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The Impact of the Index Card Match Model on Mathematics Learning Motivation in Early Adolescence

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Abstract: The objective of this research was to examine whether the Index Card Match learning model influences the mathematics learning motivation of seventh-grade students at SMPN 4 Majene. Two hypotheses were formulated for this study: (1) the application of the Index Card Match learning model has a significant impact on students' motivation to learn mathematics (H1), and (2) the application of the Index Card Match learning model has no significant impact on students' motivation to learn mathematics (H0). A quasi-experimental design with a pre-test–post-test control group approach was utilized to conduct the study. The hypothesis was tested through N-Gain analysis, revealing that the mean N-Gain score of the experimental group exceeded that of the control group. This finding suggests that the Index Card Match learning model resulted in a significantly greater improvement than the conventional direct instruction method. Statistical testing at the 0.05 significance level produced a sig value of 0.000 < 0.05, leading to the rejection of H0 and acceptance of H1. Therefore, it can be concluded that the Index Card Match model has a significant positive influence on the mathematics learning motivation of seventh-grade students at SMP Negeri 4 Majene.

Keywords: Index Card Match, Early Adolescence, Mathematics Learning Motivation

A. Introduction

Mathematics learning is often viewed as a challenging subject by many students. This relates not only to cognitive aspects (concepts, procedures, problem solving), but also to affective aspects, such as students' motivation and emotions towards mathematics. Learning motivation is an important factor that can influence how students interact with mathematical material, their persistence in the face of difficulties, and long-term learning outcomes. Recent research emphasizes that "emotions and motivation" are not merely additional variables, but essential components in mathematics education; they can act as preconditions, mediators, and outcomes of the learning process (Schukajlow et al., 2023). In a systematic review of the mathematics literature, it was found that motivation to learn mathematics consistently correlates positively with

students' mathematical literacy, meaning that students with high learning motivation tend to have better abilities in understanding and applying mathematical concepts in real-life contexts (Meti et al., 2024).

Mathematics is always used as a subject that is avoided just because the students' initial thoughts that are embedded are already negative. So that here the teacher's role is needed, the teacher is not limited to being able to master the material to be taught but the teacher must be able to make class conditions pleasant when learning mathematics so that students can participate actively when participating in learning (Kusuma Dewi et al., 2023). The 2022 Programme for International Student Assessment (PISA) report placed Indonesia in the lower-middle tier among OECD countries in mathematical literacy, with the majority of students still struggling to comprehend fundamental concepts and apply them in real-life contexts (OECD, 2023) . The low level of mathematical competence is not solely attributed to cognitive difficulties but is also influenced by affective factors such as low learning motivation, lack of self-confidence, and limited exposure to engaging and meaningful learning experiences (Suryani & Anwar. R, 2022).

Learning motivation reveals to be an important component in a learning process (Mohammad-Davoudi & Parpouchi, 2016) s Motivation and learning process have a deep connection. Motivation is the core for human being's aspirations and achievements. Thus, motivation is crucial to succeed in educational matters and without the fighting spirit nothing is possible not only in education but also in real life. The learning process is an endless life long process. In order to continuously achieve a high motivation is crucial. Motivation is the force that encourages students to face all the tough and challenged circumstances. Motivation is defined as the process to make a start, guides, and maintains goal-oriented behaviours. Basically, it leads individuals to take action to achieve a goal or to fulfil a need or expectation (Gopalan et al., 2017)

Once it became autonomous, extrinsic incentives would be unnecessary, but turned to autonomous learning. Both intrinsic and extrinsic motivation would complement one another. On the other hand, learning also requires some driving force and extrinsic motivation as it is common to learn for parent expectation, added objectives, and acquisition of some incentives. Learning motivation is a mediator between stimulation and reaction. In other words, learning motivation is a learner's individual opinions about affairs, and learners would present different knowledge acquisition needs because of distinct opinions (Lin et al., 2017). Motivation serves as the driving force that enables learners to pursue and attain their educational objectives. Recognizing the role of motivation as a fundamental aspect of effective teaching is essential, as it suggests that students' motivation could be the most decisive factor influencing the overall learning process. (Jacob Filgona et al., 2020).

