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Research Article

The Influence of Ludo Game Learning Media on the Learning Motivation of Fifth Grade Elementary School Students

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Abstract

The research problem in this study concerns the low motivation of elementary school students in learning mathematics, particularly algebra, when taught using conventional methods. The purpose of this research was to examine the effectiveness of Ludo board learning media in enhancing students' learning motivation of algebraic concepts. A quasi-experimental design with a pretest-posttest control group was employed, involving fifth-grade students divided into an experimental group and a control group. The experimental group received algebra instruction using Ludo board media, which integrated interactive elements such as dice rolls, token movements, and algebra-related questions, while the control group was taught through traditional instruction. Data on student motivation was collected using a validated 15-item questionnaire with high reliability (Cronbach's Alpha=0.883). Pretest results indicated no significant difference between groups ($p=0.548$), confirming equivalence, while posttest analysis revealed a significant improvement in the experimental group compared to the control group ($p < 0.001$). The implications of these findings highlight that game-based learning media can increas the problem of low motivation by creating an engaging, interactive, and collaborative environment. The impact of this study demonstrates that integrating Ludo board media into mathematics instruction can accommodate diverse learning styles, foster social interaction, and improve motivation learning. This approach offers a practical strategy for enhancing the quality of mathematics education at the elementary level.

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Introduction

Education plays a crucial role in shaping human potential, encompassing both physical and spiritual aspects, in accordance with the values embedded within society and culture. Education is a process through which individuals develop abilities and internalize social values, which are cultivated and enhanced through human effort [1]. Similarly, scholars emphasize that education functions as a mechanism to influence students, enabling them to adapt effectively to their environment, induce personal transformation, and prepare them to contribute positively to society [2]. In the context of rapid global changes, the educational system faces the critical task of preparing younger generations to navigate these

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transformations successfully. Therefore, it is essential to implement educational programs that are not only comprehensive but also capable of producing graduates with high-quality competencies that meet societal and cultural demands. The synergy between individual potential and educational practice ultimately supports the creation of well-rounded human resources.

The quality of human resources is heavily dependent on the quality of education they receive. In Indonesia, efforts to improve educational quality have been closely linked to curriculum reforms, which aim to enhance the learning experience and foster higher-order thinking skills among students [3]. The current curriculum, known as the "Merdeka Curriculum," introduces a flexible approach that allows both educators and students to innovate within the teaching and learning process. This curriculum emphasizes autonomy, creativity, and personalized learning, giving teachers the freedom to design educational activities that are relevant to the needs of their students [4]. By adopting this approach, education in Indonesia aims to cultivate learners who are not only academically proficient but also capable of critical thinking, problem-solving, and adapting to the demands of the 21st century.

One of the innovative strategies to support the Merdeka Curriculum is the integration of educational media into teaching practices. Educational media are tools that teachers use to create more engaging, interactive, and effective learning environments [5]. Such media are designed to increase students' interest, motivation, and participation in the learning process. Among the various options, learning through games has emerged as a particularly effective method, combining enjoyment with interactive content that reinforces cognitive skills. Games such as Ludo, which are familiar to students, can be adapted as teaching aids to deliver subject matter in a dynamic and engaging manner.

Ludo is a traditional board game typically played by two to four participants. This game encourages players to engage in critical thinking and strategic planning to achieve success [6]. In educational settings, Ludo can be modified to enhance its instructional value. Modern adaptations may include the addition of technology, such as QR codes, which transform the game into a hybrid learning tool that integrates both physical gameplay and digital content. By incorporating such innovations, teachers can foster an environment where students actively participate, practice problem-solving skills, and maintain high levels of motivation throughout the lesson.

QR codes represent an advanced form of the traditional barcode, capable of storing extensive information that can be accessed via scanners or smartphones [7]. In educational contexts, QR codes serve as a gateway to interactive content, including learning materials, questions, and instant feedback. The integration of QR codes in teaching provides a seamless way for students to engage with digital resources while participating in traditional learning activities. For instance, in the subject of mathematics education, QR codes can provide students with immediate access to instructional content and assessment questions, thereby enriching the learning process and promoting independent exploration of the material.

