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Board Games and Numeracy Literacy: A Study on Their Influence on Learning Outcomes in Islamic Junior High Schools

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ABSTRACT

This study aims to determine the effect of Kometika, a board game, on media and numeracy literacy, as well as its impact on the learning outcomes of students whose scope is limited to Madrasah Tsanawiyah. There are some problems related to numeracy literacy learning in Islamic schools (madrasahs), some of which are the result of Asesmen Kompetensi Madrasah Indonesia (AKMI) and the low interest in numeracy literacy, which affects the low learning output. The research method employed was a quantitative experiment utilizing treatment-by-level designs. The findings showed that the average scores of students who studied using the Kometika board game media were higher than those of students without the Kometika board game media. The numeracy literacy interest of students who studied using the Kometika board game media was higher than that of those who studied without it. There was an interaction effect between the use of Kometika board game media and students' interest in numeracy literacy in relation to the learning outcomes. This means that Kometika board game media and numeracy literacy interest are interdependent and affect learning outcomes; therefore, support from related stakeholders, such as the head of the madrasah and teachers, is urgently needed. This study makes a significant contribution to the field of educational media and numeracy literacy, particularly within the context of Islamic education institutions. The research expands current pedagogical strategies aimed at improving numeracy skills among Madrasah Tsanawiyah students.

ARTICLE INFORMATION

Keywords:
kometika board game; number content, interest; numeracy literacy

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INTRODUCTION

The quality of a nation's human resources plays a vital role in its overall development. One effective approach to enhancing human resource quality is to provide education that cultivates learning and innovation skills, fosters proficiency in information and communication technology and equips students with essential life skills necessary for effective collaboration and adaptability in various contexts (Mantiri, 2019; Rosyadi et al., 2021; Rodhi, 2021; Erniwati, 2022). Mathematics is a universal science that has a profound impact on the lives of every student, particularly in shaping their attitudes and creative thinking patterns (Awalia et al., 2019; Mustakim, 2020; Atih, 2021; Yantoro et al., 2022). Learning mathematics inherently involves performing calculations and understanding mathematical structures. Therefore, one of the primary objectives of mathematics education is to develop students' ability to communicate mathematical ideas effectively through the use of symbols, tables, diagrams, or other appropriate media, thereby clarifying situations and solving problems more efficiently (Qohar & Fazira, 2022; Syaiful et al., 2021).

Mathematics is a field of study taught in formal education institutions, which is an important part of efforts to improve the quality of education (Perdana & Suswandari, 2021; Atih, 2021). In mathematics learning, high-order thinking skills become one of the essential aspects. Learning mathematics depends on a person's cognitive structure, resulting in differences in mathematical knowledge among individuals (Tanujaya et al., 2017; Umbara & Suryadi, 2019). The process of thinking mathematics is active, involving investigation, justification, exploration, drawing, construction, use, explanation, development, and proof, which occurs in a socially interactive and reflective manner (Szabo et al., 2020; Trigo, 2024). However, students' difficulties in learning Mathematics are generally related to the less varied teaching methods employed by teachers in class (Jatiningtyas et al., 2022; Ibad, 2024).

This skill can be measured through high-order thinking skills (HOTS) based assignments, such as those in the Programme for International Student Assessment (PISA). The PISA survey indicates that Indonesian students lack mathematical literacy (Abidin et al., 2015). This aligns with research that suggests PISA is specifically designed to develop high-order thinking skills (Wardani et al., 2017; Mangelep & Kaunang, 2018; Muzaki & Masjudin, 2019; Ayuningtyas & Sukriyah, 2020). Meanwhile, according to the results of PISA in 2015, the mathematics literacy skills of students in Indonesia ranked 63 out of 72 countries, and in 2018, Indonesian students ranked 72 out of 79 countries. According to the test results, the average scores for students are 371 in reading, 379 in mathematics, and 396 in science. The result falls below the average of 79 PISA member countries, specifically 487 for reading skills and 489 for mathematics and science (Kusumawardani, 2018; Schleicher, 2018; Hewi & Shaleh, 2020; Rodhi, 2021; Siregar, 2022). Based on this fact, the numeracy literacy of students in Indonesia remains low and urgently needs improvement.

