



## The Effect of Fraction Adventure Gamification Media in Improving Fraction Calculation Operation Skills and Learning Motivation of Phase C Students

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### Abstract

This study aims to examine the effect of Fraction Adventure gamification media on fraction calculation operation skills and learning motivation of Phase C elementary school students. The research method used was quantitative with a 2x2 factorial pseudo-experimental design. This study involved 102 students from four elementary schools in Selogiri District, Wonogiri, who were grouped into experimental and control classes. The experimental class used Fraction Adventure gamification media, while the control class used a quartet card game. Data were collected through a fraction calculation skill test and a learning motivation questionnaire. The results of the analysis showed that there was a significant effect between learning motivation and fraction calculation operation skills. However, Fraction Adventure media directly had no significant effect when viewed separately from student motivation. This finding suggests that Fraction Adventure media is more effective on students with high learning motivation. The conclusion of the study confirms the importance of considering students' characteristics in choosing learning strategies, as well as the potential development of Fraction Adventure to support mathematics learning.

**Keywords:** Fraction operation skills, gamification media, learning motivation

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**How to Cite:** Wibowo, A.R., Gunarhadi, G., & Karsono, K. (2025). The effect of fraction adventure gamification media in improving fraction calculation operation skills and learning motivation of phase c students. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 15 (1), 207-216. <http://dx.doi.org/10.30998/formatif.v15i1.27637>

## INTRODUCTION

Learning math fraction calculation operation material is one of the materials in phase C of the independent curriculum elementary school. Fraction calculation is an important aspect of arithmetic that is closely related to various daily activities and has a relationship with other topics in mathematics (Malikha & Amir, 2018). The context of the material in the form of addition, subtraction, multiplication, and division of fractions is one of the complex materials that must be learned by students in elementary school (Kurniawan et al., 2022). This is because this material is related to decimals, comparisons, scales, and measurements that are more complex in further math learning (Jasmaniah et al., 2022).

Even so, students often consider the material of fraction calculation operation unpleasant. In line with the research results, Swaratifani and Budiharti (2022) show that many students have difficulty understanding mathematics, especially fraction operations because they are considered complicated. Students' negative view of fraction operations contributes to errors in solving problems. These errors include interpretation of mathematical symbols, formulation of problem-solving models, transformation, problem-solving process, and writing the final answer (Galuh et al., 2023). This problem is inevitable because students do not understand the relationship between the numerator and

denominator, which is usually taught abstractly by the teacher (Siegler & Lortie-Forgues, 2015).

Several causes can cause the errors that occur. One of them is the low motivation of students to learn mathematics (Ayu et al., 2021). I agree with Komalasari et al. (2022), who state that low student learning motivation often contributes to the loss of enthusiasm in participating in math lessons. The essence of learning motivation in mathematics subjects helps students invest more time, effort, and performance in learning and apply more effective learning strategies (Luttenberger et al., 2018). In addition, learning motivation helps students to concentrate on what they are doing and determine the extent of effort that needs to be made to support learning activities (Nuraini & Laksono, 2019). According to Uno (Suratman et al., 2019), learning motivation has several indicators to see the level of achievement, including (1) having the desire and desire to succeed, (2) having the drive and need to learn, (3) having goals and expectations in the future, (4) getting appreciation in learning, (5) having interesting activities while learning, and (6) an environment conducive to learning.

Therefore, teachers can innovate to increase students' motivation in learning fraction calculation operations. This innovation is important to improve the quality of education and overcome problems in developing students' skills and motivation (Elmunsyah et al., 2019). For example, the use of fractional dominoes by Setiawan et al. (2020) has the advantage of increasing response and a good understanding of fraction material. However, during its use, there were obstacles, namely the limited variation in the number of questions and the gap in student involvement. Then there is research from Purnama & Pramudiani (2021), which utilises Google Slides so that students are actively involved and interested during the learning process but requires internet access, and there is no feature that can lock the slides so that they continue to show the slides. Then Sari et al. (2024) There have been several studies that have used Articulate Storylines to teach fractions in elementary school. Still, there are constraints such as limited direct student interaction, dependence on technological infrastructure, complexity of design for teacher competence, and difficulty adjusting to students' varying ability levels.

