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# Ludo Media Collaborative Fraction to Improve the Collaboration Skills of Grade IV Students

Siti Raihani Vesya<sup>\*1</sup>, Kufita Rachman<sup>2</sup>, Ni Putu Miranda Puteri<sup>3</sup>, Ade Putri Arbiyanti<sup>4</sup>

Universitas Negeri Yogyakarta, Indonesia Sitiraihani.2021@student.uny.ac.id<sup>\*1</sup>, kufitarachman.2021@student.uny.ac.id<sup>2</sup>, ni1100fip.2022@student.uny.ac.id<sup>3</sup>, ade222fip.2021@student.uny.ac.id<sup>4</sup>

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#### ABSTRACT

Collaboration is a critical 21st-century skill that supports learners in navigating complex academic and social challenges. This study introduces Dokocah (Fraction Collaboration Ludo), an innovative educational medium designed to enhance collaboration skills among fourth-grade students during mathematics instruction on fractions. Addressing the urgent need for engaging, skill-oriented learning tools in elementary education, this research adopts the ADDIE Research and Development model, encompassing analysis, design, development, implementation, and evaluation phases. Data were collected through interviews and questionnaires, then analyzed using descriptive qualitative and quantitative methods. The validation process yielded high feasibility ratings: 91.3% for material and 87% for media. The practicality assessment showed strong student approval (85.5%). Effectiveness testing revealed a significant improvement in the experimental group (N-Gain = 0.71, "High") compared to the control group (N-Gain = 0.26, "Low"), with a statistically significant difference confirmed by an independent sample t-test. These findings indicate that Dokocah is a feasible, practical, and effective tool for improving collaboration skills, thereby supporting students in mastering key competencies such as communication and social responsibility essential for 21st-century learning.

Keywords: Collaboration Skills, Educational Game, Fractions, Ludo

#### ABSTRAK

Kolaborasi merupakan keterampilan penting abad ke-21 yang mendukung peserta didik dalam menghadapi tantangan akademik dan sosial yang kompleks. Penelitian ini memperkenalkan Dokocah (Fraction Collaboration Ludo), sebuah media pembelajaran inovatif yang dirancang untuk meningkatkan keterampilan kolaborasi siswa kelas IV dalam pembelajaran matematika pada materi pecahan. Menjawab kebutuhan mendesak akan alat pembelajaran yang menarik dan berbasis keterampilan di pendidikan dasar, penelitian ini menggunakan model Research and Development (R&D) ADDIE yang mencakup tahapan analisis, desain, pengembangan, implementasi, dan evaluasi. Pengumpulan data dilakukan melalui wawancara dan angket, kemudian dianalisis dengan metode deskriptif kualitatif dan kuantitatif. Hasil validasi menunjukkan tingkat kelayakan yang tinggi: 91,3% untuk kelayakan materi dan 87% untuk kelayakan media. Uji kepraktisan menunjukkan respons positif siswa sebesar 85,5%. Uji efektivitas menunjukkan peningkatan signifikan pada kelompok eksperimen (N-Gain = 0,71, kategori "Tinggi") dibandingkan dengan kelompok kontrol (N-Gain = 0,26, kategori "Rendah"), dengan perbedaan yang signifikan secara statistik berdasarkan uji t dua sampel independen. Temuan ini menunjukkan bahwa Dokocah merupakan media yang layak, praktis, dan efektif untuk meningkatkan keterampilan kolaborasi, serta mendukung penguasaan kompetensi penting seperti komunikasi dan tanggung jawab sosial yang esensial dalam pembelajaran abad ke-21. Kata kunci: Keterampilan Kolaborasi, Permainan Edukasi, Ludo, Pecahan