The current state of education in Indonesia, however, presents challenges that highlight the need for such innovative approaches. According to a 2018 survey by the Programme for International Student Assessment (PISA), Indonesia ranked

74th out of 79 countries, positioning it as one of the lowest-performing nations in terms of educational outcomes Lestari & Iswendi [8]. This ranking reflects a significant concern, especially considering the country's large human resource potential. Despite abundant student populations, the quality of education has not sufficiently translated into improved competencies among Indonesian learners. The low performance underscores the urgency of implementing strategies that enhance both teaching practices and student engagement.

Several factors contribute to the educational challenges in Indonesia. The success of an educational system depends on multiple variables, including student motivation, teacher competence, socio-economic conditions, infrastructure, and the broader learning environment [9]. Each of these elements can either facilitate or hinder educational outcomes, making it necessary to adopt comprehensive solutions that address these multidimensional issues. By improving both teaching resources and instructional methods, education can more effectively support the holistic development of students and enhance the nation's overall human capital.

In response to these challenges, researchers have developed innovative learning media to support teachers in delivering content more effectively. One example is the adaptation of the Ludo game, enhanced with QR codes to create an interactive educational tool [10]. This Ludo-based media has been designed for mathematics education, specifically for Grade 5 students studying algebra. The QR codes embedded in the game allow students to access content and questions prepared by the teacher, while the game board incorporates visual elements and color-coded squares to maintain engagement. Studies indicate that using such interactive media not only stimulates interest but also encourages active participation and focused attention during learning activities [11].

The integration of game-based learning with digital tools such as QR codes reflects a broader trend in educational innovation, where technology is leveraged to support cognitive and affective development simultaneously [12]. By combining traditional board games with interactive digital elements, educators can create hybrid learning experiences that cater to diverse learning styles. Students not only develop strategic thinking and problem-solving skills through gameplay but also enhance their digital literacy by interacting with QR code-based content. This dual engagement fosters a deeper understanding of subject matter, as students are actively involved in both the manipulation of physical game pieces and the exploration of digital learning resources.

Furthermore, the use of Ludo-based media with QR codes promotes collaborative learning and social interaction among students. During gameplay, students must communicate, negotiate strategies, and support each other in completing tasks, which builds teamwork and interpersonal skills [13]. Such collaborative experiences align with the goals of the Merdeka Curriculum, which emphasizes student-centered learning, creativity, and autonomy. By participating in structured yet flexible activities, students gain confidence, motivation, and a sense of responsibility for their own learning. Teachers can monitor student engagement and learning progress more effectively, as the QR code system allows for immediate assessment of comprehension and response accuracy.

The implementation of this innovative learning media has broader implications for improving educational quality in Indonesia. Beyond increasing

student engagement, the integration of interactive tools into the curriculum can serve as a model for other subjects and educational contexts [14]. By providing teachers with creative and effective instructional resources, the education system can better support the development of higher-order thinking skills and improve learning outcomes across diverse student populations. The combination of traditional games and digital technology represents a promising avenue for fostering a more engaging, inclusive, and effective learning environment that aligns with global educational standards while addressing the unique challenges of the Indonesian educational system.

This study aims to explore the development, validity, and practical implementation of Ludo-based educational media supported by QR codes. Specifically, the research seeks to determine the influence of Ludo game learning media on the learning motivation of fifth grade elementary school students [15]. The results of this study are expected to provide meaningful implications, including offering teachers an innovative instructional resource, enhancing students' motivation and engagement, and contributing to the broader discourse on integrating traditional games with modern digital tools to improve the quality of education in Indonesia. In addition, the findings of this study are anticipated to strengthen the evidence base regarding the effectiveness of game-based learning models in elementary school contexts, particularly in mathematics education. The research also aims to highlight how interactive media can bridge the gap between traditional learning approaches and technology-driven innovations, ensuring that students are better prepared for the digital era. Beyond classroom practice, the outcomes may inform policymakers and curriculum developers about the potential of adopting hybrid learning tools that align with the principles of the Merdeka Curriculum.

