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Improving Understanding of Mathematical Concepts Through a "Jatuh Bangkit Perkalian" Multiplication Activity Based on a Growth Mindset for Third-Grade Elementary School Students

Alda Anggrheini Maulina[1)]*, Hamdani [2)] Wira Puspita[3)], Masriani [4)]

[1,2,4)] PGSD Teacher Professional Education, Tanjungpura University
[3)] SD Islam Al Azhar 21 Pontianak

*Alda Anggrheini Maulina
Email : aldaanggrheini1110@gmail.com
hamdani99@student.untan.ac.id
wirayudho.150180@gmail.com
masriani@fkip.untan.ac.id

Abstract

Mathematics instruction emphasizes not only calculation skills but also conceptual understanding. Preliminary observations of third-grade students at SD Islam Al-Azhar 21 Pontianak revealed that some students were merely memorizing multiplication facts without grasping the concept of multiplication as repeated addition, and they were not yet accustomed to independently identifying and correcting their errors. This study aimed to examine the implementation of the "Jatuh Bangkit Perkalian" (Fall and Rise Multiplication) digital game—designed based on the Growth Mindset framework—to enhance students' conceptual understanding of multiplication. The study employed the Kemmis and McTaggart Classroom Action Research (CAR) model, conducted over two cycles. The participants consisted of 30 third-grade students. Data were collected through conceptual understanding tests, observations, student reflections, and documentation of the digital game. Pre-cycle results showed an average score of 66, with a class mastery rate of 46.67%. In Cycle I, four students (13.33%) consistently demonstrated a Growth Mindset. Following improvements made in Cycle II, this figure rose to 24 students (80%). The use of the game encouraged students to take risks, accept mistakes, select strategies, correct their answers, and try again. Thus, the "Jatuh Bangkit Perkalian" digital game, grounded in the Growth Mindset, supports improvements in both conceptual understanding and learning attitudes regarding multiplication.

Keywords*: Jatuh bangkit perkalian, growth mindset, conceptual understanding, multiplication, elementary school.*

INTRODUCTION

Law No. 20 of 2003 on the National Education System states that the purpose of education is to help students develop their potential. According to Ministry of Education Regulation No. 22 of 2006, the goal of mathematics instruction is for students to be able to understand concepts, explain the relationships between concepts, and apply concepts or algorithms flexibly, accurately, efficiently, and appropriately in problem-solving. Mathematics instruction should emphasize conceptual understanding, not merely the memorization of formulas.

One of the fundamental concepts that students need to master is multiplication, which can be understood as repeated addition of the same value. Hasanah & Sari, (2022) explain that multiplication is an operation of addition performed repeatedly. However, initial observations in the third-grade class at SD Islam Al-Azhar 21 in Pontianak indicate that some students tend to memorize multiplication facts without understanding their meaning. They still struggle to convert multiplication into repeated addition or to explain the relationship between the two.

This issue is consistent with a study Nisa (2020), which found that some third-grade students do not yet understand the concept of multiplication, have difficulty converting multiplication into repeated addition and solving word problems, and tend to rely on rote memorization. Faujiah (2022) also found that elementary school students' understanding of the concept of multiplication remains low, particularly in selecting appropriate computational procedures and applying the concept of multiplication to solve problems. Additionally, Paut et

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al., (2025) analyzed multiplication errors among 57 elementary school students using Newman's Error Analysis approach. These findings indicate that students' errors can provide insights into which concepts they have not yet grasped.

Field observations also show that when their answers are incorrect, some students feel incapable and wait for the teacher to provide the answer. They are not yet accustomed to checking for errors, trying other strategies, and correcting their answers independently. Therefore, instruction needs to provide students with opportunities to try, reflect, choose strategies, and correct their mistakes. One relevant approach is the growth mindset the belief that abilities can develop through effort, strategies, the learning process, and the experience of facing challenges. Research Aji et al., (2026) highlights the role of teachers in fostering a growth mindset in elementary school mathematics instruction. With this approach, incorrect answers are viewed as part of the learning process, not the end of one's efforts.