Learning motivation not only determines the extent of students' efforts in understanding mathematical concepts but also influences their perseverance and academic achievement (Hossein-Mohand & Hossein-Mohand, 2023). Research has shown that highly motivated students tend to be more active in asking questions, are more willing to try different problem-solving strategies, and demonstrate greater resilience when facing challenges (Schukajlow et al., 2023).When students possess the necessary tools and methods for learning, they are more likely to cultivate a strong sense of self-efficacy, which in turn contributes to enhanced academic achievement, often reflected through improved grades. Students driven by intrinsic motivation consistently aim for success and experience positive feelings linked to their accomplishments. When learners are intrinsically encouraged to participate in educational activities—either because they view them as meaningful for their future development or acknowledge the value of the competencies gained, they display greater internal motivation to perform well and sustain positive emotional responses toward attaining academic excellence. (El-Adl & Alkharusi, 2020).

Mathematics learning motivation in early adolescence is a crucial factor in determining students' academic success. During this period, students undergo significant cognitive and emotional changes that can influence their attitudes and motivation toward mathematics. Motivation often declines as the complexity of the subject matter and academic pressures increase. A study by (Rončević Zubković et al., 2023) indicates that mathematics motivation and performance tend to decrease during school transitions, particularly among older students, who may value mathematics less than younger peers. Furthermore, research by (Watt et al., 2019) identifies that students' motivation profiles in mathematics and science can differ, with some students showing a decline in motivation over time.

Phenomenon of low learning motivation, which affects both the learning process and outcomes, is also evident in various regions, including Majene Regency, West Sulawesi Province an area characterized by strong socio-cultural traditions and developing educational equity. According to the report of the Majene Regency Education Office, junior high school students' achievement in ma (Dinas Pendidikan Kabupaten Majene, 2023). Mathematics still shows considerable variation across schools. Many students in the early adolescent phase (Grades VII–VIII) tend to be passive during mathematics lessons, easily lose interest, and show low motivation to engage in problem-solving activities. Preliminary classroom observations also revealed that seventh-grade students appeared less enthusiastic in participating in mathematics learning activities. This condition indicates that conventional instructional approaches, such as lecturing and repetitive exercises, have not been fully effective in fostering students' interest and motivation in learning mathematics in the region. As noted by (Han & Wang, 2021),enhancing students' motivation to learn mathematics is a crucial aspect that requires serious attention. From a psychological perspective, motivating learners and engaging them in the classroom

are two interrelated processes. Therefore, teachers need to implement learning models that stimulate curiosity, strengthen social interaction, and foster a healthy sense of competition within the classroom.

One of the learning models proven to be effective in enhancing student engagement and motivation is cooperative learning. This model emphasizes student-to-student interaction, encouraging learners to assist one another in understanding concepts and completing learning tasks collaboratively. Index Card Match is a lively and engaging approach often utilized to revisit information that has already been covered. Nonetheless, it can also serve to present fresh subjects, on the condition that learners prepare the material beforehand, arriving with some foundational understanding. In this educational method, students must grasp and comprehend ideas through a card-matching exercise that employs index cards divided into two sections: question cards and answer cards. Every learner gets a chance to pick a card and engage in the task of locating its matching counterpart (Nining Puji Lestari & Nur'im Septi Lestari, 2023).

Meta-analytical studies have shown that cooperative learning models contribute positively to improving students' learning outcomes and motivation in mathematics (Ridwan et al., 2022). One particularly engaging form of cooperative learning is the Index Card Match (ICM) model. This approach entails pairing cards that have inquiries and responses in pairs or groups, requiring students to be physically active, interact with peers, and think quickly to find the correct matches (Ridwan et al., 2022). Through this process, individuals become more responsible for their own learning, fostering stronger connections between engagement, practice, and real-world application key elements that play a crucial role in sustaining learning motivation (Kong, 2021).

Previous studies have shown that the implementation of the Index Card Match (ICM) model can enhance students' participation and enjoyment in learning while simultaneously strengthening their intrinsic motivation (Ridwan et al., 2022). However, most of these studies have been limited to classroom action research focusing primarily on cognitive learning outcomes. There remains a scarcity of quasi-experimental studies that specifically examine the effect of the ICM model on students' motivation to learn mathematics, particularly among early adolescents who are undergoing a critical transitional phase in their social and emotional development.