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## Introduction

Education in the 21st century is not limited to training learners' cognitive knowledge, more broadly, it requires skills aligned to face various challenges. Learner skills such as collaboration skills are important to exchange knowledge, ideas, arguments, experiences, and other abilities to reach common targets (Fawwaziara et al., 2024: Tuti & Mawardi, 2019). In addition to being relevant to work demands, collaboration skills are also able to support the character-building of students (Arifah et al., 2025). Furthermore, collaboration skills are considered useful in developing creativity and problem-solving by students more quickly (Mufarohah et al., 2024). As elaborated by (Ulhusna et al., 2020), mastery of collaboration skills can expand students' knowledge by exchanging knowledge and information. Learning by highlighting collaboration skills excels in training effective task coordination, forming responsible characters, accumulating knowledge, and increasing creativity (Child & Shaw, 2016; Dooley & Sexton-Finck, 2017). The many benefits that have been studied in the presence of collaboration skills in learners emphasize the importance of mastering these skills. However, the reality in the field still encounters the problem of low collaboration skills in students.

The problem of low collaboration skills was proven by Mufarohah et al. (2024), which is still often experienced by students in the school environment. This can be seen from the lack of learning support that is interactive between students (Fahri & Qusyairi, 2019). In general, the use of learning tools such as blackboard media only makes students listen and record explanations from teachers without really being involved in the learning process, which has an impact on the low interaction of active students is an implication of low collaboration skills (Sufajar & Qosyim, 2022). A study by Sunbanu et al. (2019), explained that the lack of collaboration skills is seen when learning in groups. According to him, more students get time to discuss, but instead, it is used for activities outside of learning such as telling stories so that the burden of work is only borne by one or two students.

Factors that cause low collaboration skills include the lack of student interaction in groups, lack of cooperation between students, and less attractive learning media (Firman et al., 2023). Referring to the results of interviews with teachers at SD Negeri Adisucipto 1, the media used by teachers in learning is only a blackboard. The blackboard is intended to explain the material directly and write questions, so it is considered less able to facilitate the development of students' collaboration skills. Based on the preliminary study interview data, further observations were made to identify indicators of students applying collaboration skills in the classroom. The observation refers to Greenstein's theory (2012), which shows that the lowest learner

collaboration skills are found in fractional math learning with an average score of 27.5%, including the criteria "Less". This data highlights the problem of collaboration skills needing attention, especially in fraction learning.

According to Fachrurazi et al. (2018), fraction material needs to be well understood by students as a basis for advanced mathematics material. If fraction learning experiences low collaboration, then the exchange of information and knowledge is not maximized, with implications for understanding concepts to learning outcomes of fractions (Nurwahidah et al., 2021; Ulhusna et al., 2020). Based on this, interactive learning is needed that can facilitate students' collaboration skills by considering the stage of cognitive development at the elementary school level. According to Vygotsky theory (1978), interactive learning can support social interaction in students' cognitive development. Therefore, collaboration skills can be improved with a solution, namely making interactive learning through relevant learning media.

Several studies have examined the impact of interactive learning media on improving collaboration skills. Sari (2023) was able to improve collaboration skills using Google Sites media. In addition, Erviani et al. (2022) used Kokami media to improve students' collaboration. Ulhusna et al. (2020) also utilized ludo games in mathematics learning so that students' collaboration skills could improve. Although several studies have succeeded in achieving an increase in students' collaboration skills, development with fraction material and broader concepts at the elementary school level is important. The development of ludo games is considered ideal as a learning media because it can attract which is by the characteristics of students, who like to play (Matulessy & Muhid, 2022; Sakila, 2019). Reinforced by Brownell & Chazal (1935) learning theory that students are able to understand the material learned, if they repeat it regularly, such as in ludo games. Ludo is also proven by related research to be able to strengthen learners' interactions with their social environment, making active involvement in designing strategies and working together to achieve team targets (Duarmas et al., 2022). Therefore, ludo games can be an effective and relevant solution to the collaboration skills of elementary school students who improve in learning grade IV math fractions.