The PISA model implemented in Indonesian madrasas is the Indonesian Madrasah Competency Assessment (AKMI). Among the competencies assessed by AKMI is numeracy proficiency. Literacy activities in Indonesia aim to equip students with the competencies necessary to form literate citizens, encompassing both literacy and numeracy (Rakhmawati & Mustadi, 2022; Marhami et al., 2024). Numerical literacy is a reasoning skill that enables individuals to use symbols or mathematical language in everyday life and express it through writing or orally (Sriyatun et al., 2018; Abidin et al., 2021). Numerical literacy is the knowledge and ability to apply various numbers and symbols related to basic mathematics to solve problems in everyday life and then analyze information and interpret the results to predict and make decisions. The synthesis of the notion of numeracy literacy is a skill that a person possesses, involving the application of mathematical concepts, procedures, and tools to solve everyday problems.

The development of numeracy literacy aims to ensure that students are not merely equipped with formulas and computational skills for problem-solving but are also encouraged to apply reasoning, analytical thinking, and problem-solving abilities throughout the learning process. This approach enables individuals to make informed decisions based on constructive and logical-mathematical thinking patterns (Sriyatun et al., 2018; Rodhi, 2021; Syaifuddin, 2022; Kumar & Behera, 2022; Rakhmawati & Mustadi, 2022). A person with good numeracy skills can manage and respond to life's demands and vice versa. Students who possess good numeracy skills can understand, reason, and analyze problems effectively (Rohantizani et al., 2022; Marhami et al., 2024). Numeracy should be treated as an essential skill on par with literacy (Dion, 2014). This means that numeracy literacy is critical for students to master because it relates to the ability to think processes in acquiring knowledge.

Furthermore, numerical literacy uses mathematical concepts, facts, procedures, and instruments to solve practical problems. The numeracy literacy curriculum includes, among other topics, numbers, algebra, geometric, and statistical data. Students require numeracy as one of the

fundamental skills for success in life. Numerous views support this. One of which is from Stacey and Turner (2014), which states that numeracy literacy skills are needed in every aspect of life. This aligns with Perdana and Suswandari (2021), who suggest that to solve practical problems in everyday life, students must possess numeracy literacy skills, as the literacy culture in Indonesia remains low, not yet entrenched, and not yet ingrained in society. Even though mathematical numeracy literacy encompasses mastery of the material and the use of reasoning, concepts, facts, and mathematical tools to solve everyday problems, it is not limited to mere mastery of the material. Additionally, mathematical literacy requires communicating and explaining mathematical phenomena encountered (Kusumawardani, 2018; Muzaki & Masjudin, 2019; Mahmud & Pratiwi, 2019).

One of the important applications of numeracy literacy in everyday life is evident in activities such as buying and selling. The series of buying and selling processes carried out by sellers and buyers requires the application of mathematics to solve problems. If the seller or buyer cannot apply mathematics correctly, they will suffer a loss. It shows that numeracy literacy skills are important for students to support their lives, ideally balanced with good numeracy literacy skills. However, what happens is that students' numeracy literacy remains low. The acquisition of the AKMI 2021 numeracy literacy results indicates that 72% of students require assistance, 27% are at the basic level, and only 1% of students are skilled. It means that students' numeracy literacy skills need serious attention. The results show that most of the students' abilities do not meet the standards because the level of proficiency is still at the basic level and requires assistance. Some studies indicated that the age of students influences their numeracy skills. Some studies indicated that the age of students influences their numeracy skills. The shift from Mathematics to numeracy, of course, has caused a shock for both students and teachers (Kusaeri et al., 2022).

The low numeracy literacy of students must be weighed against the teacher's efforts to continue improving the quality of learning based on numeracy literacy. According to the findings, the following factors were responsible for these issues: 1) the teacher did not have a special method for numeracy literacy-based learning, 2) only provided numeracy literacy-based practice questions during evaluation, 3) made special preparations only when approaching ANBK or AKMI, and 4) provided question material that adheres to the school handbook (mostly routine questions) but does not practice higher-order thinking skills. As previously stated by Siregar (2022), the implementation of literacy learning in schools has not been maximized; for example, they still use makeshift teaching materials, and there is no specific method for teaching numeracy literacy. Various studies indicate that learning numeracy literacy in schools remains less effective (Sriyatun et al., 2018; Ekowati et al., 2019; Naziliati et al., 2022). According to Mangelep and Kaunang (2018), students are accustomed to solving traditional questions that focus on completing standard, abstract procedures unrelated to their daily lives. Therefore, questions that require mathematical reasoning, such as those on the PISA, will be difficult for Indonesian students to solve.