Based on these problems, researchers offer a new approach by implementing Fraction Adventure gamification media specifically designed to support the learning of fraction calculation operations. Gamification is the process of delivering material with the help of a game as a variation of a game (Erfan et al., 2021). As such, its learning implementation helps teach new skills and creates active learning for students without abandoning the learning objectives (Marlita et al., 2024). Therefore, Fraction Adventure media is not only oriented towards concept understanding but also utilises game elements to stimulate learning motivation. Of course, the media used must be relevant, interesting, interactive, support learning objectives in accordance with the development of reason and knowledge, be cost-efficient, practical to use, and can be applied in the long term to improve student understanding and engagement (Madhuri, 2019). Moreover, the use of gamification-based media in the learning process of mathematics is able to increase student learning motivation, including fostering a strong desire and need to learn, increasing attention and interest in mathematics, training perseverance in the face of difficulties, and fostering a desire for success (Setiawan & Soeharto, 2020).

Therefore, the combination of Fraction Adventure gamification provides a new dimension in fraction learning that prioritises students' independent exploration process supported by a fun and challenging learning experience. This study focuses on the effect of Fraction Adventure gamification on math learning, especially fraction calculation operations because few studies have been conducted on this content. In addition, another objective is to determine the more significant effect of fraction adventure media on fraction

calculation skills in terms of student motivation and explore the relationship between learning motivation and these skills.

## METHODS

This research is quantitative research with a 2x2 factorial design pseudo-experimental method. Therefore, this study involved an experimental class and a control class. The experimental class was given learning using gamification media, such as Fraction Adventure, based on Discovery Learning (A1). In contrast, the control class was given teaching with a fraction quartet card game based on Discovery Learning (A2). Treatment group I and treatment group II were measured for students' learning motivation (B) so as to obtain data on students who have high-category learning motivation (B1) and students who have low-category learning motivation (B2).

The sampling technique used cluster random sampling with a total of 102 students spread across four elementary schools in Selogiri sub-district, Wonogiri. This study began with interviews with teachers and students in 4 schools regarding the level of fraction calculation operation skills, with the results showing low fraction calculation operation skills in phase C students in grade 5 elementary schools. Therefore, from the four elementary schools, two elementary schools were selected for the experimental and control classes, respectively.

Fraction Adventure gamification media was given to the experimental class, and it can be played individually or in groups. The way to play is for students to roll the dice and move to the next box, which may contain pictures or question cards. If students do not get a question card, then they can continue the game. However, if they get a question card, then the students must answer the question with the provision that the correct answer allows the students to continue their journey, while the wrong answer requires the pawn to go down two stairs or receive a challenge from the teacher. The first pawn to reach the finish line is declared the winner. The display of Fraction Adventure gamification media can be seen in Figure 1.

Data collection in this study used two methods, namely tests and non-tests. The test method was used to measure students' learning outcomes, while the non-test method, in the form of questionnaires, was used to collect information about their learning motivation.

Based on the results of the calculation of content validation using the Aiken formula and expert judgment, the results obtained were 23 test questions and 25 quiz questions were tested on 22 fifth-grade students using the product moment correlation formula and reliability testing using the reliability ratings formula. The result is that the multiple choice questions tested are declared valid and reliable.

The prerequisite test in this study used a normality test with the Lilliefors test, a homogeneity test with the Bartlett test, and a balance test with a t-test. Furthermore, the hypothesis of the collected data was analysed using descriptive statistics and inferential statistics to test its validity. The technique used to analyse the research data inferentially is the Two Way Analysis of Variance (Two Way ANOVA) technique at the significance level  $\alpha = 0.05$ . If the analysis results show differences and interactions, then the analysis is continued with the Scheffe test.