The urgency of this research highlights the skills of students in fraction material, which is still a problem, but the learning media used is not suitable for what students need, As a result, communication skills and responsibility are low, which are needed in 21st Century learning. Starting from these problems, this research offers novelty in the form of developing ludo, which is different from previous research, where the presentation of material, rules of play, and target learners is expanded so that it can be a solution. This study aims to develop a feasible, practical, and effective fraction collaboration tool

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for collaboration skills that can be improved in fraction learning. This research contributes to enriching innovative learning studies and applying development-based research methods.

## **Research Methods**

The research is a Research and Development (R&D) model of ADDIE (Branch, 2009). The selection of the ADDIE model in this study is based on a structured stage, which refers to the needs, the product is carefully designed, passes expert validation, and is adaptive in its application. There is also a continuous evaluation to monitor the effectiveness of the media on improving students' collaboration skills, so that it can be ascertained. This study uses random sampling techniques with a population of grade IV elementary school students. The sample in this study was fourth-grade students of SD Negeri Adisucipto 1, consisting of 20 students in the control class and 20 in the experimental class. The research was conducted for four months from preliminary studies, development, to effectiveness testing.



The research stages begin with analysis, the aim is to find problems as the basis for product development, which found the problem of the lack of relevance of learning media to strengthen collaboration used at Adisucipto 1 State Elementary School. Second, the design stage in which learning media verification is carried out by applying Vygotsky's theory related to interactive learning to support social interaction, to improve collaboration skills. Appropriate testing methods were selected, namely feasibility, practicality, and effectiveness tests involving control and experimental classes. In addition, applying relevant learning objectives, compiling appropriate evaluations, and measuring the implications and effectiveness of products in the form of learning media. Third, the development stage is carried out, namely developing the Lodo Dokocah learning media and reassessing the feasibility, practicality, and

Department of Mathematics Education, Universitas Muhammadiyah Purwokerto, Purwokerto, Indonesia p-ISSN 2477-409X, e-ISSN: 2549-9084 Ludo Media Collaborative Fraction to Improve the Collaboration Skills of Grade IV Students Siti Raihani Vesya, Kufita Rachman, Ni Putu Miranda Puteri, Ade Putri Arbiyanti

effectiveness components during the product manufacturing process. Fourth, the implementation stage, where preparations are made to apply the product in the form of Ludo Dokocah learning media by paying attention to the situation and conditions in the classroom. Fifth, the evaluation stage is carried out by reviewing the effectiveness before and after learning, which applies the product in the form of a learning medium, namely in the experimental class. The ADDIE research stages can be seen in Figure 1.

Data were collected with an interview guideline instrument given to the principal and grade IV teacher to find out the initial needs related to the constraints of the learning process, the characteristics of students, and the procurement of learning tools, this data through descriptive analysis. Furthermore, the questionnaire instrument is used to assess the feasibility, practicality, and effectiveness of learning media products by material experts, media experts, teachers, and students. Qualitative data instruments have met the assumptions of validity and reliability. Questionnaire data through descriptive statistical analysis to answer research objectives by referring to the Arikunto (2013). The practicality questionnaire data by students is calculated using the Formula 1.

$$Feasibility = \frac{Total \ score \ accomplished}{Total \ maximum \ score} \times \ 100\%$$
(1)

If the feasibility assessment process has been carried out, the feasibility is categorized based on Arikunto (2013), in Table 1.

Table 1. Eligibility Criteria				
Score Category				
0% - 20%	Not Feasible			
21% - 40%	Less Feasible			
41% - 60%	Decent Enough			
61% - 80%	Feasible			
81% - 100%	Very Decent			

Referring to the eligibility criteria in the table above, ludo learning media can be said to be feasible if at least in the score range (61% - 80%). Then, the practicality questionnaire data by students is calculated using the Formula 2.

$$Practicability = \frac{\text{Total score accomplished}}{\text{Total maximum score}} \times 100\%$$
(2)

The data that has been calculated using the practicability Formula 2, then the practicality category of ludo learning media refers to Table 2.