Research Methods

A. Type of Research

The type of research employed in this study was quasi-experimental research, which is widely used in the field of education to investigate causal relationships when random assignment of subjects is not feasible. Quasi-experiments are designed to approximate the conditions of true experimental research while accommodating the practical limitations often present in real classroom settings. This research utilized a nonequivalent control group design, which involves the use of both experimental and control groups without random assignment. The experimental group received treatment through the implementation of Ludo game learning media, while the control group continued with conventional learning methods. The purpose of employing this design was to evaluate the influence of the independent variable, namely the learning media, on dependent variables such as student learning motivation. Quasi-experimental methods are considered appropriate for classroom-based studies because they allow for intervention testing while maintaining natural learning environments [16]. Although the lack of randomization may introduce certain biases, rigorous statistical analysis and the inclusion of pretests help to minimize potential threats to validity. Thus,

this approach provided a structured framework for assessing the effectiveness of the Ludo game learning media in a realistic educational context.

Quasi-experimental research is particularly valuable in educational research because it enables researchers to conduct systematic comparisons between groups under controlled conditions, despite certain constraints. In this study, the nonequivalent control group design was selected to facilitate a balanced comparison between two intact classes that could not be randomly assigned. Pretests were conducted in both the experimental and control groups to assess baseline equivalence prior to treatment implementation. This step was crucial in ensuring that differences observed after the intervention could be more confidently attributed to the independent variable rather than pre-existing disparities. The use of both pretest and posttest measurements strengthened the internal validity of the research design. Furthermore, the nonequivalent control group design is advantageous because it mirrors real teaching conditions, thus enhancing the external validity of the findings [17]. By integrating these methodological considerations, the study provided meaningful insights into how game-based learning media can impact motivational and cognitive outcomes.

B. Research Sample

The research sample in this study consisted of elementary school students who were purposively selected to represent the population of fifth-grade learners. A total of 100 sixth grades students were first involved in the trial stage to test the validity and reliability of the learning motivation instrument. The main experimental phase involved two intact classes from the fifth grade, which were divided into an experimental group (EG) and a control group (CG). The experimental group was taught using Ludo game learning media, while the control group received instruction through conventional methods. Both groups participated in pretests and posttests, allowing researchers to measure differences in learning motivation and creative thinking ability before and after the intervention [18]. This sampling design followed the nonequivalent control group model, which is commonly employed when random assignment is not possible in educational settings. The sample selection process ensured that both groups represented similar academic characteristics, thereby enhancing the comparability of the results.

C. Data Analysis Techniques

This study utilized a learning motivation instrument in the form of a questionnaire. The observed scores can be said to have a high correlation with the true scores, indicating that the instrument is reliable. Reliability can be defined as the correlation coefficient between two observed scores obtained from measurements using parallel tests. Based on this definition, a test is considered reliable if the measurement results closely approximate the actual condition of the test participants [19]. To measure reliability, factor analysis was conducted using the JAMOVI application version 2.3.2. The classification level of Cronbach's Alpha coefficient is determined based on Table 1 of Cronbach's Alpha coefficient, which includes:

Table 1. Cronbach’s Alpha Koefisien

Koefisien *Cronbach's Alpha*	Interpretasi koefisien *Cronbach's Alpha*
0,40 – 0,69	Low Reliability
0,70 – 0,89	Moderate Reliability
0,90 -1,00	High Reliability

Reliability (U) in a test is generally expressed numerically in the form of a coefficient ranging from -1.00 to +1.00. High reliability is indicated by a high coefficient, whereas a low test score corresponds to low reliability. If reliability is perfect, the reliability coefficient equals +1.00. Ideally, the reliability coefficient should be positive. Reliability is also closely related to measurement error. High reliability indicates that the error in obtaining measurement results is minimal. In other words, the higher the reliability of an instrument, the smaller the measurement error. Conversely, if the test score reliability is low, the measurement error will be larger [20].

