school level were recorded to be very low, namely 18%, higher than at junior high school (8%), senior high school (6%), and vocational high school (7%) [4]. The theoretical underpinnings of this research are rooted in Piaget's theory of constructivism and Bruner's theory of cognitive learning, which emphasizes that mathematical understanding develops through exploratory activities and meaningful social interactions. In the context of literacy and numeracy, students are not only required to memorize procedures, but build knowledge through active and reflective learning experiences. The arithmetic game-based learning model supports the principles of *learning by doing* and *discovery learning*, which allows students to form numerical concepts gradually and contextually. Statistical data from the Ministry of Education and Culture showing the low achievement of national numeracy is still relevant and accurate as an empirical basis for this study, because it describes the actual condition of Indonesian students' basic abilities in mathematics. Supported by modern

educational theory and cutting-edge data, this research has a strong scientific basis to answer the problem of low literacy and numeracy in elementary schools.

One of the causes of low interest and high difficulty of students in learning mathematics is the teaching method that is less interesting, complicated, and does not suit the needs of students. This greatly affects students' understanding of the learning material. Students' understanding is very dependent on the way the teacher delivers the material, because students' abilities in understanding mathematics material vary. Therefore, teachers must be able to adjust the teaching method to the conditions and needs of students [5]. A good understanding of mathematical concepts requires more effort and deeper thinking than simply memorizing the material that has been taught.

Students' difficulties in learning mathematics are multifactorial: (a) pedagogy monotonous, less contextual, and memorization-focused teaching methods hinder concept formation; (b) motivation and effectiveness low interest in learning and self-efficacy make students reluctant to be actively involved; (c) limited resources, facilities/infrastructure and relevant teaching materials limit contextual learning practices; and (d) the capacity of teachers (facilitation, differentiation, time management skills) that determine the success of the implementation of innovative methods. These claims are not merely descriptive: the document provides empirical data and supporting references (e.g. statements about the 18% elementary numeracy score from the Ministry of Education and Culture 2021 and studies related to self-efficacy and collaborative learning analysis), so the basis of the argument is evidence-informed although some aspects still depend on qualitative findings from small field studies.

The literature review in the document includes local studies and several international studies on educational games, e-LKPD, collaborative learning, and literacy/numeracy measurement (reference 2015–2024), thus providing a fairly broad foothold for the Indonesian context. However, the analysis shows two main gaps: (a) the limitations of the research design of a lot of evidence that is qualitative or small-scale case studies; few long-term quantitative experimental studies that test the causal effects and retention of learning; (b) scalability & resource context Low research has evaluated how solutions (especially digital) work in schools with limited infrastructure. Therefore, the existing literature supports game-based interventions/LKPDs but demands follow-up studies using quasi-experimental/experimental designs with larger samples, subgroup analysis (e.g. based on initial levels of numeracy), and cost-benefit evaluation to address implementation gaps and generalizations.

2 Methods

This study aims to see how non-digital games, such as guessing games and the use of LKPD, can help grade 3 students at the Regional Technical Implementation Unit (UPTD) of SDN Silo 03 Education Unit improve their literacy and numeracy skills. The methods used and designed to provide a real picture of students' learning experiences and the approaches applied by teachers.

2.1 Research Approach

The approach used in this study is qualitative, because the aim is to explore in depth the students' experiences during game-based learning. This approach allows researchers to understand not only the end result, but also the process of students' involvement in learning [6].

2.2 Subjects of the Study

The subjects of the study included students of grade 3 of SDN Silo 03 and their class teachers.

1. Grade 3 Elementary School Students

- This study involved a combination of students from grades 3A and 3B as participants.

- Have literacy and numeracy skills that still need to be improved

2. Class Teachers

2.3 Data Collection

Data collection was carried out using several methods, including:

1. Observation

The researcher directly observed learning in the classroom. The focus of the observation was student interaction with the game, their level of involvement, and how the teacher guided students during the learning process [7].



Figure 1. Observation of Classroom Learning

1. Interviews

Interviews were conducted in a relaxed and open manner with:

- Teachers: to understand how they view the effectiveness of this method, the challenges faced, and the impact on student learning outcomes.

- Students: to hear directly about their experiences playing games and learning mathematics through this method.

2. Documentation

Documentation includes the LKPD used and visual documentation such as photos or recordings during the activity.

3. Notes

The researcher also recorded in detail what happened during the learning process, such as students' spontaneous reactions to the game, technical obstacles, or interesting situations that might affect learning outcomes.