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Table 2. I facticality cificilia					
Score	Category				
0% - 20%	Not Practical				
21% - 40%	Less Practical				
41% - 60%	Practical Enough				
61% - 80%	Practical				
81% - 100%	Very Practical				

Table 2. Practicality Criteria

Then, the media effectiveness questionnaire data was tested by N-gain to review the level of effectiveness in improving collaboration skills with the Formula 3.

$$g = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \tag{3}$$

Explanation

 $S_{post}$  = Average post-test score  $S_{pre}$  = Average pretest score  $S_{maks}$  = Maximum Score

The results of the N-Gain test calculation are interpreted with reference to the classification that can be seen in Table 3.

Table 3. Classification of Gain Values					
Score Classification					
(N-gain) <sup>3</sup> 0,7	High				
0,7 <(N-gain) <sup>3</sup> 0,3	Medium				
(N-gain) <0,3	Low				

### **Result and Discussions**

### Feasibility of Fraction Collaboration Ludo Media

The feasibility of ludo as a learning media for fraction material is done through the assessment of material experts and media experts. The evaluation was conducted by a subject matter expert with a background as a lecturer in Primary School Teacher Education at Yogyakarta State University, with a concentration in mathematics according to the material covered, namely fractions. Before the final score is obtained, it is adjusted according to suggestions and input in the form of the size of the ludo product to make it easier for students to read. The final score of ludo media is seen in Table 4.

The average score of the material feasibility assessment is 4.56 or 91.3%, thus categorized as "Very Feasible". Supported by Sanjiwani (2022) in her study, it was stated that the developed media meets the material feasibility because it has fulfilled the aspects of content feasibility, linguistic feasibility, and the completeness of

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components. In line with the findings of Sembiring and Napitupulu (2022), decent learning tools need to pay attention to linguistic aspects. There are suggestions for improvement regarding the clarity of the ludo game rules. The material expert concluded, "Suitable for trial with revisions according to the suggestions". Therefore, the material presented in the ludo meets the feasibility of using fraction learning media for fourth grade.

Table 4. Scores of Material Feasibility Assessment						
Aspect	Average Score Acquisition	Percentage	Category			
Content Suitability	4,6	92%	Very Feasible			
Linguistic	4,5	90%	Very Feasible			
Completeness of	4,6	92%	Very Feasible			
Components			-			
Total Average Score	4,56	91,3%	Very Feasible			

Furthermore, the ludo media is studied by media experts. Media experts are lecturers in the PGSD program at Yogyakarta State University. The final score of the media feasibility assessment can be seen in Table 5.

Table 5. Wedia reasibility Assessment Score							
Aspect	Average Score Acquisition	Percentage	Category				
Efficiency	4,3	86%	Very Feasible				
Alignment with students'	4,6	92%	Very Feasible				
interests							
Alignment with the needs	4	80%	Feasible				
of the students							
Alignment with learning	4,5	90%	Very Feasible				
objectives							
<b>Total Average Score</b>	4,35	87%	Very Feasible				

Table 5. Media Feasibility Assessment Score

The average score of the media feasibility assessment is 4.35 or 87%, which falls into the "Very Feasible" category. There are suggestions for improving the ludo media, namely clarifying the appearance of the fraction material book, the ludo display, and the size of the pawns. In line with the research by Rahmanda et al. (2023) on the importance of practical aspects such as efficiency and alignment with learning objectives, which indicate that the media is efficiently used in learning and is suitable for supporting the success of the learning process. Media experts concluded, "Suitable for trial with revisions according to suggestions". Therefore, the media design presented in the ludo meets the feasibility as a learning media for the fourth-grade elementary school fraction material.

# The Practicality Results of the Fractional Collaboration Ludo Learning Media

The practicality of the ludo media is assessed based on the questionnaire scores of the students after receiving instruction using the developed Ludo Dokocah. The Ludo Dokocah media was tested on 20 fourth-grade students in the experimental group at SD Negeri Adisucipto 1. The results of the ludo media practicality assessment scores can be seen in Table 6.