Digital media and educational games can also support more engaging and interactive mathematics learning. Yuliani et al., (2023) developed an Educational Math Adventure Game for teaching fraction operations. Astawan, (2021) developed an Android-based educational game on whole numbers for sixth grade, while (Choirunnisa & Febriani, 2021) developed a digital snakes-and-ladders game for practicing fraction problems, which received an excellent response from both teachers and students. For multiplication, Winarti et al., (2021) developed a multiplication app to improve understanding of basic concepts, while Silvia et al., (2023) developed worksheets aided by multiplication tables. These various studies demonstrate the potential of media to support learning; however, the integration of digital games, an understanding of multiplication concepts, and a growth mindset through error-correction mechanisms still needs further development.

Based on this need, the digital game "Jatuh Bangkit Perkalian" based on a growth mindset—was developed for third-grade elementary school students to help them learn multiplication tables from 1 to 5. This game connects images, repeated addition, and multiplication symbols through five stages: "I Dare to Try," "I Want to Learn," "I Dare to Correct," "I'm Starting to Understand," and "I Keep Growing." When an answer is incorrect, students are guided through the process: Failure → Identify the Error → Reflect → Choose a Strategy → Correct → Success → Level Up. Students can use images, repeated addition, skip counting, multiplication facts, or other strategies. This game also has the potential to serve as a formative assessment tool for teachers to observe students' conceptual understanding, strategies, and ability to correct their answers. Thus, this study aims to investigate the application of the "Fall and Rise Multiplication" digital game based on a growth mindset in improving third-grade elementary school students' conceptual understanding of multiplication, including understanding multiplication as repeated addition, the relationship between images and multiplication forms, determining results, identifying errors, selecting strategies, and correcting answers.

RESEARCH METHODS

This study employed the Classroom Action Research (CAR) method to improve the process and outcomes of mathematics learning through the growth mindset-based digital game "Jatuh Bangkit Perkalian." The model used was that of Kemmis and McTaggart, which consists of four stages: planning, action, observation, and reflection (Rahmawati, 2022). The study was conducted in two cycles, with the reflections from each cycle serving as the basis for improvements in the subsequent learning cycle.

During the planning phase, researchers formulated learning objectives and steps and prepared teaching modules, instructional materials, student worksheets, digital game media, assessment instruments, and observation sheets. The action phase was carried out as planned through five stages of the game: "I Dare to Try," "I Want to Learn," "I Dare to Correct," "I'm

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Starting to Understand," and "I Keep Growing." When an answer was incorrect, students were guided to identify the mistake, reflect on it, choose a strategy, correct their answer, and try again.

The research instruments included a multiplication concept comprehension test, an observation sheet, a student reflection sheet, and documentation of the results of the digital game. Data were collected through tests, observations, reflections, and documentation. The study involved 30 third-grade students at Al-Azhar 21 Islamic Elementary School in Pontianak through pre-cycle, cycle I, and cycle II activities, with 3 JP (2 × 20 minutes) allocated for each cycle online.

RESULTS AND DISCUSSION

Result

Pre Cycle

Pre-cycle activities were conducted to determine the students' initial numeracy skills before implementing instructional interventions. At this stage, the researcher assessed numeracy skills through an initial assessment. The assessment results were used as a basis for determining the students' initial skills and identifying instructional improvements to be implemented in the next cycle. Based on the results of the initial assessment, student learning outcomes show variation. Some students have been able to achieve relatively higher scores, while others still receive low scores. This situation indicates that students' proficiency in mathematics is not yet uniform, so instructional strategies are needed that can provide learning experiences that are more engaging, progressive, and tailored to students' needs.

