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Which Habits of Mind Dimensions Uniquely Predict Mathematical Creative Thinking? A Hierarchical Regression Study of Integral Calculus Students

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ABSTRACT: The ability for mathematical creative thinking is crucial to meet the demands of integral calculus learning, which emphasizes conceptual understanding and strategic flexibility. This study analyzed the relationship between Habits of Mind (HoM) and students' Mathematical Creative Thinking (MCT) and identified which HoM dimensions uniquely predict MCT. A correlational–predictive design involved 60 Mathematics Education students in an Integral Calculus course. Data were collected through an eight-dimensional HoM questionnaire and a three-indicator MCT test, analyzed using Spearman's rho, multiple linear regression, and hierarchical regression. Total HoM and MCT scores showed a strong positive relationship (r_s = 0.775; $p < 0.001$). The eight-dimension regression model was significant, $R^2 = 0.765$, $F(8, 51) = 20.75$, $p < 0.001$. Because several HoM dimensions were highly intercorrelated (VIF up to 11.36), only applying past knowledge to new situations emerged as a significant unique predictor ($B = 1.412$, $\beta = 0.324$, $p = 0.019$), confirmed by hierarchical regression ($\Delta R^2 = 0.027$, $p = 0.019$). Theoretically, the findings distinguish collective HoM effects from the unique contribution of knowledge transfer. Practically, calculus instruction should emphasize applying prior concepts to unfamiliar problems.

Keywords: habits of mind, integral calculus, mathematical creative thinking

ABSTRAK: *Kemampuan berpikir kreatif matematis sangat penting untuk memenuhi tuntutan pembelajaran kalkulus integral, yang menekankan pemahaman konseptual dan fleksibilitas strategis. Penelitian ini menganalisis hubungan antara* Habits of Mind *(HoM) dan* Mathematical Creative Thinking *(MCT) mahasiswa serta mengidentifikasi dimensi HoM mana yang secara unik memprediksi MCT. Desain korelasional–prediktif ini melibatkan 60 mahasiswa Pendidikan Matematika pada mata kuliah Kalkulus Integral. Data dikumpulkan melalui kuesioner HoM delapan dimensi dan tes MCT tiga indikator, yang dianalisis menggunakan Spearman's rho, regresi linear berganda, dan regresi hierarkis. Skor total HoM dan MCT menunjukkan hubungan positif yang kuat (r_s = 0,775; p < 0,001). Model regresi delapan dimensi tersebut signifikan, R^2 = 0,765, F(8, 51) = 20,75, p < 0,001. Karena beberapa dimensi HoM saling berkorelasi tinggi (VIF hingga 11,36), hanya dimensi menerapkan pengetahuan sebelumnya pada situasi baru yang muncul sebagai prediktor unik yang signifikan (B = 1,412, β = 0,324, p = 0,019), yang dikonfirmasi oleh regresi hierarkis (ΔR^2 = 0,027, p = 0,019). Secara teoretis, temuan ini membedakan efek kolektif HoM dari kontribusi unik transfer pengetahuan. Secara praktis, pembelajaran kalkulus sebaiknya menekankan penerapan konsep sebelumnya pada permasalahan yang belum dikenal.*

Kata kunci*: berpikir kreatif matematis,* habits of mind*, kalkulus integral*

INTRODUCTION

Mathematics education is a field that consistently attracts broad interest. Mathematics supports everyday problem-solving and is widely applied across professional and technological fields. Beyond this practical relevance, mathematics learning can foster critical, analytical, and logical reasoning, promote mathematical creativity through open-ended and multiple-solution tasks, and support students' cognitive development when delivered through cognitively challenging instruction (Bicer, 2021; Jean-Pierre & Jean-Pierre, 2026; Seleznyov, Adhami, Black, Hodgen, & Twiss, 2022). One aspect receiving increasing attention in mathematics education is creative thinking ability. Mathematical creative thinking refers to the ability to generate new mathematical ideas and produce multiple and varied solution approaches, particularly in solving open-ended problems (Bicer, 2021; Rahayuningsih, Sirajuddin, & Ikram, 2021). In other words, mathematical creative thinking encompasses an individual's ability to solve mathematical problems innovatively, create new connections, and view solutions from multiple perspectives. Creative thinking is vital in an ever-changing and increasingly complex world and is key in preparing younger generations to face future challenges.