Multiple other findings indicate that the aforementioned issues are influenced by students' lack of interest in numeracy literacy. Conditions in the field were identified when students were asked to answer questions requiring higher-order thinking skills, such as: 1) Many students complained, 2) only intelligent students wanted to complete the questions, 3) some students rested their heads on the table, and 4) the work on the questions was not completed in a single meeting despite there being only three questions, for example. Even though students' interest in learning and the learning process is low, it has a significant impact on their academic performance (Prastika, 2021; Rodhi, 2021). Rahmawati and Hidayati (2022) reinforce the notion that monotonous learning without involving students will affect students' learning interests.

To overcome these obstacles, teachers must develop learning materials that foster a conducive environment for numeracy literacy instruction, thereby enhancing student interest in numeracy

literacy and learning outcomes. The significance of learning media in promoting a conducive learning environment, stimulating interest in learning, and improving student learning outcomes is significant (Mustika, 2015; Widodo & Wahyudin, 2018; Puspitarini & Hanif, 2019; Ikhsan et al., 2019). This is why learning media is one of the essential components for affecting student learning outcomes. Videos, used goods, and YouTube content are among the media used to teach numeracy literacy. In the form of a board game known as Kometika, the author created an innovative tool for numeracy literacy learning.

As its name suggests, Kometika is a Kometika-based board game. Board games are placed or moved on a surface marked or divided according to rules that can train players to predict transient results and detect patterns that exist in the media as a model or aid in learning (Widiyanto & Yunianta, 2021). Games are based on a combination of strategy and chance and have specific goals to achieve. Another name for board games is board games. Kometika is short for arithmetic box. The Kometika board game falls under the category of educational games. Educational games are a form of educational activity carried out using educational game media that can improve student learning outcomes (Darmadi, 2018; Widiyanto & Yunianta, 2021). In addition, through the existence of this board game media, it is also hoped that teachers can be assisted in providing learning materials in the form of interesting and innovative exercises that can train higher-order thinking skills.

There are several reasons that Kometika board games train higher-order thinking skills that are synonymous with numeracy literacy. At the beginning of the game, the players divide the money equally among themselves. They are indirectly carrying out two calculation processes. The first is the summation, summing up all the existing money. The second is division, namely dividing the amount of money by the number of existing players. If it falls under the Bloom taxonomy, then it enters the C3 level, specifically the application level. When the player's pawn is in the shop box, the player is given a stimulus in the form of the price of the item on the "goods" card, along with the option to write a discount or pay value-added tax (VAT), or a fixed price on the "shop" card. Players must be able to determine how much money to spend. Not only that, players need to review the remaining money and decide which bills to issue and how much to issue. If in bloom taxonomy, then enter level C4, namely analyzing.

Apart from these two things, another reason why a Kometika board game can train higher-order thinking skills is when the player's pawn is in the market box, the player is given a stimulus in the form of several prices of goods on the "goods" card, and written profit percent, loss percent or break-even on the "goods" card. Players must be able to determine the total price of the overall item and then calculate the percentage of profit or loss. The player who acts as a guard needs to see the remaining money and decide which bills to issue and how much of each. If in bloom taxonomy, then enter level C4, namely analyzing. Then, when the player's pawn is in the free market box, the player has two choices. Whether to sell all items or buy, he needed to see how much money was left. He must make a decision. If you decide to sell, the steps are the same as when in the market box. If you decide to buy, the steps are the same as when in the storage box. In the Bloom taxonomy, it reaches the C5 level, namely evaluation. Therefore, Kometika board game media is implemented in mathematics learning, focusing on number content to improve student learning outcomes. Likewise, students interested in numeracy literacy will be enthusiastic about the scores obtained, and vice versa. If interest is low, students tend not to pay attention to the value of the lesson (Rohantizani et al., 2022). The results of implementing the Kometika board game media and numeracy literacy initiatives can impact student learning outcomes.