This study employed construct validity, which measures the extent to which an instrument can reveal a particular ability or theoretical construct intended for assessment. The process of construct validation begins with the identification and specification of the variables to be measured, which are then expressed in the form of a logical construct based on relevant theory. From this theory, practical consequences related to measurement outcomes under specific conditions are derived, and these consequences are tested. If the results align with expectations, the instrument is considered to possess good construct validity [21]. In this study, since mathematical creative thinking is an extension of creative thinking skills, metacognitive abilities, and learning readiness which are relatively novel concepts it is necessary to explore further the factors related to these variables. Construct validity in this research was determined using Exploratory Factor Analysis (EFA), applied when the measurement model of an instrument's construct is still in the exploratory stage. Subsequently, the computer generates a variance-covariance matrix and calculates eigenvalues, which are used to determine the percentage of explained variance and to plot a scree plot. Construct validity was assessed using the JAMOVI application version 2.3.2.

For operational product testing, this study employed a quasi-experimental design. Prior to data analysis, two prerequisite tests were conducted: first, the normality test, which aims to determine whether the data from each variable are normally distributed. The normality test was applied to learning motivation data (pretest and posttest) collected from two classes: the control class (CC) and the experimental class (EC). These data were then statistically analyzed using Jamovi version 2.3.28 with the Shapiro-Wilk Multivariate Normality Test to evaluate the normality assumption. If $p > 0.05$, the data are considered normally distributed; if $p < 0.05$, the data are not normally distributed [22]. Normality tests were conducted on both pretest and posttest scores. The criteria for hypothesis testing are as follows:

H_0 : *Data are normally distributed*

H_1 : *Data are not normally distributed*

The homogeneity test was conducted to determine whether the sample used in the study came from a population with equal variances. This process was performed using Jamovi version 2.3.28. Homogeneity was determined

based on the significance level (sig.); if sig. > 0.05, the data are considered homogeneous, whereas if sig. < 0.05, the data are considered non-homogeneous. The homogeneity test was applied to both pretest and posttest data. The criteria for hypothesis testing are as follows:

H_0 : Group variances are homogeneous

H_1 : Group variances are not homogeneous

The field trial employed a nonequivalent control group design, which is similar to a pretest-posttest control group design. This design allows comparison between the control class and the experimental class, enabling researchers to assess the effect of the intervention while accounting for initial differences between the groups. Showing a comparison between the experimental and control groups through pretest and posttest measurements without random assignment based on Figure 1, such as:

Eksperiment (KE)	*Pretest Measure*	*Treatment*	*Posttest Measure*
	O_1	X_1	O_2
Control (KK)	*Pretest Measure*	*Treatment*	*Posttest Measure*
	O_3	-	O_4

Figure 1. Quasi-Experimental Design dengan Nonequivalent Control Group Design

To determine differences in mean scores between the control and experimental classes, an independent sample t-test was employed. Prior to hypothesis testing, all prerequisite tests were conducted to ensure data suitability. The t-test was used to examine the effect of the independent variable learning using the Ludo game media for Indonesian cultural diversity material on the dependent variables, including learning motivation and creative thinking ability. The analysis was performed using Jamovi version 2.3.28, with the significance level set at 5% ($\alpha = 0.05$). The research hypotheses were formulated.

H_0: There is no significant difference in learning motivation or creative thinking ability between students who receive instruction using the Ludo game learning media and those who do not ($\mu 1 = \mu 2$).

Ha: There is a significant difference in learning motivation or creative thinking ability between students who receive instruction using the Ludo game learning media and those who do not ($\mu 1 \neq \mu 2$).

This design allows for a clear comparison between the experimental and control groups, ensuring that the impact of the Ludo game learning media on students' motivation and creativity can be reliably assessed.