Mathematical creative thinking can be cultivated through various mathematics courses, including Integral Calculus. Calculus learning can facilitate connections among mathematical concepts and representations and, when supported by visualization and contextualized STEAM activities, can foster reasoning, critical thinking, problem-solving, and creativity (Buriticá, Sierra, & Flores, 2025; Caridade & Pereira, 2026; Panneerselvam & Priyadharsini, 2026). However, observations of classroom processes and outcomes reveal that many students have yet to achieve optimal levels of mathematical creative thinking. For example, students often struggle to provide multiple correct answers during learning activities (Solfitri & Siregar, 2021). Similar difficulties have been documented in descriptive assessments of mathematical creative thinking, with students generally demonstrating low or limited performance when solving mathematical problems (Madani & Sari, 2025; Sidik, Herman, Prabawanto, Riyadi, & Marji, 2026). Other research found that only high-ability students could complete creative thinking tests, medium-ability students performed adequately only on the fluency indicator, and low-ability students could not (Huljannah, Sa'dijah, & Qohar, 2018). These findings underscore the need to develop mathematical creative thinking skills further.

One factor believed to play a crucial role in enhancing mathematical creative thinking is Habits of Mind (HoM), the productive thinking dispositions employed when encountering novel situations or complex problems. Habits of mind can be understood as mindful and thoughtful dispositions for intelligent action when individuals face problems whose answers are not immediately known. In the self-regulatory dimension, these habits are reflected in awareness of one's thinking processes, effective planning, the use of available capabilities, responsiveness to feedback, and evaluation of one's performance (A. Elsayed, Wardat, Alawaed, & Albaraami, 2025; Lane, Altan, & Franzenc, 2024). Costa & Kallick (2008) describe HoM as a repertoire of dispositions, including thinking flexibly, metacognition, and applying past knowledge to new situations, among sixteen originally identified characteristics, that individuals employ mindfully when confronted with problems

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whose solutions are not immediately apparent, and which can be cultivated through sustained educational practice. As a mental skill, HoM can be systematically nurtured through education. Students with strong HoM tend to be reflective, persistent, and creative in problem-solving. Ideally, mathematics learning should not only develop students' procedural competence but also foster their mathematical creativity. Creativity in mathematics involves both creative thinking ability, reflected in fluency, flexibility, elaboration, and originality, and creative disposition, reflected in students' willingness to take risks, engage with challenges, show curiosity, and use imagination when responding to mathematical situations (Ibrahim, Khalil, & Prahmana, 2024). In relation to Habits of Mind, Marzano's framework classifies HoM into self-regulation, critical thinking, and creative thinking, indicating that HoM is closely associated with students' capacity to regulate their learning, think critically, and generate new ways of approaching problems (Hidayati & Idris, 2020).

Existing research suggests a connection between habits of mind and mathematical creative thinking, although the findings are not entirely consistent. S. A. M. Elsayed & Nasef (2021) found that a mathematics learning program based on habits of mind significantly improved university students' mathematical creative thinking. Similarly, Fineldi & Hidayati (2023) reported that students with very high and high HoM experienced fewer difficulties in solving mathematical creative-thinking problems than those in the lower HoM categories. However, Nugroho, Riyadi, & Triyanto (2019) found that strong mathematical HoM did not necessarily correspond to high levels of creative thinking, while Desti, Pertiwi, Sumarmo, & Hidayat (2020) reported no significant relationship between mathematical creative thinking and mathematical habits of mind. These mixed findings may reflect the tendency of previous studies to treat HoM as an undifferentiated composite rather than examining its constituent dimensions separately. Because HoM dimensions are conceptually and empirically intercorrelated, an association involving total HoM cannot identify which dimensions provide unique explanatory power after their shared variance is controlled. The studies reviewed here have not disentangled the unique-versus-redundant contributions of the eight HoM dimensions in predicting students' Mathematical Creative Thinking, particularly in college-level Integral Calculus.