Table 1. Pre-Cycle Student Learning Outcomes

Indicator	Result
Number of students	30
Mean	66
Highest score	100
Lowest score	20
Complate (≥75)	14
Incomplate (≤75)	16
Classical completion	46,67%

A pre-cycle assessment was conducted to determine the students' initial abilities before implementing the instructional interventions. Based on the assessment results of 30 students, the average score was 66.00, with the highest score being 100 and the lowest being 20. Of the 30 students, 14 (46.67%) met the mastery criteria with a score of ≥75, while 16 (53.33%) did not meet the mastery criteria. The results show that during the pre-cycle phase, the classical mastery rate was still 46.67%. Therefore, instructional interventions were needed in Cycle I to improve students' understanding and learning outcomes. Subsequently, the results from Cycle I were used as the basis for improvements in Cycle II.

Cycle I

Cycle I was conducted in a single session using a Game-Based Learning model through the digital game "Multiplication: Fall and Rise," which is based on a growth mindset. The learning activity began with a prompt question about objects arranged into several groups of equal size to explore the students' prior knowledge of the concept of multiplication. Next, the teacher presented the learning objectives and explained the concept of multiplication through repeated addition, using instructional videos, demonstrations, and a question-and-answer session.

During the implementation phase, students participate in the digital game "Multiplication: Fall and Rise" in stages, starting from Level 1: Dare to Try, Level 2: Willing to Learn, Level 3: Correcting Errors, Level 4: Understanding, to Level 5: Growing. Throughout the game, students are given the opportunity to attempt to solve problems, receive feedback, identify mistakes, and correct their answers. Teachers act as facilitators by providing direction, guidance,

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and motivation, while reinforcing the idea that mistakes are a natural part of the learning process and an opportunity for growth.

The learning activity concluded with a reflection on the learning process and the students' experiences during the game. Students were given the opportunity to answer questions about how they arrived at their answers, the strategies they used, what they did when they got an answer wrong, and their willingness to try again. The results of observations on the implementation of the growth mindset and learning assessments are used as the basis for planning improvements in the next cycle.

Table 2. Student Learning Outcomes for Cycle I

Indicator	Result
Number of students	30
Adopting a Growth Mindset	4 (13,33%)
Has Not Yet Adopted a Growth Mindset	26 (86,67%)

The results of observations during Cycle I showed that 4 out of 30 students had successfully adopted a growth mindset, while the other 26 students had not yet consistently demonstrated a growth mindset. These four students have demonstrated the courage to try again, accept feedback, correct their mistakes, and move on to the next challenge. Meanwhile, most students still need guidance in dealing with mistakes and overcoming learning challenges. Based on these results, the adoption of a growth mindset in Cycle I reached 13.33%.

The results indicate that the implementation of the "Fall, Rise, Multiplication" digital game based on a growth mindset has begun to provide a learning experience that encourages students to dare to try, accept mistakes, and make improvements. However, the adoption of a growth mindset among students remains relatively low, as only 4 out of 30 students consistently demonstrated its indicators. Therefore, improvements are needed in the implementation of learning in Cycle II, particularly in reinforcing the processes of trying, correcting mistakes, using problem-solving strategies, and building the belief that mathematical ability can be developed through effort and practice.

Cycle II

Cycle II was conducted in a single session using a Game-Based Learning model through the digital game "Multiplication: Fall and Rise," which is based on a growth mindset, as a follow-up to the reflections from Cycle I. The learning activity began with a review of the concept of multiplication as repeated addition and a recap of the students' experiences while playing the game in Cycle I. The teacher encouraged the students to be more daring in trying, not to give up easily when making mistakes, and to be willing to correct their answers based on the feedback provided. This activity was aligned with the game's objective, which emphasizes not only correct answers but also the process of growth in mathematical ability.

During the implementation phase, students once again played the digital game "Multiplication: Fall and Rise" in stages, progressing through the levels "Dare to Try," "Willing to Learn," "Improve," "Understand," and "Grow." Based on the reflections from Cycle I, the teacher provided more intensive guidance to students who were still hesitant to try and tended to give up easily when they got an incorrect answer. Students were given the opportunity to repeat the problem, identify their mistakes, choose a solution strategy, correct their answers, and move on to the next challenge.