Recognizing the effect of Kometika board game media and interest in numeracy literacy on students' learning outcomes in learning Mathematics, especially in the context of numbers at Madrasah Tsanawiyah, it is important to study this problem further to prove the hypothesis: 1) is

there a difference in learning outcomes between students who study and Kometika board game media and without Kometika board game media; 2) whether there is an interaction effect between the use of Kometika board game media and interest in numeracy literacy on learning outcomes; 3) whether there are differences in groups of students who have a high interest in the learning outcomes of students who study with and without Kometika board game media; 4) whether there are differences in groups of students who have low interest in the learning outcomes of students who study with and without Kometika board game media.

METHOD

This study employs a quantitative research method with an experimental design, utilizing a treatment-by-levels approach. Specifically, a 2 × 2 factorial design is implemented to evaluate the effects of two interventions (A and B) compared to a control group. Participants are randomly assigned to one of four groups: control, intervention A only, intervention B only, or both interventions A and B simultaneously (White et al., 2024). Two-way analysis of variance (ANOVA) can be used to assess the main effects of group size and interactions between these variables (Haerling & Prion, 2020). This design was chosen to investigate the effect of the independent variables and their interaction with the attribute variable on the dependent variable. The independent variable is the use of the Kometika board game (A), which consists of two conditions: learning with the Kometika board game (A1) and learning without it (A2). The attribute variable is students' interest (B), which is categorized into high interest (B1) and low interest (B2). The dependent variable is students' learning outcomes (Y). This design allows for testing the main effects of the independent variable (A) and the attribute variable (B) on the dependent variable, as well as their interaction effect. Additionally, it enables an examination of the simple effects of each treatment condition (A1 and A2) at each level of student interest (B1 and B2). The design used is presented in Table 1.

Table 1. The design of experimental research

Interest	Learning to use a Kometika board game **(A_1)**	Without the use of a Kometika board game **(A_2)**
High	A_1 B_1	A_2 B_1
Low	A_1 B_2	A_2 B_2

The subjects used were Class 7 students at Madrasah Tsanawiyah Miftahul Huda, Bandung City, consisting of Class 7A as the experimental class and Class 7B, each with 35 students. The Kometika board game media is implemented in learning number content in Basic Competency 3.9 Class 7 curriculum 2013. The data collection techniques employed in this study consisted of tests and questionnaires. The test was used to determine the effect of the Kometika board game media on students' learning outcomes after treatment in the experimental class. In addition, a questionnaire was administered to measure students' interest in numeracy literacy, which encompassed the following indicators: (1) feelings of enjoyment during learning; (2) concentration of attention and thoughts on learning; (3) interest in learning activities; and (4) active involvement in learning. These indicators were operationalized into 36 statement items with four response options: always, often, sometimes, and never. The validity of the questionnaire was confirmed through content validity, as evaluated by five experts who deemed it valid. Reliability testing yielded a reliability coefficient ($\alpha = r_{11}$) of 0.993, which exceeds the accepted threshold of 0.70, indicating high reliability. The validated questionnaire was subsequently administered to the control class, which received instruction without

the Kometika board game media, and to the experimental class, which engaged in learning activities using the Kometika board game media.

The data analysis technique employed in this study uses inferential statistics, specifically an ANOVA test for a non-equivalent two-cell design and the Scheffé method for post hoc comparisons. Prior to the experiment, the mean equivalence of both the experimental groups and the control group was assessed to ensure the validity of the experimental results derived from the administered treatment. The balance test was conducted to examine whether the means of the experimental and control groups were equivalent, assuming that the samples were drawn from a population that is normally distributed and homogeneous.

RESULTS AND DISCUSSION

The Kometika board game is square in shape and contains small and large boxes containing pictures and writing. Each image and writing has its meaning and rules. The pictures and writings contained in the small squares of the game board include: 1) pictures of pointing hands and the words "start," 2) pictures of the soles of the feet and the words "excuse me," 3) pictures of buildings and the words "shop," 4) pictures of cards and words "surprise," 5) the words "3 steps forward", 6) the building pictures and the words "free market," 7) the kiosk pictures and the words "market," 8) the words "3 steps back", 9) the words "1x bonus throw ", and 10) the words “stay until the opponent passes 1 round”. In addition to the small box, there is also a large box labeled with the words "transaction tool," "surprise card," "store card," "goods card," and "market card." There is also extensive writing in the form of "Kometika" as the name of the game. The Kometika board game, which has been designed, measures 40 cm x 40 cm and comes with several items in one package. In addition to the game board, it is equipped with one dice and a dice shaker, four pawns, play money, and four types of cards. The cards consist of 10 shop cards, 10 market cards, 16 goods cards, and 10 surprise cards. This is illustrated in Figure 1.



