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Integrated Volume Card Game Make A Match Learning Model: Improving Motivation of Learning Outcomes of the Concept of Spatial Building

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ABSTRACT

Purpose of the study: This study aims to design, develop, and evaluate the effectiveness of an innovative interactive learning medium, a volume card game integrated with the Make a Match cooperative learning model, to enhance students' conceptual understanding of volume in mathematics.

Methodology: Using an ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Data collection tools included pretest-posttest questionnaires, expert validation sheets, and N-Gain analysis to assess the media's validity and learning effectiveness. Statistical analysis, including the Paired Samples T-Test, was conducted using SPSS software.

Main Findings: The findings revealed that the volume card game achieved a high validity score of 91% according to expert evaluations, indicating that it is well-suited for classroom use. Furthermore, the game significantly improved student learning outcomes, as evidenced by the Paired Samples T-Test results ($p = 0.000$) and an N-Gain score of 0.7575, which falls in the high category. Positive feedback was overwhelming, with 98.6% of students reporting that the game was engaging, enjoyable, and effective in fostering their understanding of volume concepts.

Novelty/Originality of this study: This study introduces an innovative combination of interactive learning tools and cooperative learning strategies, addressing the challenges of teaching abstract mathematical concepts. By merging gamification with collaborative learning, the volume card game provides an engaging and practical approach to enhance motivation and deepen conceptual understanding. The novelty of this research lies in its dual focus on integrating educational games with cooperative learning and demonstrating its scalable potential for application in broader mathematical topics and academic contexts.

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1. INTRODUCTION

Education is the cornerstone of national progress, equipping individuals with critical thinking, analytical skills, and creativity to navigate an increasingly complex world. In Indonesia, education is governed by Law Number 20 of 2003 on the National Education System, which mandates equitable access to quality education for all citizens while emphasizing the importance of innovative and adaptive teaching methodologies [1]. This legal framework aligns with the principles enshrined in the 1945 Constitution of Indonesia, affirming

education as a fundamental human right. Through education, individuals are expected to develop not only academic competence but also character, creativity, and the ability to contribute meaningfully to society.

Mathematics is a key discipline that plays a pivotal role in fostering logical reasoning, analytical thinking, and problem-solving skills across all educational levels. Nainggolan et al, highlights mathematics as essential for enhancing intellectual abilities and addressing technological challenges [2]. However, the implementation of mathematics education often falls short of expectations due to monotonous teaching methods, lack of engagement, and the predominance of conventional, teacher-centered approaches. These challenges hinder students' ability to think critically and develop a profound understanding of mathematical concepts, leading to low motivation and suboptimal learning outcomes.

One area where students particularly struggle is in understanding the concept of the volume of geometric solids. Mastery of this concept is essential for developing spatial reasoning, a critical component of mathematical thinking. However, factors such as the abstract nature of the material, lack of effective teaching methods, and insufficient use of learning media contribute to students' difficulties. Observations at elementary school Jogorogo 1 Ngawi revealed that Grade 4 students exhibit low comprehension of the volume of geometric shapes, as evidenced by poor performance on evaluations and tests. This issue is compounded by limited student interest and motivation, as well as the use of less interactive and monotonous teaching methods.

Previous research underscores the potential of teaching aids and interactive learning models to address these challenges. For instance, Maharani and Nugroho, demonstrate that using concrete objects, such as unit cubes, enhances students' understanding of volume concepts [3]. Similarly, Hidayah et al, report that constructivist approaches and interactive media significantly improve student engagement and comprehension of geometric volume [4]. These studies suggest that innovative, hands-on methods can effectively overcome obstacles in learning abstract mathematical concepts. One promising approach to enhancing mathematics education is the Make A Match learning model, developed by Lorna Curran. This cooperative learning strategy involves matching question and answer cards, encouraging students to actively engage with the material while fostering collaboration and critical thinking [3]. The interactive and gamified nature of the Make A Match model has been shown to increase student motivation and facilitate deeper understanding of concepts [5], [6].