Table 6. Media Feasibility Assessment Score							
Aspect	Average Score Acquisition	Percentage	Category				
Quality of material	3,42	85,5%	Very Practical				
presentation							
Ease of media usage	3,42	85,5%	Very Practical				
Attractiveness of media	3,26	81,6%	Very Practical				
appearance							
Student participation	3,4	85%	Very Practical				
Meaningfulness	3,63	90,7%	Very Practical				
<b>Total Average Score</b>	3,42	85,5%	Very Practical				

The average score for the media practicality assessment was 43.42 or 85.5%, categorizing it as "Very Practical ". In line with the findings of Rachman et al. (2025) who used practicality aspects to assess learning media such as aspects of ease of use and meaningfulness in learning. Most students in the large group trial responded that the Fraction Collaboration Ludo media was very interesting and enjoyable, and it made them enthusiastic about participating in the learning because they could play while learning. Therefore, the fraction collaboration ludo media meets the practicality as a medium that can be implemented in teaching fraction material for fourth grade.



The Ludo Dokocah that was originally developed has a relatively small size. It was not effective for many students in one class to play. To support ease of use, Ludo Dokocah enlarged each of its components, such as dice, pawns, and boards, so that they can be

easily accessed by many students. The following is the result of the Ludo Dokocah media based on the improvements that have been made, as seen in Figure 2.

## The Effectiveness Results of the Ludo Media Collaboration with Fractional Pieces

The effectiveness test was conducted by involving 20 students from the control class (class IV B) and 20 students from the experimental class (class IV A). To measure the effectiveness of the fraction collaboration ludo media, prerequisite tests and hypothesis tests were conducted on the questionnaire data of the control and experimental class students. Prerequisite tests include normality and homogeneity tests. In line with (Usmadi, 2020), in the process of statistical hypothesis testing, it is important to decide on the relevant statistical test, such as using parametric or non-parametric statistical tests. The normality test can assess whether the obtained data is normally distributed or not (Sonjaya et al., 2025). The normality test of the data on the research variables can be seen in Table 7.

Variable	Class	ss Kolmogorov-Smirnov		iirnov
		Statistic	df	Sig.
Collaboration Skills	Pre-test Experiment	0.920	20	0.101
	Post-test Experiment	0.912	20	0.070
	Pre-test Control	0.935	20	0.195
	Post-test Control	0.919	20	0.094

It is known that the probability of the t-statistic > Level of Significance = 0.05, meaning that all the data is greater than 0.05. Thus, the data taken from the control and experimental classes meet the assumption of normality, which is considered good data. Then, a homogeneity test was conducted to assess whether the two groups of control and experimental class data taken from the population had the same variance (Sianturi, 2022). The homogeneity test on both can be seen in Table 8.

Table 8. Results of the Homogeneity Test

	¥	Levene Statistic	df1	df2	Sig.
Collabo Pretest	Based on Mean	1.832	1	38	0.184
ration	Based on Median	1.524	1	38	0.225
Skills	Based on Median and with adjusted df	1.524	1	37.8	0.225
	Based on trimmed mean	1.696	1	38	0.201
Posttest	Based on Mean	3.971	1	38	0.054
	Based on Median	3.924	1	38	0.055
	Based on Median and with adjusted df	3.924	1	29.1	0.057
	Based on trimmed mean	4.156	1	38	0.048

The results of the homogeneity test indicate that the t-statistical probability value > Level of Significance = 0.05. It is concluded that the data from the pretest and posttest

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in both classes meet the homogeneity assumption, thus the population in this study is declared homogeneous.

It is concluded that the data from the pretest and posttest in both classes meet the homogeneity assumption, so the population in this study is declared homogeneous. Furthermore, hypothesis testing was conducted, including the n-gain test and the independent two-sample t-test. Next, hypothesis testing was conducted, including the n-gain test and the independent two-sample t-test. The purpose of the n-gain test is to assess the improvement in students' collaboration skills after being provided with fraction ludo media. The recombination scores of the control and experimental classes in Table 9.