Figure 1. Complete Package of Kometika Board Game

The Kometika board game in this study was implemented in Basic Competency 3.9 of Class 7 of the Madrasah Tsanawiyah Curriculum 2013. The rules of the Kometika board game that each player must follow are as follows: this game can be played by 2-4 people. Some act as players, while others act as guards. The player is responsible for moving the pawns and adhering to all the established rules. The guard is responsible for receiving money from all forms of transactions and issuing it to the players according to the rules, as well as shuffling the cards. Before playing, the players share the money equally among themselves and the guards. Next, the players choose which pawns to play while

the guard arranges the money and all the available cards in their respective places. For example, money is placed in the "transaction tool" box, shop cards in the "shop card" box, market cards in the "market card" box, surprise cards in the "surprise card" box, and goods cards in the "goods card" box. The cards are placed face down. The players and the guardians determine the length of time to play. All players place their checkers in the “Start” box. The guard draws lots of players to determine which player will play first.

Players who win the lottery will play first. Players start playing by rolling the dice and moving the checkers. If the die shows multiple dots, then the pawn moves three steps, and so on. If the player's pawn occupies the "PERMISSION" box, then the player passes. No consequences whatsoever. If the pawn occupies the "SHOP" box, then the player must buy one item by taking one "item card" and one "shop card." The item card contains the item name and price. On store cards, discounts are available, and VAT is either paid or a fixed price applies. For example, the player gets the following item card and shop card. The item card says "shirt for Rp. 150.000.00," and the shop card says "10% discount." This means that players have to buy a shirt that costs Rp. 150.000.00 but gets a 10% discount. So that, players have to pay Rp. 135,000.00 to the guard, and players are entitled to have one item card, namely a shirt. If the pawn occupies the "SURPRISE" box, then the player takes the "surprise card" and follows the directions. For example, the player gets the following surprise card.

If the player receives the card, they will receive IDR 40,000 from the guard. If the player's pawn occupies the "MARKET" box, then the player must sell all the item cards he has by taking the "market card" first. For example, a player has two item cards worth a total of IDR 200.000 and gets the following market card. If the player obtains the market card, they sell their two-item cards to the guard for Rp. 200.000.00 plus 10% profit, which is Rp. 20.000.00, for a total of Rp. 220,000.00. If the player's pawn occupies the "FREE MARKET" box, the player may buy one item card or sell all the cards they have. The terms of selling and buying are the same as those of selling in the market and buying in shops. The player with the most money at the end of the playing time is the winner. After playing, students work in groups to discuss the worksheet, which contains questions related to the game. After discussing, each group presented the results of their discussion, which were listened to by all students. Students create material resumes with teacher guidance, highlighting important points that arise during learning activities, and the teacher awards groups accordingly. The research data, based on the analysis of the prerequisite test and a normality test on the data group, are presented in Table 2.

Table 2. The normality test on the data group

Group	*Sig.*	L_{Count} (L_{obs})	L_{table} (L_t)	Description
A_1	0.05	0.092296	0.146	
A_2	0.05	0.099564	0.146	It is assumed that the sample originates from a normally
B_1	0.05	0.136982	0.153	distributed population.
B_1	0.05	0.080515	0.1405	

The test with the normality test in Table 2, namely: 1) data on student learning outcomes using the Kometika board game media (A_1) obtained $L_{0,05;35}$= 0.146 ;$DK = \{L_{obs}|L_{obs} > 0.146\}$; L_{obs} = 0.092296∉DK. The decision for the H_0 test is accepted, meaning that the sample is drawn from a population that is normally distributed; 2) data on student learning outcomes without using a board game Kometika media (A_2) obtained $L_{0,05;35}$= 0.146 ; $DK = \{L_{obs}|L_{obs} > 0.146\}$; L_{obs} = 0.099564∉DK. The decision for the H_0 test is accepted, meaning that the sample originates from a normally distributed population; 3) data on groups of students who have high interest (B_1) obtained $L_{0,05;32}$=

0.153; $DK = \{L_{obs} | L_{obs} > 0.153\}$; L_{obs} = 0.136982∉DK. The decision to reject the null hypothesis (H_0) indicates that the sample originates from a population that is not normally distributed.; 4) The group of students who have low interest (B_2) obtained $L_{0,05;38}$= 0.1405; $DK = \{L_{obs} | L_{obs} > 0.1405\}$; L_{obs} = 0,080515∉DK. The decision of the H_0 test is accepted, meaning that the sample comes from a normally distributed population.