Additionally, the integration of Volume Card games into this learning model offers a creative and effective way to teach the concept of geometric volume. Volume Card games involve students solving problems or completing challenges related to the volume of solids through visualization and hands-on activities. Combining Make A Match with educational games significantly enhances students' conceptual understanding and motivation compared to traditional methods [7], [8]. These strategies provide students with opportunities to actively practice and apply their knowledge in an engaging and interactive manner.

While existing studies highlight the effectiveness of Make A Match and educational games in improving student outcomes, there is limited research on their combined application in the context of teaching geometric volume concepts to elementary school students. Furthermore, few studies explore the specific challenges faced by Indonesian students, particularly in rural settings like elementary school Jogorogo 1 Ngawi. This gap in the literature presents an opportunity to investigate the effectiveness of the Make A Match model, integrated with Volume Card games, in enhancing students' motivation and understanding of the volume of geometric solids.

This study aims to: Evaluate the effectiveness of the Make A Match learning model in improving Grade 4 students' understanding of the volume of geometric solids. Explore the role of Volume Card games as a supplementary learning tool in enhancing students' motivation and engagement, and Identify the challenges and opportunities associated with implementing interactive learning strategies in rural elementary schools. This research is expected to contribute to the development of innovative teaching strategies that address the specific needs of elementary school students in understanding abstract mathematical concepts. By combining the Make A Match learning model with Volume Card games, this study seeks to provide practical insights for educators and policymakers on improving the quality of mathematics education. The findings will not only benefit students at Elementrary school Jogorogo 1 Ngawi but also inform broader efforts to enhance interactive and effective teaching practices in similar educational contexts.

2. RESEARCH METHOD

In this study, a development research method was used, known as R&D (Research and Development). According to Rumetna et al, the RnD method is an important tool used in studies aimed at improving the system [9]. The development model used in research and development is the ADDIE model (analysis, design, development, implementation, evaluation). Sezer et al. quoted in Rayanto and Sugianti, explained that the ADDIE model involves an analysis of the relationships between parts that coordinate with each other with the various stages that exist [10]. This is an illustration of a learning media development model based on the theory put forward by Robert Maribe Branch, which adopts the ADDIE model (analysis, design, development, implementation, evaluation) [11].

The subjects of this study consisted of 6 students selected using purposive sampling techniques for small-scale product trials, and 27 students for large-scale trials, which also constituted the population of grade 4 students. The independent variable in the study was the use of volume card games through the make a match learning model, while the dependent variables were student motivation and learning outcomes. The research procedure was carried out by developing a volume card game using the make a match learning model on spatial geometry material. This development process focused on assessments aimed at evaluating the success of the product through teacher response assessments, which were then used as the main benchmark in measuring the effectiveness of the development results.

Analysis of teacher and student needs surveys using the Guttman scale consisting of yes or no answer choices. The range of values on this scale is 1 for yes and 0 for no.

$$P = \frac{\Sigma x}{\Sigma xi} \times 100 \ldots (1)$$

Description:
P : Percentage score
Σx : Total score of respondents' answers in one item
Σxi : Total ideal score in one item

Table 1. Teacher and Student Needs Questionnaire Criteria

Percentage (%)	Criteria
80 – 100	Strongly agree
60 – 80	Agree
40 – 60	Less agree
20 – 40	Disagree
0 – 20	Strongly disagree

Analysis of teacher responses using a Likert scale consisting of five categories, namely 1 (strongly disagree), 2 (disagree), 3 (quite agree), 4 (agree), and 5 (strongly agree).

$$\text{V – pg} = \frac{TSe}{TSh} \times 100\% \ldots (2)$$

Description:
V-pg : User Validation
Tse : Total empirical score achieved
TSh : Total expected score

Table 2. Teacher response questionnaire criteria

Score (%)	Validation Category
85 – 100	Strongly agree
69 – 84	Agree
53 – 68	Less agree
37 – 52	Disagree
20 – 36	Strongly disagree