Based on these conditions, this research seeks to explore how the Index Card Match (ICM) teaching model influences the motivation of junior high school students in learning mathematics. The study took place at SMP Negeri 4 Majene and utilized a quasi-experimental approach featuring a pre-test–post-test control group method to offer concrete evidence on how effectively the ICM model boosts math learning motivation in young adolescents. The results of this research are anticipated to aid in the advancement of adaptive methods, interactive, and contextually relevant

mathematics learning strategies within the regional educational setting. Given the challenges of low student motivation in mathematics learning and the potential effectiveness of the Index Card Match (ICM) framework, as previously mentioned, this research aims to explore the following question: "How does the use of the Index Card Match (ICM) learning method impact junior high school students' motivation to study mathematics?" The results of this investigation are anticipated to offer valuable insights for both theoretical and practical applications in mathematics education. On a theoretical level, this study enhances current knowledge regarding cooperative learning by offering empirical data on how the Index Card Match (ICM) model improves student's motivation to learn mathematics. It also contributes to the understanding of how interactive and student-centered learning models can foster intrinsic motivation among early adolescents during a crucial developmental stage.

Practically, the results of this study offer valuable insights for educators, particularly mathematics teachers, in designing engaging and participatory learning environments. The application of the ICM model may serve as an alternative instructional approach that encourages engagement, teamwork, and enjoyment in learning mathematics. Furthermore, the study's implications can guide educational policymakers and curriculum developers in integrating more adaptive and contextually relevant pedagogical approaches that align with students' social and cultural backgrounds, especially in developing regions such as Majene Regency, West Sulawesi.

B. Methods

In this study, the researcher employed a quantitative experimental method using a quasi-experimental design with a pre-test–post-test control group design. This method was applied to determine whether there was a difference in students' learning motivation before and after the treatment (Hastjarjo, 2019) , specifically to examine whether the Index Card Match (ICM) learning model had a significant effect on the mathematics learning motivation of seventh-grade students at SMP Negeri 4 Majene. The total population consisted of 76 seventh-grade students, with 26 students assigned to the experimental group (Class A) and 25 students assigned to the control group (Class C). The class selection was conducted randomly because all classes had similar characteristics and were considered homogeneous.

Table 1 Pre-test-Post-test Control Group Design

Sample	Group	Pre-test	Treatment	Post-test
Random (R)	Experiment	Q_1	X_1	Q_3
Random (R)	Control	Q_2	X_2	Q_4

(Sugiyono, 2022)

The study was conducted during the 2024/2025 academic year. The sampling technique used in this research was simple random sampling, which involves

selecting samples randomly without considering the existing strata within the population (Dasar & Zahwa, 2022).A total of 51 participants were selected as the sample, consisting of students from classes VII-A and VII-C, which served as the control and experimental groups, respectively. In the data collection procedure, we employed a questionnaire as the main research instrument. The questionnaire was administered to measure students' learning motivation in mathematics after implementing the Index Card Match (ICM) learning model, as well as to assess their understanding of the subject matter (Dasar & Zahwa, 2022). The questionnaire used a Likert scale and consisted of 30 items. Prior to its use, the instrument underwent validity and reliability testing. Only after all items were confirmed valid and reliable was the instrument deemed appropriate for data collection. The data analysis involved the N-Gain analysis, and t-test to ensure accurate data interpretation. All analyses were performed using SPSS version 24, with a significance level of 5% ($\alpha = 0.05$).

C. Results and Discussion

The findings of the study reveal a striking difference in mathematics learning motivation between the experimental class, which implemented the Index Card Match (ICM) model, and the control class, which received direct instruction. This distinction is clearly reflected in the pre-test–post-test results as well as in the N-Gain scores of both groups. This study utilized a quasi-experimental framework featuring a pre-test and post-test with a control group. Before initiating the primary research, the researcher piloted the questionnaire at a school with a comparable level of accreditation. The validation assessment indicated that 22 items were deemed valid, whereas 8 items were found to be invalid. Once the validity of the instrument was established, the research moved forward with a pre-test measuring learning motivation for both the experimental and control groups to evaluate the initial motivation levels of students in mathematics. Following this, a post-test was conducted to assess students' motivation after applying the Index Card Match learning model. The pre-test and post-test data for both the experimental and control classes are presented in Table 2 below.