Furthermore, a summary of the results of the homogeneity test for variance scores of students' learning outcomes using Kometika board game media (A1) and the group without using Kometika board game media (A2) is presented, along with the value of *Sig.* > 0.05. Where ${\chi^2}_{0,05;1}$ = 3.841 ;$DK = \{{\chi^2}_{obs} | {\chi^2}_{obs} > 3.841\}$. It means that the two groups are homogeneous, where there is no difference in variance between the two groups tested. Furthermore, testing the homogeneity of the variance of the two groups of research subject categories, namely the group of students who have high interest (B_1) and the group of students who have low interest (B_2), shows that the test data for homogeneity of variance group category attributes of research subjects B1 and B2 turns out to be *Sig.* > 0,05. Where ${\chi^2}_{0,05;1}$ = 3.841 ;$DK = \{{\chi^2}_{obs} | {\chi^2}_{obs} > 3.841\}$; ${\chi^2}_{obs}$ = 2.43515∉ DK. The results indicate that both groups are homogeneous, showing no significant difference in variance. The test of homogeneity of variance between the cell groups in the experimental design, specifically between A_1B_1 (students with high interest using the Kometika board game) and A_1B_1 (students with low interest using the Kometika board game), shows a significance value greater than 0.05 (Sig. > 0.05), confirming that the variances of these groups are homogeneous. Likewise, the homogeneity of variance test between A_2B_1 (students with high-interest learning without the Kometika board game) and A_2B_2 (students with low-interest learning without the board game in mathematics) also resulted in a significance value greater than 0.05 (Sig. > 0.05), indicating that these groups are homogeneous as well, with no significant variance differences between them.

The test is continued by testing the hypothesis with a 2-factor analysis of variance technique (Anova 2x2) with unequal cells for H_{0A} is $F_A = \frac{RKA}{RKG}$ which is the value of a random variable that has an F distribution with degrees of freedom p – 1 dan N – pq. For H_{0B} is $F_B = \frac{RKB}{RKG}$ which is the value of a random variable that has an F distribution with degrees of freedom q – 1 and N – pq. For H_{0AB} is $F_{AB} = \frac{RKAB}{RKG}$ which is the value of a random variable that has an F distribution with degrees of freedom (p – 1)(q – 1) and N – pq. The computational results are presented in Table 3.

Table 3. The Notation and Layout of 2 -way unequal cells Anova Data

Class		Interest	
		High	**Low**
Experiment	N	15	20
	T	1215	1330
	$\bar{X}$	81	66.5
	$\sum X^2$	100675	90850
	$\frac{T^2}{n}$	98415	88445
	SS	2260	2405
Control	N	17	18
	T	1130	1140
	$\bar{X}$	66.47	63.333
	$\sum X^2$	76850	73650
	$\frac{T^2}{n}$	75111.76	72200
	SS	1738.235	1450

Based on the results of the 2-way Anova calculation, it is obtained: 1) F_A;$DK = \{F_A | F_A > F_{0,05;1,66}\} = \{F_A | F_A > 3.988\}$; $F_A \in DK$; 2) for F_B;$DK = \{F_B | F_B > F_{0,05;1,66}\} = \{F_B | F_B > 3.988\}$; $F_B \in DK$; 3) for F_{AB}; $DK = \{F_{AB} | F_{AB} > F_{0,05;1.66}\} = \{F_{AB} | F_{AB} > 3.988\}$; $F_{AB} \in DK$. The conclusion of H_{0A} test is rejected, H_{0B} is rejected, and H_{0AB} is rejected. It means: 1) learning with Kometika board game media and without Kometika board game media produces different learning outcomes; 2) It is not true that learning with Kometika board game media and without Kometika board game media has the same effect on learning outcomes; 3) There is an interaction between the use of Kometika board game media and interest in numeracy literacy on learning outcomes. Briefly presented in table 4.