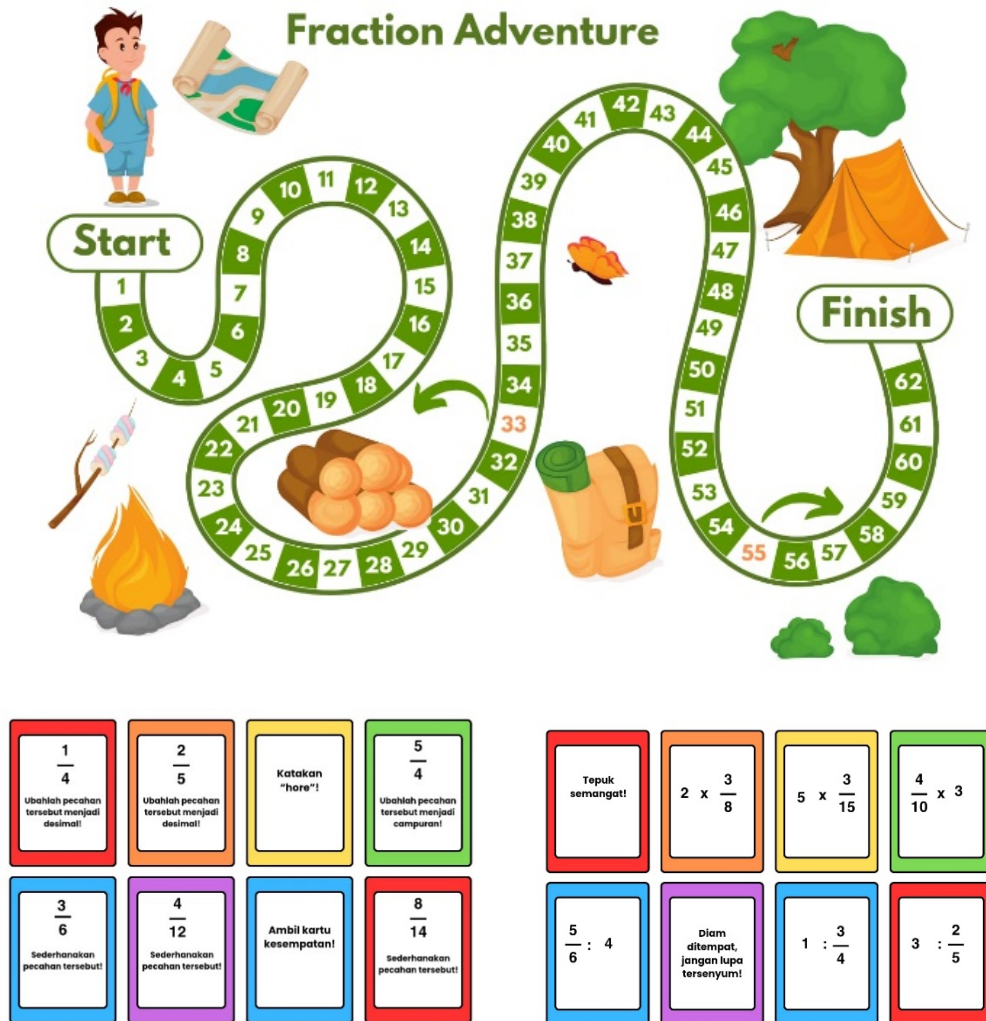


Figure 1. Fraction Adventure Gamification Media

## RESULTS & DISCUSSION

### Results

This study was conducted to determine the fraction calculation operation skills and learning motivation before and after being given treatment in the form of Fraction Adventure gamification media. After the data on students' initial ability through pre-tests about fraction counting operation was obtained, the analysis was conducted. Based on the data, it can be seen in Table 1.

Table 1. Data on Initial Ability of Fraction Counting Skills

| Class      | N  | Max | Min | $\bar{x}$ | Var    | SD    |
|------------|----|-----|-----|-----------|--------|-------|
| Experiment | 52 | 87  | 33  | 58,90     | 181,72 | 13,59 |
| Control    | 51 | 87  | 33  | 58,16     | 173,61 | 15,6  |

From Table 1, it can be seen that the average value of the initial ability of fraction operation skills in the experimental group is 58.90, and the control group is 58.16. The acquisition of student motivation data in each class can be seen in Table 2.