Table 2. Pre-test Score Data of Students' Mathematics Learning Motivation Questionnaire in the Experimental and Control Classes

Statistic	Pre-test Statistical Value		Post-test Statistical Value	
	Experiment	Control	Experiment	Control
Highest Value	40	35	90	50
Lowest Value	10	10	63	23
Mean	20,19	22,00	76,04	33,04
Median	17,50	20,00	75,00	33,00
Mode	15	20	75	26
Standard Deviation	8,998	7,360	7,947	7,618
Variance	80,962	54,167	63,158	58,040

From Table 2, it can be seen that the average level of students' learning motivation ranges between 20 and 22, which falls into the low category. The frequency distribution and percentage of students' motivation levels, both before and after the treatment, are presented in Table 3 below.

Table 3. Frequency Distribution and Percentage of Pre-test–Post-test Scores on Students' Mathematics Learning Motivation Questionnaire in the Experimental Class

Skor	Pre-test Experiment		Category	Post-test Experiment		Category
	Frequency	Percentage		Frequency	Percentage	
0 – 20	17	65,4	Very Low	0	0	Very Low
21 – 40	9	34,6	Low	0	0	Low
41 – 60	0	0	Medium	3	11,5	Medium
61 – 80	0	0	High	18	69,2	High
81 − 100	0	0	Very High	5	19,2	Very High
Total	26	100		26	100	

Based on Table 3 above, it can be observed that there was a substantial change in the overall percentage distribution of students' mathematics learning motivation before and after the implementation of the Index Card Match learning model. During the pre-test, the dominant percentage fell within the *very low motivation* category, whereas after the treatment, the dominant percentage shifted to the *high motivation* category. The results from the experimental class can be compared with those of the control class, as presented in Table 4 below.

Table 4. Frequency Distribution and Percentage of Pre-test–Post-test Scores on Students' Mathematics Learning Motivation Questionnaire in the Control Class

Score	Pre-test Control		Category	Post-test Control		Category
	Frequency	Percentage		Frequency	Percentage	
0 – 20	17	65,4	Very Low	13	53,8	Very Low
21 – 40	8	34,5	Low	12	46,2	Low
41 – 60	0	0	Medium	0	0	Medium
61 – 80	0	0	High	0	0	High
81 − 100	0	0	Very High	0	0	Very High
Total	25	100		25	100	

According to Table 4 mentioned earlier, it is evident that there was no significant difference in the overall percentage distribution of students' motivation for learning mathematics before and after the use of the Index Card Match teaching model. The results from both the pre-test and post-test show that the level of motivation among students for studying mathematics stayed in the very low range.

Following the collection of pre-test and post-test information from both the experimental and control groups, the N-Gain scores were determined using the pre-test and post-test findings. The mean N-Gain scores are shown in Table 5 below.

Table 5. N-Gain Scores of the Mathematics Learning Motivation Questionnaire in the Experimental and Control Classes

Value	Experiment	Control	Category
N-Gain≤ 0,30	1	25	Low
$0{,}30 \leq N - gain < 0{,}70$	14	0	Medium
$N - Gain \geq 0{,}70$	11	0	High
Average	0,65	0,03	
Number of Students	26	25	

According to Table 5, it can be determined that the mean N-Gain score for the experimental group surpassed that of the control group. This suggests that implementing the Index Card Match (ICM) learning model was more beneficial than employing the direct instruction model. The analysis of N-Gain also indicated that the preliminary tests validated the data regarding students' motivation for learning mathematics as being normally distributed and consistent. The next table shows the outcomes of the normality examination carried out on the N-Gain scores from the mathematics motivation survey.

Table 6. Results of the Normality Test for the Mathematics Learning Motivation Questionnaire

Questionnaire	Class	Number of Sample	Significant	Conclusion
N-Gain	Experiment	26	0,088	Normal
	Control	25	0,124	Normal

According to Table 6, it is evident that for the experimental group, the significance level of the mathematics learning motivation survey was 0. 088. This figure exceeds α = 0. 05, suggesting that the data follows a normal distribution. Likewise, the control group showed a significance level of 0. 124, which is also above α = 0. 05, indicating that these data are similarly normally distributed. As a result, we can infer that the pre-test and post-test data from the mathematics learning motivation survey for both the experimental and control groups are normally distributed.

The findings from the homogeneity test derived from the N-Gain values calculation are shown in the subsequent table.