Table 4. The Summary of 2-way Anova Analysis

Variance Sources	JK	Dk	RK	F_{obs}	F_{α}
Factor A (Kometika board game media)	1355.364	1	1355.364	11.39	3.988
Factor B (Interest)	1346.369	1	1346.369	11.315	3.988
Interaction (AB)	558.8156	1	558.8156	4.696	3.988
Error	7853.235	66	118.9884		
Total	11113.78	69			

The analysis process is continued with a follow-up test (Scheffé test). For a comparison of the mean between rows, the H_{0A} decision was rejected. This means that learning with Kometika board games and without them has different learning outcomes. In this case, there is no need to make post-Anova comparisons between rows because there are only two variables. From the marginal average, it is evident that the learning average with the media of Kometika board games is higher than the learning average without the media of the board games. Thus, it can be concluded that learning with the media of board games has better learning outcomes compared to those without the media of board games.

Furthermore, the H_{0B} decision was rejected for the average comparison between columns. This means that students with high and low interest have different learning outcomes. In this case, there is no need to do post-anova comparisons between columns because there are only two variables. The marginal average shows that the average high interest rate is better than the low interest rate. This means that the group of students with a high interest in numeracy literacy has better learning outcomes compared to the group of students with a low interest. Meanwhile, for the comparative analysis of the mean between cells in the same row and column, it can be concluded that: 1) Learning with a Kometika board game media has the same learning outcomes as without a Kometika board game media for students who have low interest; 2) Learning with Kometika board game media has better learning outcomes than learning without Kometika board game media for those who have high interest; 3) Students who have high interest have better learning outcomes than those with low interest in learning with Kometika board game media; 4) Students who have high interest are the same as learning outcomes with low interest in learning without Kometika board game media.

The conclusion of the post-ANOVA follow-up test results, using the Scheffé test, indicated that the value of Fcount = 10.67 is greater than Ftable = 3.14 at a significance level of α = 0.05; therefore, H0 is rejected. It means that in groups of students with low interest, the learning outcomes of students who study with the Kometika board game media (A_1B_2) are better than those who study without the Kometika board game (A_2 B_2).

Mathematics is a cultural construct that includes symbolic systems, rigorous structure, rules, and artifacts. In mathematics education, game-based learning is considered a fundamental learning tool that can help students acquire conceptual knowledge (Sun et al., 2021; Papandreou & Tsiouli, 2022). When children engage with digital applications or media, they draw on multiple cognitive resources, including attention, comprehension, memory, and perspective-taking. Among these, attention serves as a fundamental prerequisite for the activation and effective use of higher-order cognitive processes (Wartella et al., 2018; Liu et al., 2021). Student characteristics play a crucial role in determining student engagement, and teachers must monitor engagement levels and draw informed conclusions about the underlying characteristics of their students (Manubey et al., 2021; Seidel et al., 2021; Kamid et al., 2021). Therefore, teachers need to understand their students' characteristics in order to design learning activities that are both appropriate and practical.

Learning with Kometika board game media yields higher learning outcomes than students who learn without it. Students with a high interest in numeracy literacy have better learning outcomes than those with a low interest in learning with Kometika board game media. Meanwhile, students with high interest have the same learning outcomes as those with low interest in learning, regardless of whether they use the Kometika board game media. Likewise, learning with the Kometika board game media is equivalent to learning outcomes without the Kometika board game for students with low interest. These findings indicate that Kometika board game media and interest in numeracy literacy are interdependent and affect learning outcomes in grade 7 number content learning at MTs Miftahul Huda.

This research aligns with previous studies, which have consistently demonstrated that board game media positively impacts learning outcomes, as noted by Nugroho (2021). With board game media, there are three aspects included: visual aspects (images), audio (discussions, questions, and answers), and affective (attitudes). These aspects can help train students' concentration and memory, enabling them to solve problems and think creatively and critically. Rahmawati and Hidayati (2022) state the advantages of Kometika board game media supporting numeracy literacy-based mathematics learning, namely: 1) the terms and pictures on board games and cards are very close to the lives of students, 2) when students play according to existing rules, students are actually learning, 3) the rules of the game in a Kometika board game are designed according to the mathematics

curriculum for MTs/equivalent students, 4) actively involve all students, 5) the learning process makes students the main actors of the activity, their involvement in the learning process determines academic success, 4) can played anytime and anywhere, not tied to class learning, and 5) practice higher order thinking skills based on taxonomy. This research is also consistent with Hasan et al. (2020), who found that the use of board game media is proven to make students actively involved in building their knowledge and understanding of a subject matter. Diana (2022) also demonstrates that the use of board game media can create a pleasant learning atmosphere, which in turn affects student learning outcomes.