Table 2. Student Motivation Data

| Class      | N  | Max | Min | $\bar{x}$ | Var   | SD    |
|------------|----|-----|-----|-----------|-------|-------|
| Experiment | 52 | 90  | 64  | 73,23     | 30,18 | 5,547 |
| Control    | 51 | 85  | 63  | 73,16     | 22,48 | 4,789 |

From Table 2, it can be seen that in the experimental group, there were 25 students with low motivation and 27 students with high motivation. In the control group, 24 students had low motivation, and 27 students had high motivation. Then, the results of students' abilities after being given treatment through the post-test on fraction counting operations can be seen in Table 3.

Table 3. Data on Fraction Calculation Skills in Each Learning Method and Student Motivation to Learn

| Motivasi |           | Kelas      |         |
|----------|-----------|------------|---------|
|          |           | Eksperimen | Kontrol |
| Tinggi   | N         | 27         | 27      |
|          | Max       | 100        | 93      |
|          | Min       | 47         | 40      |
|          | $\bar{x}$ | 78,78      | 69,07   |
|          | SD        | 14,265     | 14,425  |
| Rendah   | N         | 25         | 24      |
|          | Max       | 87         | 93      |
|          | Min       | 47         | 40      |
|          | $\bar{x}$ | 63,4       | 71,38   |
|          | SD        | 10,456     | 16,715  |

Based on Table 3, it can be concluded that the Fraction Adventure group with high motivation has a higher mean score than those with low motivation. The fraction quartet card group with high motivation has a lower average score than the low motivation group. The average score results are presented in diagram form in Figure 2.

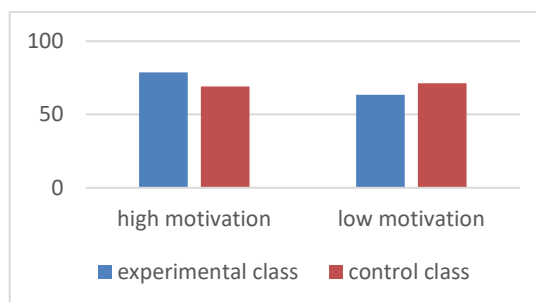


Figure 2. The Average Score Results

After the results of the prerequisite tests that have been carried out are known that the data are normally distributed, homogeneous, and in the same ability, then hypothesis testing can be carried out. The results of hypothesis testing using the two-way Anava test with unequal cells can be seen in Table 4.

Table 4. Two-way ANOVA Test Results

| Source           | JK         | dk  | RK        | F <sub>obs</sub> | F <sub>α</sub> | p             |
|------------------|------------|-----|-----------|------------------|----------------|---------------|
| Method (A)       | 19,188     | 1   | 19,188    | 0,096            | 3,937          | < 0,05        |
| Motivation (B)   | 1.098,005  | 1   | 1.098,005 | 5,504            | 3,937          | > <b>0,05</b> |
| Interaction (AB) | 2.006,775  | 1   | 2.006,775 | 10,059           | 3,937          | < 0,05        |
| Error            | 19.750,14  | 99  | 199,496   | -                | -              | -             |
| Total            | 22.874,108 | 102 | -         | -                | -              | -             |

Based on Table 4, three decisions can be known, namely 1) there is no effect of the learning method on fraction operation skills because the main effect of A (learning method)  $F_A = 0.096$  and  $F_{table} = 3.937$ , so  $F_A \notin DK$ ; 2) there is an effect of learning media on fraction operation skills because the main effect of B (motivation)  $F_B = 5.504$  and  $F_{table} = 3.937$ , so  $F_B \in DK$ ; and 3) there is interaction and relationship between learning method and student motivation on fraction operation skills because the main effect of AB (interaction of learning method and motivation)  $F_{AB} = 10.059$  and  $F_{table} = 3.937$ , so  $F_{AB} \in DK$ .

Thus, it was concluded that student motivation plays an important role in determining the success of learning fraction operation skills. This is supported by activity observations during the learning process, which show that students with high motivation are more enthusiastic about learning than students with low motivation. Furthermore, the use of Fraction Adventure gamification media is more optimal for students with high motivation but does not show significant differences when viewed separately. This media also supports the involvement of highly motivated students compared to the use of Fraction Quartet Cards media in the control class. This shows that using the right media can support the increase of students' motivation during learning. Of course, students' significant learning motivation affects their learning outcomes.