Results and Discussion

A. Results

This study employed a learning motivation instrument in the form of a questionnaire consisting of 15 items. The questionnaire was trialed on 100 fifth-grade elementary school students to assess the reliability and validity of the research instrument. Based on the results of the learning motivation instrument test analyzed using the JAMOVI application, the findings are as presented in Table 2, as follows:

Table 2. Scale Reliability Statistics

Mean	Cronbach's α
4.40	0.883

The learning motivation test instrument demonstrated a reliability coefficient of 0.883, as indicated by Cronbach's Alpha calculated using the JAMOVI application, reflecting the reliability level of the measured data. According to the classification of Cronbach's Alpha coefficients presented in Guilford's table, a value of 0.883 falls within the high reliability range. This high coefficient indicates that the instrument is highly reliable. It provides confidence that each item effectively measures the intended aspect, and the total test score accurately reflects the students' level of learning motivation. Therefore, based on the analysis using the JAMOVI application, the learning motivation test instrument can be categorized as reliable.

In this study, validity was determined using Exploratory Factor Analysis (EFA) because it was not yet clear whether learning motivation, as an extension of general motivation, shares the same underlying factors. The analysis results showed a Bartlett's Test of Sphericity value of < .001. According to, a p-value less than 0.01 indicates that the sample size used in this factor analysis is adequate. Based on the results of the Exploratory Factor Analysis, it can be concluded that this questionnaire instrument is valid for measuring students' learning motivation in general and has been empirically proven as presented in Table 3, as follows:

Table 3. Bartlett's Test of Sphericity

χ^2	Df	p
403	105	< .001

One of the research problems in this study is to examine the effect of the Ludo game learning media on the learning motivation of fifth-grade elementary school students. To address this research problem, a quasi-experimental study with a pretest-posttest design was conducted. Therefore, it was necessary to calculate the results of both the pretest and posttest. The test was administered to 100 elementary school students, consisting of 50 students in the control class (who learned using conventional teaching methods) and 50 students in the experimental class (who learned using the Ludo game learning media). The control class was conducted at SDN 2 Tasikmadu, Grade 5A, while the experimental class was conducted at SDN 2 Tasikmadu, Grade 5B.

The test consisted of 15 items from the learning motivation questionnaire, which had been validated and tested for reliability. Since the study used a pretest-posttest design, measurements were required for both pretest and posttest data. Data on mathematical learning motivation (pretest

and posttest) were collected from the two classes, namely the control class (CC) and the experimental class (EC), and then analyzed statistically using Jamovi version 2.3.28 to examine the assumptions of normality and homogeneity. The table shows a p-value of 0.140 for the pretest and 0.151 for the posttest, both greater than 0.05. This indicates that the data are normally distributed, and the null hypothesis (H0) is accepted, as presented in Table 4 is normality test and Table 5 is homogeneity test, as follows :

Table 4. Normality Test (Shapiro-Wilk)

W	p
0.967	0.140
0.968	0.151

Table 5. Homogeneity of Variances Test (Levene's)

	F	Df	df2	p
Pretest	1.72	1	53	0.195
Postest	1.22	1	53	0.274

The table shows a p-value of 0.195 for the pretest and 0.274 for the posttest, both of which are greater than 0.05. This indicates that the data are homogeneous, and the null hypothesis (H_0) is accepted. The prerequisite tests for conducting an independent sample t-test have been satisfied, namely that the data are normally distributed and homogeneous, allowing further testing to proceed. Subsequently, an independent sample t-test was conducted in Table 6, as follow:

Table 6. Independent Samples T-Test

	Statistic	df	p
Pretest	0.605	53.0	0.548
Postest	-14.143	53.0	<.001

Based on Table 6, the p-value obtained was 0.548. Since this value is greater than 0.05, the null hypothesis (H_0) is accepted. This indicates that there was no significant effect on the learning motivation of elementary school students between the experimental and control classes during the pretest. However, during the posttest, as shown in Table 6, the p-value was less than 0.001, which is below the 0.05 threshold. Therefore, because $p < 0.05$, the null hypothesis (H_0) is rejected, and the alternative hypothesis (Ha) is accepted. This demonstrates that there is a significant effect on creative thinking ability between students who used the Ludo game learning media and those who did not. The hypothesis is stated as H1: $\mu 1 \neq \mu 2$. Figure 2 illustrates the Ludo game media used in teaching algebra for fifth-grade elementary students.