This research gap is significant because university-level calculus instruction possesses distinct characteristics, such as more abstract concepts, demands for generalization, and the need for knowledge transfer across topics. Moreover, students transitioning from secondary school often lack sufficient academic preparation, as evidenced by limited foundational knowledge, ineffective study strategies, and weak time management skills (Zhu, Lu, Wang, Ma, & Xu, 2025). Traditional instructional approaches can further hinder HoM dimensions that require flexibility and imagination. Recent studies show that mathematics instruction still frequently emphasizes rote memorization of formulas and definitions, impeding deep conceptual understanding and flexible problem-solving (Eliza, Utami, & Warahma, 2022; Danlami, Zakariya, Balarabe, Alotaibi, & Alrosaa, 2025). Consequently, a more nuanced understanding of the specific contributions

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of each HoM dimension to mathematical creativity at the university level is urgently needed.

Building on this theoretical synthesis, the present study organizes the eight HoM dimensions into three functionally distinct blocks that reflect their proximity to the cognitive demands of mathematical creative performance (Figure 1). The first block comprises self-regulatory habits (managing impulsivity, metacognition, persisting, and striving for accuracy), which govern how students monitor and control their problem-solving process. The second block comprises creative-generative habits (thinking flexibly, creating/imagining/innovating, and remaining open to continuous learning), which are theoretically most proximal to originality and flexibility as core components of creative thinking. The third block consists of a single dimension, applying past knowledge to new situations, theorized as the mechanism most directly responsible for knowledge transfer, and therefore expected to be most proximal to performance on transfer-dependent tasks such as constructing novel integral calculus problems (Jonsson, Granberg, & Lithner, 2020; Jäder, Sidenvall, & Sumpter, 2017). This conceptual framework does not propose the three blocks as new latent constructs distinct from Costa & Kallick (2008) original HoM dimensions. Rather, it provides a theoretically motivated ordering for evaluating each block's incremental contribution to MCT beyond the others.

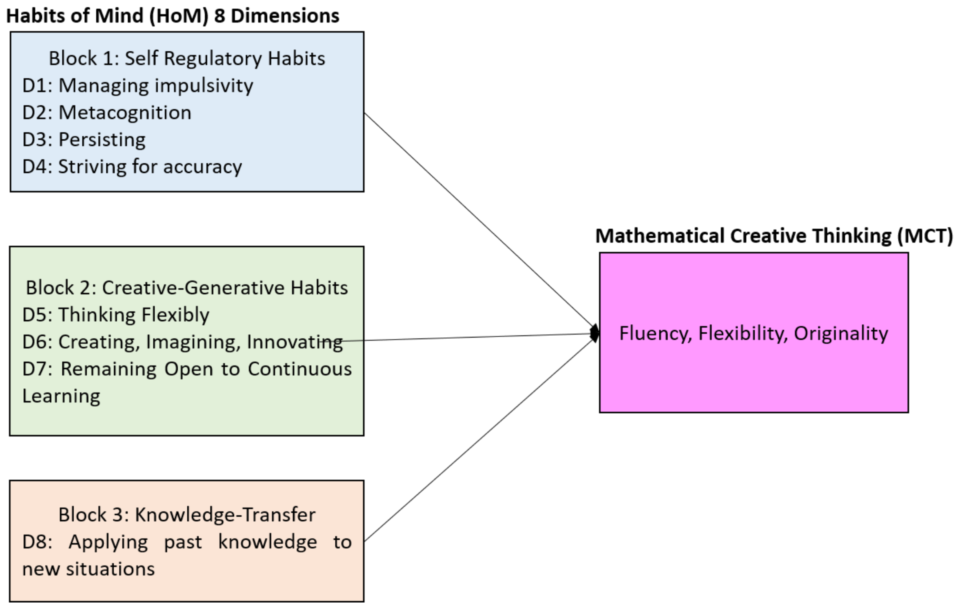

Figure 1. Conceptual Framework of Habits of Mind Dimensions Predicting Mathematical Creative Thinking

Based on this theoretical foundation and empirical evidence, the present study aims to analyze the relationship between total HoM scores and students' mathematical creative thinking in an Integral Calculus course, and to identify which HoM dimensions uniquely predict mathematical creative thinking once shared variance among dimensions is taken into account. This objective is pursued through a staged analytic approach, bivariate correlation, simultaneous multiple regression, and hierarchical block regression that allows the unique versus

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overlapping contribution of each HoM dimension to be distinguished. The insights gained are expected to provide practical implications for instructors and curriculum developers in designing instructional interventions emphasizing content mastery and cultivating thinking habits conducive to fostering mathematical creativity. Thus, this study not only enriches the literature on the relationship between HoM and MCT but also offers a new perspective, grounded in a three-block conceptual framework, on the differentiated role of specific HoM dimensions in higher mathematics education.