Table 9. N-gain Test Results							
Highest Value Lowest Value Average							
Control Class	0,57	0,02	0,26				
Category	Medium	Low	Low				
Experimental Class	0,86	0,47	0,71				
Category	High	Medium	High				

The n-gain score in the control class was obtained with an average of 0.26, which is classified as "Low". Next, in the experimental class, the n-gain score was found to have an average of 0.71, which is classified as "High". To see the difference in n-gain scores between the control class that received treatment with ludo media and the experimental class that did not receive treatment with ludo media, a two-sample t-test was conducted (Rozak & Hidayati, 2019). The tool used was SPSS version 27 to conduct the independent two-sample t-test. The results of the independent two-sample t-test in Table 10.

The data shows that the Sig. (2-tailed) value is 0.000 < 0.05, thus  $H_0$  which states that there is no difference in the average N-Gain scores of the two classes is rejected. There is a significant difference between the control class and the experimental class scores based on the average N-Gain scores of both classes. Thus, the collaborative ludo media for fractions is deemed capable of enhancing the collaboration skills of elementary school students. This finding is in line with Ulhusna et al. (2020) findings, which state that the game of ludo in mathematics learning aims to enhance collaboration skills. This is because the Ludo media developed is in accordance with the factors that increase collaboration according to Pratama et al. (2025), namely being able to support learner interaction, motivation in acquiring knowledge, and good instructional support. Therefore, based on the findings of this study, supported by related research findings, collaborative Ludo media is effectively able to improve students' collaboration skills.

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	Та	ble 10	. Rest	alts of	the Two	) Indepe	endent S	ample	T-Test	
	Levene's Test	for Eq	uality		1	t-test for	r Equalit	y of Me	ans	
	of Vari	iances								
	F		Sig.	t	df	Sig. (2- tailed)	Mean Differen ce	Std. Error Differe	95% Co Interva Diffe	nfidence Il of the rence
								nce	Low	Uр
									-er	-per
N-Gair	1 Equal variances assumed	1.894	0.177	-9.760	38	0.000	-45.150	4.626	-54.515	-35.785
	Equal variances not assumed			-9760	34.015	0.000	-45.150	4.626	-54.551	-35.749

The research findings also revealed that collaboration skills have an impact on the learning outcomes of the participants. Based on the comparison of fraction material scores before using the ludo media, the average score was 52, while the group learning outcomes using Ludo Dokocah had an average score of 83. In line with the research by Shofiyah et al. (2022) that learning outcomes can be influenced by students' collaboration skills, because when collaborating, students share understanding, thereby gaining broader knowledge through joint exploration. In addition, related research explains that learning media with game concepts are effective for improving students' understanding of mathematics (Kumala et al., 2024).

The challenge in this research is that a lot of time is required for students to play the collaborative fraction ludo media. For further improvements, such as game rules that can optimize learning time. This research has implications for improving collaboration skills during mathematics learning on fractions by providing interactive learning media, and it can serve as a reference for teachers to create learning media oriented toward the needs of students.

### Conclusion

This study concludes that the developed Fraction Collaboration Ludo media is effective in enhancing the collaboration skills of elementary school students during mathematics instruction on fractions. The media demonstrated high feasibility, with average material and media feasibility scores of 91.3% and 87%, respectively, both categorized as "Very Feasible." It also proved to be highly practical, receiving an 85.5% approval rate from students. Effectiveness testing showed a significant improvement in collaborative skills among students in the experimental group (N-Gain = 0.71, "High") compared to the control group (N-Gain = 0.26, "Low"), with statistical

significance confirmed through an independent sample t-test. These findings highlight the potential of collaborative game-based media as an innovative and engaging instructional tool in elementary mathematics education. Teachers are encouraged to integrate such media into classroom practice to foster essential 21st-century competencies, particularly collaboration. Schools should also provide adequate support and resources to facilitate implementation. Future research may explore broader applications of game-based media across different subjects and skills—such as communication, critical thinking, and creativity—to further support holistic student development in the 21st century.

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