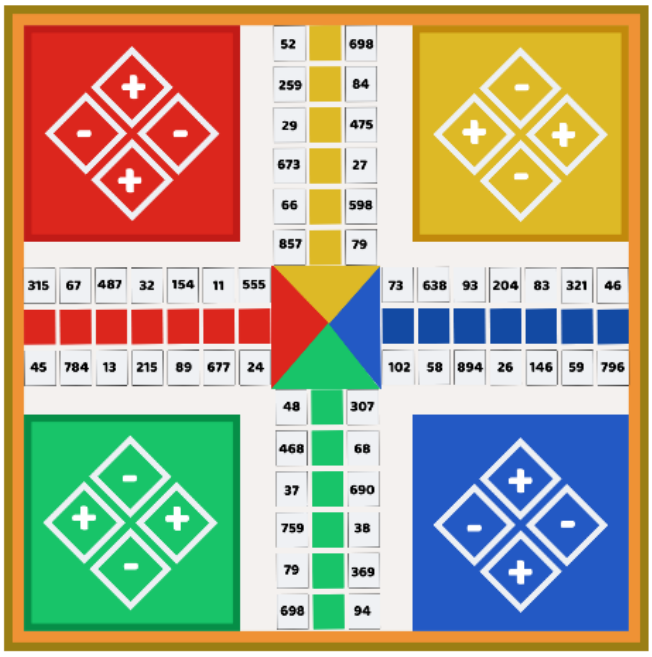

Figure 2. Ludo Game Learning Media in Mathematics

The game is designed for four players, allowing students to learn algebraic concepts through interactive and engaging gameplay. Based on the results of the study, the implementation of group guidance using the Ludo game technique showed a positive impact on fifth-grade elementary students' learning motivation, particularly in algebra. The students who participated in the study were guided using the Ludo game approach, which helped improve their self-confidence during the learning process. By integrating algebraic problems into the gameplay, students were encouraged to engage actively with the subject matter while enjoying a playful and interactive learning environment. The main objective of this approach was to identify the effect of group-based learning using the Ludo game technique on students' motivation and engagement in learning algebra.

B. Discussion

The primary objective of this study was to examine the influence of the Ludo game as a learning medium on fifth-grade elementary students' motivation in learning algebra. The findings revealed that implementing group guidance through the Ludo game significantly enhanced students' learning motivation, self-confidence, and active engagement. The integration of algebraic problems within the Ludo game context encouraged students to participate more actively and to perceive learning as enjoyable and interactive. This result is consistent with the research of [24], who emphasized that playful and interactive instructional tools effectively foster student engagement and comprehension in mathematics. Highlighted that aligning learning media with the concrete operational stage improves students' ability to grasp abstract concepts, supporting the outcomes of this study.

The impact of the Ludo game learning media is evident in several aspects. It successfully increased students' motivation by creating a relaxed yet stimulating environment, integrating algebra into a playful format that

promoted collaboration, competition, and peer learning. These findings with Rinelda & Iswendi [25] and Fauza & Iswendi [26], who reported that interactive group-based learning strategies improve motivation, problem-solving skills, and social abilities. Furthermore, this research confirms [27] that multimodal learning experiences combining visual, kinesthetic, and auditory elements reinforce abstract concepts more effectively. Thus, the results of this study contribute to the growing evidence that game-based learning has a significant positive effect on elementary mathematics instruction.

Despite the promising results, this study also has limitations. One major challenge concerns the time required to implement the game, which can be difficult to manage within limited classroom hours . Additionally, the adaptation of algebraic problems into the Ludo game format required substantial preparation and careful design to ensure alignment with learning objectives [28]. Future research should address these challenges by developing more time-efficient game models and exploring digital adaptations of Ludo to enhance flexibility. Researchers could also examine the long-term effects of Ludo-based learning on students' academic achievement and critical thinking skills, expanding beyond algebra to other mathematical domains.