In Cycle II, students appeared more willing to try and more open to making mistakes. Some students began to show a change in how they approached difficult problems—namely, by trying again after getting an answer wrong and using the teacher's guidance to correct their answers. The teacher also provided encouragement through growth-oriented statements, explaining that students don't have to understand math right away but can learn it gradually through a process of trying, identifying mistakes, correcting them, and continuing to improve.

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The learning activity concluded with a reflection on the strategies used, the actions taken when an answer was incorrect, the courage to try again, and areas for improvement in the next learning session.

Table 3. Student Learning Outcomes for Cycle II

Indicator	Result
Number of students	30
Adopting a Growth Mindset	24 (80%)
Has Not Yet Adopted a Growth Mindset	4 (20%)

The results of observations on the application of a growth mindset in Cycle II showed an improvement compared to Cycle I. In Cycle I, only 4 out of 30 students or 13.33% consistently demonstrated a growth mindset. After implementing instructional improvements in Cycle II, the number of students who successfully applied a growth mindset increased to 24 out of 30 students or 80%. Meanwhile, 6 students (20%) still require guidance in consistently applying a growth mindset.

These results indicate that the implementation of the "Jatuh Bangkit Perkalian" digital game, based on a growth mindset, can support the development of students' attitudes toward daring to try, facing mistakes, correcting answers, and persevering in the mathematics learning process. Since 80% of students had adopted a growth mindset by Cycle II, the study was deemed successful and concluded at the end of Cycle II.

Discussion

The research results show that students' initial numeracy skills before the instructional intervention were still uneven. Based on the pre-cycle assessment of 30 students, the average score was 66.00, with the highest score being 100 and the lowest 20. A total of 14 students (46.67%) met the mastery criteria with a score of ≥75, while 16 students (53.33%) did not meet the mastery criteria. These findings indicate that some students already possess foundational skills in mathematics, but others still require instruction that is more engaging, progressive, and provides opportunities to learn according to their individual needs. The results of this initial assessment served as the basis for the researcher to implement the "Multiplication: Fall and Rise" digital game based on a Growth Mindset through the Game-Based Learning model.

The implementation of the digital game "Fall and Rise Multiplication" in Cycle I provides a different learning experience compared to instruction focused solely on solving problems. Students are not only asked to find the correct answer but are also given the opportunity to try, receive feedback, identify mistakes, correct their answers, and move on to the next challenge. This process aligns with constructivist theory, which holds that knowledge is actively constructed by students through learning experiences. In mathematics instruction, teachers serve as facilitators who help students build understanding through activities such as observing, experimenting, seeking solutions, and reflecting on their learning experiences Yeni et al., (2021). They explain that constructivist-based mathematics instruction encourages students to develop thinking skills based on prior learning experiences, while teachers act as facilitators.

The characteristics of digital games that give students the opportunity to try and receive feedback are also consistent with the principles of Game-Based Learning. In this study, the game was structured into several stages: Level 1 Dare to Try, Level 2 Willing to Learn, Level 3 Improve, Level 4 Understand, and Level 5 Grow. These stages provide a gradual learning experience and do not immediately label mistakes as ultimate failures. A study Anggreni et al., (2026) that specifically examined Game-Based Learning (GBL) in multiplication for third-grade elementary school students showed that the implementation of GBL increased the average learning outcome from 66.8 on the pretest to 78.8 on the posttest and had a positive impact on mathematics learning outcomes in multiplication. These findings reinforce the relevance of using games as an approach to teaching multiplication at the elementary school level.