The student response questionnaire to the media used the Guttman scale with 2 answer choices, namely a score of 1 (agree) and a score of 0 (disagree).

$$\text{V – pg} = \frac{TSe}{TSh} \times 100\% \ldots (3)$$

Description:
V-pg : User Validation
TSe : Total empirical score achieved
TSh : Total expected score

Table 3. Student response questionnaire criteria

Score (%)	Validation Category
81 – 100	Very interesting
61 – 80	Pull
41 – 60	Quite interesting
21 – 40	Less attractive
0 – 20	Unattractive

The effectiveness of student learning outcomes can be analyzed through cognitive learning outcomes by calculating the scores obtained by students and testing the results before treatment (pretest) and after treatment (posttest). Initial data analysis involves a normality test. The normality test is used in this study to determine whether the data is normally distributed or not. According to Ghozali, the normality test is very important

because normally distributed data can be used for more accurate and representative parametric statistical testing of the population [12]. In this study, researchers used the Kolmogorov-Smirnov normality test through SPSS version 22 software to ensure whether the data meets the criteria for normal distribution or not.

Table 4. Normality Test Criteria

Results	Description
If the significance value is 0.05≤	Ho was rejected
If the significance value > 0.05	Ho accepted

The final data analysis includes paired samples test, T-Test test, and N-Gain test. The Paired Samples T-Test test is conducted to test the difference in means between two paired samples. According to Ghozali, the paired sample test is used on samples involving the same subject but given two different treatments, such as before and after treatment [12]. In this study, the researcher used SPSS version 22 software to analyze the pretest and posttest results using the paired samples t-test. This test can be applied to normally distributed parametric data.

Table 5. Paired Samples T-Test Testing Criteria

Results	Description
If -t calculate -t table or ≥ t calculate t table≤	Ho was rejected
If -t calculate -t table or < t calculate t table>	Ho accepted

Table 6. Decision Making Based on the Significance of the Paired Samples T-Test

Results	Description
If the significance value is 0.05≤	Ho was rejected
If the significance value > 0.05	Ho accepted

Furthermore, gain index analysis is used to calculate the increase between pretest and posttest scores. In this study, the gain in question is the normalized gain (N-Gain). N-Gain is the normalization of the increase obtained by comparing the difference in pretest and posttest scores with the difference in the ideal maximum score (SMI) and the pretest score. This N-Gain calculation is used to evaluate student learning outcomes in mathematics after the volume card game through the make a match learning model on the volume of geometric shapes.

$$\mathrm{N-Gain} = \frac{\text{Score posttest} - \text{score pretest}}{\text{Score maximal} - \text{score pretest}} \ldots (4)$$

Table 7. Average Gain Test (N-Gain)

Interval	Criteria
N-Gain ≥ 0,7	Tall
0,3 ≤ N-Gain ≤ 0,7	Keep
N-Gain < 0,3	Low

3. RESULTS AND DICUSSION

Development of volume card game through make a match learning model on volume material of spatial shapes using ADDIE model. ADDIE model is an abbreviation of five stages in the development process, namely analyze, design, development, implementation, and evaluation.

3.1. Analyze

At this stage, the researcher conducted an analysis of student needs through observation, interviews, and distributing questionnaires on student and teacher needs. Based on the results of observations and questionnaires, it was found that grade 4 students had difficulty understanding the concept of volume of geometric shapes, especially in applying formulas and performing calculations. This is due to the limited variety of learning media used and the low motivation of students in participating in learning. In addition, teachers also face obstacles in creating interactive and interesting learning methods for students.

Table 8. Results of teacher and student needs questionnaire.