RESEARCH METHOD

This study employed a quantitative approach with a correlational–predictive design. This design was chosen because it is appropriate for examining the strength of the relationship between Habits of Mind (HoM) and Mathematical Creative Thinking (MCT), while simultaneously testing the predictive contribution of each HoM dimension to MCT through multiple linear regression analysis. This design allowed for a comprehensive analysis of the relationship between the two variables and identification of specific HoM dimensions that significantly predict students' mathematical creativity.

The study population comprised all mathematics education students at a university in Riau who were enrolled in an integral calculus course. The sample consisted of 60 third-semester students selected through purposive sampling based on the availability of active classes. All participants shared similar academic backgrounds and provided informed consent to participate. Before the study, approval was obtained from the program administrators, and the confidentiality of respondents' identities was ensured throughout data collection and analysis.

The sample size was constrained by the accessible population, and all eligible students from the available Integral Calculus classes were included. To assess its statistical adequacy, a sensitivity analysis was conducted for a fixed-effects multiple regression model with eight predictors, $\alpha = 0.05$, and statistical power of 0.80. The analysis indicated that a sample of 60 participants was sufficient to detect an overall effect size of approximately Cohen’s $f^2 = 0.29$ or larger. Thus, the sample was considered adequate for detecting medium-to-large model-level effects, although it had limited sensitivity for identifying small unique effects of individual HoM dimensions. This limitation was taken into account when interpreting nonsignificant regression coefficients.

Data were collected using two primary instruments: a Habits of Mind questionnaire and a Mathematical Creative Thinking test. The HoM questionnaire was a four-point Likert scale measuring eight dimensions of thinking habits: managing impulsivity; metacognition; persisting; striving for accuracy; thinking flexibly; creating, imagining, innovating; remaining open to continuous learning; and applying past knowledge to new situations. Scores were obtained by summing the item scores within each dimension and then calculating the total HoM score. MCT was measured through three open-ended questions on integral calculus, assessing the indicators of fluency, flexibility, and originality. Student responses were evaluated using a mathematical creative thinking rubric.

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Content validity of both instruments was evaluated by three mathematics education experts using Aiken's V across ten evaluation criteria. Aiken's V values ranged from 0.667 to 1.00 (M ≈ 0.73) for the HoM questionnaire and from 0.667 to 1.00 (M ≈ 0.78) for the MCT test, both falling in the moderate-to-high category. Both instruments were subsequently piloted with 87 students who did not participate in the main study. Item-total construct validity, evaluated using Pearson product-moment correlation, showed that all 15 HoM items (r = 0.428–0.800) and all 3 MCT items (r = 0.772–0.843) were statistically significant ($p < 0.05$); no items were removed following the pilot test. Internal consistency reliability (Cronbach's α) was 0.84 for the HoM questionnaire and 0.71 for the MCT test.

To provide contextual illustration for the quantitative findings, brief follow-up conversations were also conducted with six students purposively selected after the test session. These conversations were audio-recorded and later reviewed to identify representative examples of students' problem-solving approaches. This procedure served as supplementary illustrative material to contextualize the statistical results, rather than as an independent, formally coded qualitative strand.

Data were gathered during a single scheduled class session. Answer sheets were checked, scored, and entered into SPSS for analysis. All HoM and MCT scores were converted into attainment percentages and categorized according to the following criteria.

Table 1. Categories of Habits of Mind and Mathematical Creative Thinking Attainment

Percentage Interval	**Interpretation**
$86 \le p \le 100$	Very Good
$76 \le p < 86$	Good
$60 \le p < 76$	Fair
$50 \le p < 60$	Poor
$p < 50$	Very Poor

Subsequently, hypothesis testing was performed using Spearman's rho correlation analysis with SPSS. When significant correlations were found, the correlation coefficient was examined to determine the strength of the relationship. Interpretation of the coefficients followed the criteria below (Schober, Boer, & Schwarte, 2018).