Table 7. Results of the Homogeneity Test for the Mathematics Learning Motivation Questionnaire

Value	**Significant**	**Conclusion**
N-Gain	0,631	Homogen

Based on the information in Table 7, the significance level for the N-Gain results from the mathematics learning motivation survey in both the experimental and control groups was 0. 631, with α set at 0. 05. This indicates that since the significance value

exceeds 0. 05, the variances in the data are consistent. After verifying that the results of the normality and homogeneity tests showed the data were regularly distributed and had equal variances, hypothesis testing was carried out. The hypothesis for this research proposes that the mathematics learning motivation among seventh-grade students at SMP Negeri 4 Majene who were instructed using the Index Card Match learning approach is greater than that of those who were taught with the direct instruction method. Moreover, an Independent Samples Test on the N-Gain scores was conducted between the experimental and control groups using SPSS version 24, as described in the appendix. The findings from the hypothesis testing are summarized in Table 8.

Table 8. Results of Hypothesis Testing

Independent Samples Test				
	Levene's Test For Equality of Variances		T-Test for Equality of Mean	
		Sig	Df	Sig
N-gain	Equal variances Assumed	0.251	49	0.000

Based on the table above, the significance value obtained is 0.000 < 0.05, indicating that H_0 is rejected and H_1 is accepted. This means that the Index Card Match learning model has a significant effect on the mathematics learning motivation of eighth-grade students at SMP Negeri 4 Majene. The summary of the hypothesis testing results is presented in Table 9 below.

Table 9. Independent Samples Test of Mathematics Learning Motivation

Post-test		Conclusion
Sig	0,000	The motivation for learning mathematics among students instructed with the Index Card Match approach was greater than that of seventh graders at SMP Negeri 4 Majene who received education through the standard direct teaching method. This shows that the Index Card Match method notably influences the mathematics learning motivation of seventh-grade students at SMP Negeri 4 Majene.

According to Table 9, the two-tailed significance value for the post-test comparing the experimental and control groups was 0. 000. Because a one-tailed hypothesis test was utilized, the calculated p-value was halved, yielding a figure that is lower than the significance threshold of 0. 05. This suggests that the average score of the experimental group surpassed that of the control group following the intervention. The extent of the difference in mathematical learning motivation between the experimental and control groups after the intervention can be observed in Table 10 below.

Table 10. Group Statistics of Mathematics Learning Motivation

	Mean	Category
N-gain Experimental Class	0,6536	Medium
N-gain Control Class	0,0294	Low

Based on Table 10, the post-test mean score of the experimental class was 0.636, while that of the control class was 0.0294. Therefore, it can be concluded that the mathematics learning motivation of students taught using the Index Card Match model was higher compared to that of seventh-grade students at SMP Negeri 4 Majene who were taught using the conventional direct instruction model.

The main finding of this study indicates that students taught using the Index Card Match (ICM) learning model demonstrated significantly higher motivation to learn mathematics than those taught through conventional direct instruction. This is reflected in the N-Gain score of the ICM group, which reached 0.6536, far exceeding the score of 0.0294 observed in the control group. These results clearly show that the ICM model had a substantial positive effect on seventh-grade students' mathematics learning motivation at SMP Negeri 4 Majene.

The observed improvement in motivation can be interpreted through the perspective of Self-Determination Theory (SDT), which asserts that intrinsic motivation increases when the needs for autonomy, competence, and relatedness are fulfilled. During the ICM activities, students experienced strong peer interaction and collaboration, which fostered their sense of relatedness. Their ability to successfully match question and answer cards provided immediate feedback that strengthened their sense of competence. In addition, the active and game-like nature of the ICM model, which allows students to move, select roles, and contribute ideas, promoted a greater sense of autonomy compared to the passive nature of conventional instruction. These experiences together help explain why the experimental group showed stronger enthusiasm, persistence, and positive attitudes toward mathematics.

From a constructivist perspective, the ICM model requires students to actively construct meaning through interaction and problem-solving. Matching tasks engage students cognitively as they analyze information, discuss with peers, and validate their answers. Such active participation stands in contrast to traditional direct instruction, which tends to limit students to passive listening. Active learning models such as ICM are known to enhance motivation because they encourage deeper processing, increase engagement, and create a more meaningful learning experience, consistent with findings reported by ((Kong, 2021; Ridwan et al., 2022)). These results are particularly relevant for early adolescents, whose developmental needs include opportunities for collaboration, social validation, and interactive learning activities, as suggested by (El-Adl & Alkharusi, 2020).