Subject	Result (%)
Teachers	98.4
Students	93.0
Average	95.7

Table 8 shows the results of the distribution of teacher and student needs questionnaires. Based on the assessment results, the results obtained were an average of 95.70%. These results are important evidence that underlies the development of volume card games through the make a match learning model to improve student motivation and learning outcomes. One of the main factors that became an obstacle was the lack of variation in learning media used in the teaching and learning process, which caused students to feel difficult and less interested. In addition, low student motivation in learning was also a major problem, which influenced their low understanding of the material. Based on the results of the questionnaire given to students and teachers, it was found that 95.70% of respondents stated that more interactive and interesting learning media were needed to support mathematics learning, especially in understanding the concept of volume of geometric shapes. This shows an urgent need to develop more innovative learning methods, which can arouse students' interest and involvement more actively in the learning process.

3.2. Design

The development of a volume card game using the Make a Match learning model is an effective solution. This approach allows students to learn directly through interaction with the material, which can improve their understanding in a more fun and efficient way. With the Make a Match method in the volume card game, students are given the opportunity to work together to complete challenges, which makes it easier for them to remember and understand the concept of the volume of spatial figures in a more real and interesting way. This finding is in line with Rahmaputri's research, which states that the use of interactive learning media can significantly increase student engagement [13]. Interactive media provides opportunities for students to participate more actively in learning, not only as recipients of information, but also as active participants in the learning process. This approach supports a deeper understanding and accelerates mastery of the concepts taught. At this planning stage, the development of learning media in the form of a volume card game with the make a match learning model was designed to increase students' motivation and understanding of the concept of spatial figures. This stage begins with creating a card design using the Canva application, which is used to create an attractive card display that is easy for students to understand.

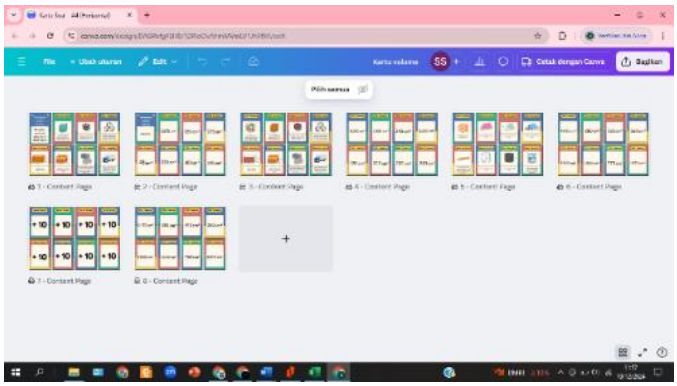

Figure 1. Volume Card Design

3.3. Development

The development stage begins with the creation of learning media in the form of a volume card game using the Canva application to produce an attractive design that suits students' needs. After the design is complete, the cards are printed through a printing house to ensure good print quality, so that the resulting cards can be used optimally in learning.

Figure 2. Volume Card

After the printing process, the learning media was validated by expert validators, consisting of lecturers of learning media development courses and lecturers of mathematics education courses. Validation was carried

out to ensure that the material on the card was in accordance with the curriculum, easy to understand, and effective in helping students understand the concept of volume of spatial figures. In addition, the validator also assessed the visual aspects and appeal of the media. The validation results were used to revise and improve the media before being applied in learning.

Table 9. Results of media and material validity tests

Validator	Percentage score	Criteria
Media	90%	Very valid
Material	92%	Very valid
Average	91%	Very valid

Table 9 shows the results of the validation of materials and media by expert validators. Media scored 90% (Very Valid), materials 92% (Very Valid), with an average score of 91% (Very Valid). These results indicate that the materials and media meet the eligibility standards and are ready to be used in learning. This success shows that the developed volume card game can be applied effectively to support mathematics learning, especially in understanding the concept of volume of spatial figures. This finding is in line with Gosachi's research, which found that Make a Match-based picture card media can significantly improve students' understanding [14]. In his research, Gosachi stated that game-based learning media with visual and interactive elements can attract students' attention, and help them understand the material in a more fun and memorable way. This approach has proven effective in helping students overcome difficulties in understanding more complex concepts, such as the volume of spatial figures.