Several previous studies have also demonstrated that interest influences learning outcomes. One of them is Avianto and Prasida (2018), which states that Board games can be used as a learning medium that fosters students' interest in learning. Mesta and Linda (2018) described how board games can be used as an interactive learning medium that can improve students' learning interests. Nurfaizah et al. (2021) and Nugroho (2021) found that board game media can improve students' learning interest and is effective for use in mathematics learning. Amalia and Mansoor (2021) stated that board games are effective as learning media to improve the learning level of students, especially in thinking more critically and processing the messages obtained from board games. Besides, Safitri (2020) notes that board game media is designed with rules that involve completing question cards to gain points, thereby encouraging each individual to compete for the win and fostering interest in learning.

The studies above demonstrate and support the idea that board game media and interest influence learning outcomes. This strongly supports the findings of this study, which suggest that teachers need the Kometika board game media to improve learning outcomes. Using media in mathematics learning can make students less bored and the class more active and dynamic (Yaftian & Barghamadi, 2022). Likewise, interest in numeracy literacy influences learning outcomes because it can make students feel engaged following well-structured lessons, maintain good attention, and find the material interesting to learn from. Darmadi (2017) stated that students who have high interest are shown through indicators: 1) focus, 2) feelings of pleasure when learning, and 3) willingness and tendency to be seen as active in learning and wanting to get the best results. Friantini and Winata (2019) also state that interest indicators are characterized by a feeling of pleasure in learning, a focus on and thoughts about learning, a willingness to learn, and an internal motivation to be actively engaged.

Meanwhile, Rohantizani et al. (2022) stated that students' interest in AKM numeration questions was characterized by a feeling of pleasure, attention, interest, and involvement in learning. Feelings of pleasure can encourage students to follow the lessons well obtained. Students who demonstrate a strong interest in numeracy literacy are more likely to maintain sustained attention during mathematics instruction. Similarly, students with a strong interest in numeracy literacy tend to demonstrate a sustained enthusiasm for learning. Moreover, students are more likely to develop a high level of numeracy literacy interest when they understand the relevance and benefits of numeracy in relation to their daily lives and the environment in which they live. This is crucial because numeracy is inherently contextual and closely connected to real-life situations encountered by students.

Although the implementation of the Kometika board game media and numeracy literacy demonstrates an effect on students' learning outcomes within the limited context of Madrasah Tsanawiyah, where religious education is prioritized, the findings nevertheless confirm that students in this setting possess a high level of literacy interest in learning mathematics, which positively influences their learning outcomes in numerical content. These results imply that teachers who incorporate board game media into their teaching achieve higher student learning outcomes compared to those who do not. Similarly, the greater the students' interest in numeracy literacy, the

higher their learning outcomes; conversely, lower interest in literacy corresponds with lower learning achievement. The next phase of this research will build upon these findings to develop a framework that positions the Kometika board game media as a mediating tool for enhancing mathematical literacy and supporting effective teaching practices. However, before this approach is widely implemented in Indonesian schools, it is important to assess its feasibility and necessity. For this initiative to succeed, at least two conditions must be met: first, teachers must have a clear understanding of the concept of mathematical literacy; second, the use of the Kometika board game media in classroom instruction must be practically feasible and supported within the teaching context.

CONCLUSION

The findings of this study indicate an interaction effect between the Kometika board game media and students' interest in numeracy literacy on learning outcomes. The Kometika board game media and numeracy literacy interest are interrelated and jointly influence students' academic performance. This is demonstrated by the difference in the average learning outcomes: students who learned using the Kometika board game media achieved higher mean scores than those who learned without it. Among students with high interest, the learning outcomes of those who used the board game media were higher than those of students who did not. The use of the Kometika board game enables students to understand numerical content more easily, makes learning more engaging and enjoyable, and ultimately improves learning outcomes. To ensure the broader implementation of the Kometika board game, support from various stakeholders, including school principals and teachers, is essential. If its use becomes widespread, students will have an alternative learning medium to enhance their numeracy literacy, particularly in mastering number-related content.

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