The consistency of these findings with previous research strengthens the conclusion that ICM is an effective strategy for increasing student motivation. Several prior studies, including those by (Bara et al., 2023), (Dasar & Zahwa, 2022), (Fauzi, 2024), (Hartiningrum & Ula, 2019), (Oktaviani et al., 2024; Sinaga et al., 2023)and (Zainal et al., 2024), also reported that ICM enhances student motivation and engagement more effectively than traditional instruction. Further supporting evidence from (Anggraini et al., 2022; Rahman, 2024; Ratansari et al., 2024; Wartini et al., 2024), indicates that ICM not only increases motivation but is also effective in improving critical thinking skills. These results suggest that the motivational benefits of ICM are robust across contexts and student populations.

The inadequacy of conventional instruction in improving student motivation was also evident in the control group, where motivation remained low both before and after the intervention. This outcome suggests that instructional approaches dominated by lectures and routine exercises may fail to meet the motivational and developmental needs of junior high school students. Despite the positive findings, this study has several limitations that should be acknowledged. The research was conducted in a single school with a relatively small number of participants, limiting the generalizability of the results. The duration of the intervention was short, making it unclear whether the motivational improvements would persist over time. There is also the possibility of a teacher effect if the same instructor taught both the experimental and control groups, potentially influencing student outcomes. Additionally, the study relied on self-report questionnaires, which may be susceptible to bias and may not fully capture complex motivational dynamics.

Nevertheless, the results have important implications for teaching practice and curriculum development. Teachers can immediately apply the ICM model by incorporating short card-matching activities during lesson introductions, practice sessions, or concept reviews. Preparing sets of concept–definition or problem–solution cards and conducting brief collaborative matching exercises can stimulate student interest, enhance participation, and strengthen understanding. For curriculum developers, the findings suggest the value of integrating structured cooperative and game-based tasks into mathematics instructional materials. Schools may also consider adopting ICM-style activities in enrichment programs or remedial classes to build motivation and confidence among students who struggle with mathematics.

Overall, this study provides strong empirical support for the idea that student motivation is highly responsive to well-designed instructional methods. The significant differences in motivation between the experimental and control groups demonstrate that interactive, student-centered models such as Index Card Match can meaningfully improve both affective and cognitive engagement in mathematics learning. These findings contribute to the growing body of evidence that effective

mathematics instruction should prioritize active participation, collaboration, and autonomy in order to foster deeper motivation and better learning outcomes.

D. Conclusions

Based on the research inquiries, predictions, and observable outcomes, this investigation entitled "*The Effect of the Index Card Match Approach on Motivation for Learning Mathematics in Early Adolescents*" demonstrated a significant and statistically meaningful impact. The t-test results indicated a significance level of $0.00 \leq 0.05$, suggesting that the Index Card Match (ICM) instructional method effectively enhanced students' motivation for learning mathematics. Furthermore, the N-Gain assessment revealed that the average post-test score of the experimental group (0.636) was substantially higher than that of the control group (0.0294). This result indicates that learners taught through the ICM method exhibited greater motivation for mathematics learning compared to those who received conventional direct instruction in the seventh grade at SMPN 4 Majene.

Students engaged in the ICM learning model showed increased participation, higher enthusiasm, and more positive attitudes toward mathematics than those in the conventional learning setting. These findings underscore the potential of interactive and collaborative learning strategies as effective pedagogical alternatives for addressing low student motivation in junior high school mathematics. From a practical standpoint, the findings emphasize the importance of designing learning environments that are more engaging and participatory. The ICM model can be integrated across various mathematical topics to strengthen conceptual understanding while fostering students' intrinsic motivation toward the subject.

In terms of future research, several more specific directions are recommended based on the limitations of the current study. First, future studies should involve a larger sample size across multiple schools or regions and employ a randomized controlled trial (RCT) design to enhance the generalizability and external validity of the findings. Second, subsequent research should investigate the long-term effects of the ICM model through longitudinal approaches to determine whether improvements in motivation are sustained over time. Third, researchers are encouraged to examine the impact of the ICM model not only on learning motivation but also on standardized academic achievement scores to provide a more comprehensive understanding of its effectiveness. Finally, future studies may explore potential moderating or mediating variables—such as students' self-efficacy, engagement level, or learning styles—as well as hybrid applications of ICM combined with digital platforms or project-based learning to better align with the demands of 21st-century education.

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