3.4. Implementation

In the implementation stage, learning media in the form of volume card games were applied in learning activities in class 4 of Elementary school Jogorogo 1 Ngawi. The process began with a pretest to measure students' initial understanding of the concept of volume of geometric shapes. After that, the teacher introduced the rules of the game and learning steps using the make a match model. Students were grouped into four groups to increase interaction and cooperation.

During learning, students were invited to match question cards with the appropriate answer cards, so that they could understand the concept of volume of geometric shapes actively and enjoyably. Researchers monitored activities, provided guidance, and ensured that all students were actively involved in learning. After the activity was completed, students were given a posttest to evaluate their increased understanding of the material taught. Data from the pretest and posttest were used to analyze the effectiveness of the developed learning media.

In this stage, data analysis includes three stages. The first stage is the analysis of initial data, which is carried out with a normality test to ensure the distribution of pretest and posttest data is normal. The second stage is the analysis of final data using the Paired Samples T-Test to determine significant differences between the results of the pretest and posttest. The third stage is the analysis of the average increase with the N-Gain test to measure the effectiveness of learning media in improving students' understanding of the concept of volume of geometric shapes.

Normality test

Table 10. Normality Test Results in Large Group Tests

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre	0.130	27	.200*	0.962	27	0.415
Post	0.140	27	0.186	0.950	27	0.216

Initial data analysis was conducted to determine whether the pretest and posttest data were normally distributed. This normality test is important to determine the type of statistical test that is appropriate for the next stage. If the data is normally distributed, then the analysis can be continued with a parametric test, such as the Paired Samples T-Test. The normality test is conducted using the significance value (p-value), where the data is considered normally distributed if the p-value> 0.05.

Table 10 shows the results of the normality test in the large group test activity. Based on the table output in the Shapiro-Wilk sig column, the value before treatment was 0.415 > 0.05, and the value after treatment was 0.216 > 0.05. Both values are greater than 0.05, so it can be concluded that the data before and after treatment are normally distributed. Thus, the requirements for conducting a paired sample t-test have been met. Because the results of the normality test show normally distributed data, the t-test can be carried out. The results of the t-test were obtained from data before and after treatment processed through SPSS 22.

Paired Samples T-Test (Paired t-Test)

Table 11. T-Test Results on Limited Trials

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-Post	-35,926	8,090	1,557	-39,126	-32,725	-23,074	26	,000

After ensuring that the data is normally distributed, the analysis is continued with the Paired Samples T-Test to test whether there is a significant difference between the pretest and posttest results. This test aims to evaluate the effectiveness of learning media in improving student understanding. The results of this test are seen from the significance value (p-value). If the p value <0.05, then there is a significant difference between the pretest and posttest results.

Table 11 shows the results of the t-test in the large group experiment. The criteria for testing the paired sample t-test are if the sig value (2-tailed)> 0.05, then there is no significant difference between the pretest and posttest results. In the table, the sig value (2-tailed) is 0.000 <0.05, so it can be concluded that there is a significant difference between the pretest and posttest results in the large group. Thus, the volume card game through the make a match learning model can improve student learning outcomes in the volume of geometric shapes.

Average Gain Test (N-Gain)

Table 12. N-Gain test results in large group trials

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain	27	0.4000	1.0000	0.7575	0.1485
Valid N (listwise)	27				

N-Gain analysis is used to measure the average increase in student learning outcomes after using learning media. N-Gain is calculated by comparing the pretest and posttest scores. N-Gain results are categorized as low (0.00 - 0.30), medium (0.31 - 0.70), or high (> 0.70). This analysis provides an overview of the extent to which learning media contributes to improving students' understanding of the concept of volume of geometric shapes.

The results of the N-Gain analysis in table 12 show that the average increase in student learning outcomes is 0.75, which is included in the high category. This shows that the volume card game through the make a match learning model is effective in improving students' understanding of the material on volume of geometric shapes. This increase shows that students experience significant understanding after using the learning media. With a high average N-Gain, it can be concluded that the learning media used has succeeded in encouraging increased motivation and student learning outcomes in the material being taught.