The Ludo learning media proved effective in increasing students' motivation for several reasons. First, the game is interactive and engaging, combining elements of play that capture students' attention and stimulate active participation in the learning process. Second, Ludo creates a fun and relaxed learning atmosphere, allowing students to perceive learning as an enjoyable activity rather than a monotonous task. Third, the game promotes active involvement, as students take turns rolling dice, moving their pieces, and solving algebra-related questions integrated into the game [29]. This interactive approach aids in understanding and retaining algebraic concepts more effectively. Additionally, Ludo encourages collaboration and healthy competition among students, enhancing their social skills and cooperative abilities [30]. Through the game, students apply theoretical knowledge in practical contexts, reinforcing their memory and comprehension of algebraic concepts. Moreover, Ludo accommodates various learning styles visual, kinesthetic, and auditory making it suitable for diverse learners. Therefore, Ludo serves as an effective and efficient instructional tool for motivating fifth-grade students in algebra.

The learning media were carefully adapted to the developmental stage of elementary school students, who are generally in the concrete operational stage. At this stage, students are better able to grasp abstract concepts when presented in a concrete and tangible manner [31]. To facilitate the understanding of algebraic concepts, the Ludo game was modified to include numbers, operations, and simple algebraic equations. By playing the adapted Ludo board game, students could connect abstract algebraic concepts, such as variables and expressions, with hands-on experiences, making learning more meaningful and accessible.

Furthermore, the Ludo game contributes to active student participation during lessons. When students engage directly in enjoyable activities, their motivation to learn increases significantly. They become more interested in understanding algebraic problems and more willing to solve challenges presented during the game. Implementing the Ludo learning media in fifth-grade algebra classes demonstrated positive outcomes, with noticeable improvements in students' engagement, comprehension, and problem-solving skills [32]. This approach aligns with students' cognitive development and offers an innovative and effective method for teaching abstract mathematical concepts. As such, Ludo can serve as a reference for developing interactive instructional methods in other elementary classrooms.

The Ludo game enhances learning outcomes through several effective mechanisms. First, the media creates a lively and interactive learning environment, directly improving students' motivation and participation [33]. When students engage in a Ludo game containing algebraic questions, they become more eager to understand the concepts being taught. Second, the game supports group-based learning, promoting collaboration, communication, and peer-to-peer learning. This not only aids comprehension but also develops essential social and teamwork skills.

Additionally, the visual and kinesthetic aspects of the Ludo game reinforce understanding of abstract algebraic concepts through hands-on experiences. Students can see, touch, and move their game pieces while solving algebraic tasks, supporting multi-modal learning [34]. This approach is especially valuable in algebra, where students often struggle with abstract concepts and benefit from visual and manipulative representations. The Ludo game also provides immediate feedback during gameplay, allowing students to assess their understanding and correct mistakes in a supportive environment. This encourages reflective thinking and strengthens their conceptual knowledge.

The advantages of using Ludo as a learning media include increasing students' interest and motivation, facilitating comprehension of algebraic concepts, and assisting teachers in delivering lessons more effectively [35]. The activity becomes more active and enjoyable, reducing boredom and disengagement. Furthermore, the media can be adapted for other subjects, providing flexibility in teaching strategies. Ludo encourages interaction and collaboration, enhancing communication and social skills among students. It also introduces variety into the learning process, preventing monotony and fostering enthusiasm for lessons.

However, like any instructional tool, the Ludo game has certain limitations. One of the main challenges is the time required to complete the game, which may be considerable, especially in classrooms with limited time. Additionally, teachers may need extra preparation to adapt algebraic content to the game, organize groups, and ensure smooth gameplay [36]. Despite these challenges, the benefits of using Ludo for teaching algebra, including increased motivation, engagement, collaboration, and practical understanding of abstract concepts, outweigh the drawbacks, making it a highly effective tool for elementary mathematics education.

Overall, the integration of the Ludo game in teaching fifth-grade algebra demonstrates that interactive and playful learning media can significantly enhance students' motivation, participation, and comprehension. By bridging abstract concepts with concrete experiences, students develop a stronger foundation in algebraic thinking while enjoying a collaborative and dynamic classroom environment [37]. This approach exemplifies an innovative method for promoting active learning and improving academic outcomes in elementary mathematics education.