3 Results and Discussion

3.1 Research result

Based on this research, it shows that the application of guessing games and Student Worksheets (LKPD) in mathematics learning has a positive impact on students' understanding and interest [8]. Most students admitted to being more interested and involved in mathematics lessons after being introduced to these two methods. Previously, mathematics lessons tended to be boring, but now they are more fun and interactive, which encourages students to be more active in participating in the teaching and learning process.

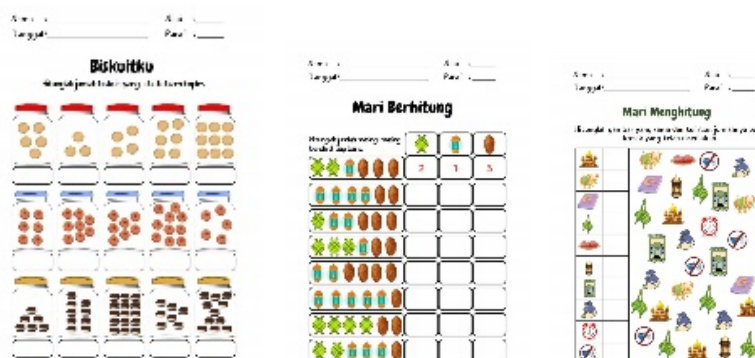


Figure 2. LKPD used

The Guessing Game has been proven effective in helping students understand basic mathematical concepts. This game also trains students' fast and critical thinking skills, and improves their memory and concentration. With a dynamic learning atmosphere, students are more encouraged to think quickly and solve problems in a fun way.



Figure 3. Guessing Game (JAGO: Mathematics Expert with Arithmetic Operation Games)

Meanwhile, the use of LKPD provides an important contribution to mathematics learning. When working on LKPD, students work in groups, which encourages them to discuss and share ideas on how to solve problems. This process strengthens their understanding of the material, and allows them to correct each other's mistakes, thereby increasing deeper understanding.



Figure 4. Group Work on LKPD

According to the feedback received, most students felt that learning mathematics had become more interesting and no longer boring [9]. They hope that the variety of

games will be increased, so that the learning atmosphere remains lively and not monotonous.

3.2 Discussion

Overall, this study revealed that guessing games and LKPD can provide significant changes in the way students view mathematics. Guessing games provide a more interesting learning experience compared to traditional learning methods [10]. In this game, students are encouraged to think quickly and use their math knowledge to solve problems quickly. This not only helps them understand math concepts, but also trains their critical thinking skills, concentration, and memory. However, for students with lower math understanding, this game can be more challenging, and they may need more time to understand the material and additional support from the teacher.

LKPD provides opportunities for students to learn collaboratively [11], [12]. Group discussions make learning more in-depth. By working together, students not only understand the steps to solving problems, but also deepen their understanding of previously learned concepts. This also helps students identify and correct their mistakes more quickly.

Another advantage is how games and LKPD help students see the direct connection between mathematics and everyday life. Students begin to see the relevance of mathematics in practical activities, such as calculating shopping money or determining distance, which helps them feel more confident in working on math problems.

However, although these two methods provide great benefits, there are challenges that need to be considered. Some students may feel less confident if they are unable to answer questions quickly in a guessing game. This can affect their motivation to continue participating. Therefore, it is important for teachers to adjust the difficulty level of the game and provide more time for students who need it, so that all students can benefit from the game without feeling pressured.

Finally, games and LKPD also play an important role in improving students' HOTS (Higher Order Thinking Skills) abilities. Through this method, students are trained to think more deeply and critically, which will help them in solving problems with a higher level of difficulty.

Overall, the results of this study indicate that the use of guessing games and LKPD is a very effective learning method for increasing students' interest and understanding in mathematics [13], [14], [15]. This method not only makes learning more fun, but also helps students develop critical thinking and collaboration skills. With the right support from teachers, both methods can create a more lively classroom atmosphere and improve the teaching and learning process.

4 Conclusion

From the results of this study, it can be concluded that the use of guessing games and Student Worksheets (LKPD) in mathematics learning has a significant positive

impact on students' understanding and interest. With this method, students not only feel more interested and involved in mathematics lessons, but also show improvements in their numeracy skills and academic results. Guessing games create a fun and interactive learning atmosphere, encouraging students to think quickly and critically. On the other hand, LKPD supports collaboration and discussion among students, thereby strengthening their understanding of the material being studied. Although some students, especially those with a weak mathematical foundation, face challenges, proper support from teachers can help them overcome these difficulties. Overall, both methods have proven effective in increasing students' learning motivation and helping them understand the relevance of mathematics in everyday life. With proper implementation, guessing games and LKPD can be invaluable tools for creating more engaging and meaningful learning experiences in the classroom.

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