3.5. Evaluation

In the evaluation stage, to get a deeper picture of the success of the volume card game through the make a match learning model, a media response questionnaire was given to class teachers and students. This questionnaire was designed to assess several important aspects, such as the practicality of using the media in learning, the level of student involvement during the teaching and learning process, and the effectiveness of the media in helping students understand the concept of the volume of geometric shapes. In addition, this questionnaire also aims to evaluate the extent to which this media can facilitate interaction between students and materials, and how the media is received by students and teachers in a broader learning context. By collecting feedback from both parties, namely teachers who provide professional perspectives on the appropriateness and effectiveness of the media, and students who provide their personal views on their learning experiences, it is hoped that comprehensive information can be obtained regarding the extent to which this media contributes to increased motivation, conceptual understanding, and a more enjoyable and interactive learning experience.

Table 13. Teacher Response Questionnaire Results

Class	Results
Teacher of class 4	94%

Table 13 shows the results of the questionnaire responses given to class teachers regarding the use of volume card games through the make a match learning model. Based on the results of the questionnaire, 94% of

teachers gave a positive assessment of this media. Teachers stated that this media is very effective and worthy of use in learning, because it can help students better understand the concept of volume of geometric shapes and increase their involvement in the learning process.

Table 14. Student Response Questionnaire Results

Class	Sum	Results
Class IV	27 students	98,60%

Table 14 shows the results of the student response questionnaire on the use of the same media. The results of the questionnaire show that 98.6% of students felt very interested and enthusiastic during the use of the volume card game in learning. Students expressed that this media made learning more fun and easier to understand, and increased their motivation to learn the concept of volume of geometric shapes in a more interactive way.

In the implementation stage, large group trials showed a significant increase in students' understanding of the concept of volume of geometric shapes. Analysis of pretest and posttest data using the Paired Samples T-Test produced a significance value of 0.000 (<0.05), indicating that the use of volume card games can significantly improve students' learning outcomes. This confirms the effectiveness of the media in helping students understand mathematics materials, especially the concept of volume of geometric shapes, in a more interesting and interactive way. In addition, the N-Gain test analysis showed an average increase in students' understanding of 0.7575, which is included in the "high" category, indicating significant progress in students' understanding after using the learning media. In addition, 98.6% of students gave positive responses to this learning media, stating that this media was not only interesting but also helped them understand the material more easily and enjoyably. These findings support the conclusion that game-based learning media can increase student motivation and facilitate a more effective learning process. Therefore, the volume card game has proven to be a very effective tool for improving students' understanding of the concept of volume of geometric shapes.

This study highlights the integration of interactive learning media, particularly volume card games, within constructivist learning theories and cooperative learning models. The results demonstrate that these media significantly improve students' motivation, engagement, and learning outcomes. This aligns with the constructivist theory, which underscores the importance of active student involvement in constructing knowledge through direct experiences, interactions, and reflections [15]-[19]. The findings also reinforce the effectiveness of the Make a Match cooperative learning model, which enhances collaboration and social skills while fostering deeper understanding of mathematical concepts [20]-[24]. These results are further supported by previous research, which confirms the role of interactive media in improving educational outcomes, promoting engagement, and creating an enjoyable learning environment.

The use of volume card games aligns with the constructivist approach by enabling students to actively engage in their learning process. Constructivist theory posits that knowledge is constructed through experiences, exploration, and reflection, rather than passive reception [25]-[27]. The interactive nature of volume card games allows students to manipulate and explore geometric volume concepts, fostering deeper comprehension and retention. By encouraging hands-on activities, reflection, and peer discussions, this approach transforms abstract mathematical concepts into tangible learning experiences. The study thus confirms that interactive media designed with constructivist principles can serve as a catalyst for improving both learning outcomes and student engagement.

The Make a Match cooperative learning model, when paired with interactive media, enhances both cognitive and social development. The structured collaboration inherent in Make a Match not only supports teamwork but also facilitates knowledge exchange among students, enriching their learning experience [28]-[30]. Furthermore, the competitive and interactive elements of the model increase student motivation, encouraging active participation in the classroom. This combination of volume card games and Make a Match creates a dynamic learning environment that supports diverse learning styles and fosters both individual and group achievements.