### Discussion

The results of this study support previous research on the use of gamification-based media, which has a significant effect on student learning motivation. Such research by İlhan (2021) states that game-based learning can increase students' learning motivation through students' attention, interest, and curiosity during the learning process. This is in line with Yeh et al. (2019), who stated that gamification provides a fun and interesting learning experience that can increase students' motivation and interest in learning math.

This result is reinforced by research by Zhang et al. (2020), which shows that digital games are able to improve fraction skills through an interactive approach. In addition, Vygotsky's play theory explains that active social interaction through play can support cognitive development (Wardani et al., 2023). In the context of Fraction Adventure, the game elements helped students understand the concept, although some low-motivated students had difficulty due to the lack of explicit guidance. Similar results were also found in the research of Taub et al. (2020), which stated that minimal guidance can hinder effective learning in students with low initial skills.

The application of the Discovery Learning model in Fraction Adventure provides relevant challenges for students, thus increasing their active involvement in learning. This is in line with the opinion of Gazali and Pransisca (2022), who stated that discovery-based learning improves learning outcomes by involving students in active exploration. On the

other hand, Afifah and Hartatik's (2019) research shows that the use of game media can increase student motivation, especially intrinsic motivation, which contributes to learning success. This motivation is a key factor that influences the effectiveness of game-based learning methods, as also stated by Ramadhani (2021).

The Fraction Adventure method provides a more dynamic learning experience by inviting learners to be able to analyse problems through problems, choose the right method to solve them and think logically to find the correct solution. This hones problem-solving skills and encourages learners to think critically when solving a given problem. Students who use this method show improved problem-solving skills, as reported by Fauzi et al. (2023), who emphasised the importance of challenges in 21st-century learning. Discovery Learning-based Fraction Adventure Game.

The game also enhances learners' intrinsic motivation with fun activities, meaningful learning experiences, and relevant challenges that link lessons to everyday life (Filgona, 2020). Intrinsic motivation results in improved performance, deep engagement, better creativity and high confidence in learning (Westera, 2019). This is reflected in the elements of intrinsic motivation, such as the pleasure and satisfaction learners feel when enjoying the challenge of solving fraction problems or facing challenge cards on the game track.

In addition to intrinsic motivation, extrinsic motivation also has a significant effect on fraction calculation operation skills. Extrinsic motivation is encouragement from external factors, such as rewards, praise, or desired results, which encourage individuals to engage in certain activities (Filgona et al., 2020). In this study, extrinsic motivation is influenced by innovative learning methods that use interesting game media. The challenge provided in the game, as well as the interesting way of playing, serves as an external push that encourages learners to try harder and be actively involved in learning fraction operation skills.

Afifah and Hartatik's (2019) research corroborates that extrinsic motivation in learning through games arises when teachers provide guidance, media attracts learners' attention, praise motivates active participation, and challenges create healthy competition. Visual elements, such as pawns, interesting tracks, challenge cards, and fraction problems, also serve as external stimuli that encourage learners to continue participating enthusiastically in the game.

From these findings, Yulianti and Marhayani (2024) stated that high motivation encourages learners to be more actively involved in learning and understanding the concept of fractions, thus improving learners' understanding, skills, and final scores in fraction materials. In addition, learners feel personal satisfaction when completing challenges in the game, which can improve fraction calculation operation skills.

## CONCLUSION

This study shows that learning motivation has a significant influence on elementary school students' fraction operation skills. Fraction Adventure gamification media did not directly have a significant effect on fraction operation skills compared to other learning methods. Still, it proved to be more effective when used with students with high learning motivation. The findings also revealed an interaction between learning motivation and learning method, suggesting that students' motivation level strongly influences the effectiveness of the Fraction Adventure method. The results of this study emphasise the importance of considering students' characteristics, especially learning motivation, in choosing the right learning strategy or media. In addition, Fraction Adventure has the potential to be further developed as an interactive learning media on other materials in

mathematics, considering that the gamification elements used can increase student engagement in learning. This study still has limitations on the scope of the population, so it is recommended to conduct further research that covers a wider population or use different research methods to verify and expand these findings. Research could also focus on developing gamification media with more varied elements to increase its appeal and effectiveness for students with low learning motivation.

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