In addition to enhancing motivation and engagement, the Ludo game also fosters critical thinking and problem-solving skills. Each turn challenges students to make strategic decisions, such as which piece to move or which algebraic problem to solve first [38]. By integrating algebraic expressions and simple equations into the game, students are encouraged to apply logical reasoning, evaluate multiple options, and anticipate outcomes [39]. This type of decision-making activity helps students develop a stronger sense of numerical reasoning and strengthens their ability to approach algebraic problems with confidence and accuracy.

Moreover, the Ludo-based learning approach supports differentiated instruction. Teachers can adjust the difficulty level of algebraic problems according to students' abilities, allowing both advanced and struggling learners to participate meaningfully. For instance, some students may solve basic addition and subtraction problems with variables, while others tackle more complex equations or pattern recognition tasks [40]. This flexibility ensures that every student is challenged appropriately and can progress at their own pace, promoting inclusivity and equitable learning opportunities within the classroom.

Another significant benefit of using Ludo for algebra learning is its ability to enhance students' memory retention. By repeatedly engaging with algebraic problems during gameplay, students reinforce key concepts in a contextual and memorable manner. The combination of physical activity, visual cues, and immediate feedback strengthens neural connections related to numerical and symbolic reasoning [41]. Consequently, students are more likely to recall and apply algebraic concepts in subsequent lessons, homework tasks, or assessments, demonstrating long-term retention and understanding.

The implications of this study for educational development are significant. First, the integration of Ludo demonstrates that abstract concepts like algebra can be effectively taught through interactive and playful learning approaches, bridging the gap between theory and practice. Second, the collaborative and engaging nature of the game fosters essential social skills, such as communication, teamwork, and leadership, which are crucial for holistic student development [42]. Finally, the differentiated instruction potential of Ludo ensures inclusivity by accommodating diverse learners, as supported by Putrawan, *et al.* [43] and Lai & Hu [44]. Therefore, this study not only enriches the literature on game-based learning but also offers practical insights for teachers in designing innovative strategies that motivate and engage students while promoting deeper conceptual understanding in mathematics.

Conclusion

Research on the impact of Ludo board learning media on fifth-grade students' motivation in Mathematics shows that this media significantly enhances both understanding and motivation. The Ludo board, as an interactive learning tool, makes the learning process more engaging and effective compared to conventional methods. This is supported by T-Test results showing a 2-tailed significance value of 0.548, which is greater than 0.05, indicating that the Ludo board is effective in improving students' comprehension of algebraic concepts. The purpose of this study was to analyze the impact of Ludo board learning media on fifth-grade students' motivation in Mathematics, especially in algebra. This study aimed to determine whether the use of Ludo as a learning tool could enhance students' engagement and comprehension compared to conventional methods. The impact of the research results is evident in the way this innovative approach not only helps students understand algebraic material better but also increases their motivation and interest in learning. It further highlights the potential of integrating game-based learning media to improve the quality of education. However, the shortcomings of this research include its focus only on algebra and the limited scope of its sample, which may affect the generalizability of the findings. Recommendations or hopes for future research include expanding the use of Ludo board learning media across other Mathematics topics and involving broader student populations to strengthen the validity of the results. Future studies are also encouraged to explore modifications of the Ludo game design to suit diverse learning contexts. The implications of this research for the development of education are substantial, as it shows that playful and interactive learning media like Ludo can transform classroom dynamics. By enhancing motivation, Ludo-based learning contributes to innovative teaching practices and provides a valuable reference for improving Mathematics education at the elementary level.

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Author Contributions

Dya Ayu Agustiana Putri: conceptualization; formal analysis; data curation; methodology, writing-review and editing. Leny Suryaning Astutik: methodology; data curation, writing-review and editing. James Leonard Mwakapemba: validation; data curation; writing - original draft; writing - review & editing.

Availability of data and materials

All data is available from the authors.

Competing interests

The authors declare no competing interest.

Additional information

No additional information from the authors.

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