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The results of observations during Cycle I indicate that the application of a growth mindset remains relatively low. Of the 30 students, only 4 (13.33%) consistently demonstrated a growth mindset, while 26 (86.67%) did not yet apply it consistently. These four students have shown the courage to try again, accept feedback, correct their mistakes, and move on to the next challenge. Meanwhile, most students still need guidance when facing mistakes and challenges in their learning. This situation indicates that the use of digital games alone does not directly lead all students to adopt a Growth Mindset; rather, it must be accompanied by practice, guidance, feedback, and reinforcement from the teacher. The findings from Cycle I are consistent with a study Tsauri et al., (2026) that explains that a growth mindset is associated with the belief that abilities can be developed through effort, appropriate strategies, and ongoing learning experiences. The study also indicates that a Growth Mindset can play a role in enhancing students' motivation, perseverance, self-efficacy, and engagement in learning. Teachers play a crucial role by providing constructive feedback, valuing the learning process, and creating a safe and supportive learning environment. This aligns with the findings from Cycle I, which showed that most students still need support to be able to face mistakes and challenges in a more positive manner.

Learning improvements in Cycle II were based on the reflections from Cycle I. The teacher reviewed the concept of multiplication as repeated addition, reminded students of their experiences in Cycle I, motivated them to try again, and provided more intensive guidance to students who were still unsure or prone to giving up. Students gradually returned to the game and were given the opportunity to repeat the problems, identify their mistakes, choose problem-solving strategies, correct their answers, and move on to the next challenge. These improvements demonstrate that the application of a Growth Mindset is not limited to verbal encouragement but is embodied in learning activities that allow students to experience the process of trying, making mistakes, correcting them, and trying again.

The results of Cycle II observations showed a significant increase in the application of the Growth Mindset. The number of students applying the Growth Mindset increased from 4 students (13.33%) in Cycle I to 24 students (80%) in Cycle II. Thus, there was an increase of 66.67 percentage points. Meanwhile, the number of students who were not yet consistently applying the Growth Mindset decreased from 26 students (86.67%) to 6 students (20%). This increase indicates a change in how students approach difficulties during learning. In Cycle II, more students began to have the courage to try again after giving an incorrect answer, accept the teacher's guidance, correct their answers, and continue the learning process.

This improvement aligns with the findings of a study Sundara et al., (2026) on the implementation of a Growth Mindset in elementary schools. The study explains that a Growth Mindset can be fostered through student-centered learning, a learning culture that values effort and progress, the provision of constructive feedback, and assessments that emphasize the development of competencies. Teachers serve as facilitators and motivators in fostering this mindset. The application of the Growth Mindset is also linked to students' motivation, self-confidence, perseverance, and ability to tackle challenges. This was evident in this study when teachers reinforced the idea that a wrong answer is not the end of learning but rather an opportunity for students to identify their mistakes and correct them.

Thus, the research results indicate that the implementation of the "Jatuh Bangkit Perkalian" digital game, based on a Growth Mindset, contributes to the development of students' learning attitudes toward the mathematics learning process. The most noticeable change was observed in the adoption of the Growth Mindset, which increased from 4 students (13.33%) in Cycle I to 24 students (80%) in Cycle II. This increase occurred after improvements were made, including concept reinforcement, providing opportunities to try again, more intensive guidance, feedback, correction of answers, and reinforcement of the learning process. Therefore, the success of the interventions in this study lies not only in the use of digital games but also in the

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integration of Game-Based Learning, opportunities to correct mistakes, teacher feedback, and the cultivation of a Growth Mindset in the mathematics learning process.

CONCLUSION

Based on the research findings, the implementation of the digital game "Fall and Rise in Multiplication"—which is based on Game-Based Learning and a Growth Mindset—can support the development of students' learning attitudes in mathematics lessons on multiplication. This development is evidenced by an increase in the number of students adopting a Growth Mindset, from 4 students (13.33%) in Cycle I to 24 students (80%) in Cycle II. The use of the game provides students with the opportunity to dare to try, accept mistakes, receive feedback, correct their answers, and try again. Thus, the "Fall and Rise Multiplication" digital game, based on a Growth Mindset, can be used as an alternative method for teaching mathematics that encourages students to be more courageous in facing difficulties, correcting mistakes, and continuing to grow in the learning process.

Teachers are encouraged to utilize digital games that incorporate the principles of a growth mindset as an alternative approach to teaching mathematics—particularly when covering multiplication—by giving students the opportunity to try, receive feedback, correct their mistakes, and try again in a step-by-step process.

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