Previous studies corroborate the findings of this research, emphasizing the value of interactive media in education. Rahmaputri, demonstrated that game-based media positively influence learning outcomes, engagement, and comprehension [13]. Gosachi, highlighted the success of Make a Match-based picture card media in improving collaboration and problem-solving skills in mathematics [14]. Wulandari and Lestari, confirmed that gamified learning tools, such as Quizizz, boost motivation and enthusiasm, making learning more enjoyable and effective [31]. These studies collectively validate the potential of interactive learning media, such as volume card games, to transform traditional teaching methods into engaging, student-centered approaches. This study introduces a novel approach by combining interactive volume card games with the Make a Match cooperative learning model, providing a dual benefit: Improved cognitive outcomes through deeper understanding of geometric volume concepts. Enhanced social and collaborative skills through structured

teamwork and interaction. This combination leverages game-based learning principles and cooperative models, offering an innovative solution for addressing challenges in mathematics education.

Implications of this study are Enhanced Learning Experiences: The integration of interactive media transforms mathematics from an abstract subject into an engaging and hands-on learning experience, improving both motivation and comprehension. Social Skill Development: The cooperative nature of the Make a Match model fosters teamwork, communication, and problem-solving abilities, preparing students for collaborative environments. Curriculum Alignment: The study demonstrates how interactive media can align with curriculum goals, offering scalable solutions for improving educational practices in mathematics.

Limitations of this study are the research focuses on a specific mathematical concept (volume of geometric shapes), which may limit its generalizability to other topics or subjects. Implementing interactive media like volume card games requires adequate resources, such as teacher training, materials, and classroom time, which may not be universally available. The study does not extensively explore the effectiveness of this approach for students with diverse learning needs, such as those requiring additional support or accommodations.

Recommendations, Extend the use of interactive media and Make a Match models to other mathematical topics and subjects to evaluate their broader applicability and effectiveness. Develop digital versions of volume card games, integrating features like augmented reality (AR) or mobile apps to make the learning tool more accessible and interactive. Provide professional development programs to train educators in effectively implementing game-based and cooperative learning models in their classrooms. Adapt interactive media to accommodate diverse learning styles and abilities, ensuring all students benefit from this approach. Conduct Longitudinal Studies: Evaluate the long-term impact of using interactive media on students' academic performance, motivation, and skill development.

4. CONCLUSION

The research and development of volume card game learning media through the Make a Match model demonstrated its effectiveness in enhancing both student learning motivation and outcomes. The student response questionnaire yielded a score of 98.6%, placing it in the “very interesting” category. This indicates that the interactive learning approach and engaging card design successfully increased student enthusiasm and participation during the learning process, fostering a fun and dynamic learning atmosphere. This motivated students to engage more deeply with the material and promoted a better understanding of mathematical concepts. Furthermore, the paired t-test analysis revealed a significant impact of the media on learning outcomes, with a sig value (2-tailed) of $0.000 < 0.05$ and an average N-Gain score of 0.75, classified as high. This demonstrates a substantial improvement in students’ understanding of the volume of geometric shapes, highlighting the media's efficacy as a valuable tool for grade 4 mathematics instruction.

These findings suggest that the integration of interactive and visually appealing educational tools, such as the volume card game, can greatly enhance students' motivation and comprehension in mathematics. Teachers are encouraged to adopt similar approaches to create engaging and effective learning environments that cater to young learners’ needs. Future research should explore the scalability of this media for other mathematical topics or grade levels, as well as its potential in addressing diverse learning styles. Additionally, studies could investigate how integrating digital elements into the card game might further enhance its interactivity and appeal, providing insights into the role of technology in modernizing traditional educational tools. Such efforts could contribute to broader advancements in mathematics education, promoting active learning and improved outcomes across various contexts.

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