Table 2. Correlation Coefficient Criteria

Coefficient Range	**Interpretation**
$0 \le r < 0.10$	Negligible
$0.10 \le r < 0.4$	Weak
$0.4 \le r < 0.7$	Moderate
$0.7 \le r < 0.9$	Strong
$0.9 \le r < 1$	Very Strong

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Data analysis was carried out in several stages. First, descriptive analysis was conducted to obtain means, percentages of attainment, and category classifications for each variable. Second, the relationship between total HoM and MCT scores was tested using Spearman's rho with a 0.05 significance level. Third, multiple linear regression was performed to identify which HoM dimensions were predictors of mathematical creative thinking with MCT as the dependent variable and the eight HoM dimensions as independent variables. Regression assumptions—including residual normality, linearity, and homoscedasticity were examined and met at the 0.05 significance level, allowing the regression analysis to proceed. Multiple linear regression was then applied at the 0.05 significance level to assess the strength and significance of each HoM dimension's contribution. The study ensured that the collected data met statistical requirements through these procedures, thereby enabling an accurate depiction of the relationship and predictive contributions of HoM dimensions to students' mathematical creative thinking. Effect sizes for the regression model and for individual predictors were interpreted using Cohen (1988) benchmarks for f^2 (small ≈ 0.02, medium ≈ 0.15, large ≥ 0.35).

RESULT AND DISCUSSION

Result

This study aims to identify the Habits of Mind (HoM) dimensions that contribute to students' Mathematical Creative Thinking (MCT). The results are presented in four stages: descriptive statistics for HoM and MCT, bivariate correlations between HoM and MCT, multiple regression analysis identifying which HoM dimensions uniquely predict MCT when considered simultaneously, and hierarchical regression analysis examining the incremental explanatory contribution of each dimension block.

Table 3. Descriptive Statistics of Habits of Mind (HoM) Dimensions and Mathematical Creative Thinking

Variable/Dimension	Mean	Attainment (%)	Category
Habits of Mind (Total)	33.65	56.08%	Poor
Managing impulsivity	2.38	59.5%	Poor
Metacognition	2.44	61%	Fair
Persisting	2.48	62%	Fair
Striving for accuracy	2.28	57%	Poor
Thinking flexibly	2.47	61.75%	Fair
Creating, imagining, innovating	2.11	52.75%	Poor
Remaining open to continuous learning	1.88	47%	Very Poor
Applying past knowledge to new situations	2.03	50.75%	Poor
Mathematical Creative Thinking	6.53	54.42%	Poor

Table 3 shows that students' total HoM scores fall within the low category. Most dimensions are also classified as poor, with Remaining open to continuous

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learning reaching the very poor category. Only Metacognition, Persisting and Thinking flexibly reaching the fair category. The Mathematical Creative Thinking scores are likewise relatively low, indicating that thinking habits have not developed optimally in most participants and align with their still limited level of mathematical creativity. Based on this initial overview, the subsequent analysis examines the direct relationship between the two main variables and between mathematical creativity with each dimension of HoM. The results of the statistical test can be found in the following table.

Table 4. Correlations between HoM (Total and Dimensions) and MCT

Variable/Dimension	Spearman's r_s	p	Category
Total HoM – MCT	.775	< .001	Strong
D1 – Managing impulsivity	.430	= .001	Moderate
D2 – Metacognition	.478	< .001	Moderate
D3 – Persisting	.532	< .001	Moderate
D4 – Striving for accuracy	.646	< .001	Moderate
D5 – Thinking flexibly	.654	< .001	Moderate
D6 – Creating, imagining, innovating	.636	< .001	Moderate
D7 – Remaining open to continuous learning	.544	< .001	Moderate
D8 – Applying past knowledge to new situations	.597	< .001	Moderate

Bivariate correlation using Spearman's rho (Table 4) revealed a strong positive relationship between the total HoM score and mathematical creativity (r_s = 0.775; p < 0.001). A higher total HoM score therefore corresponds to greater ability to generate creative ideas in solving integral calculus problems. At the dimension level, all eight HoM dimensions were positively and significantly correlated with MCT, each falling within the moderate range, from Spearman's r_s = 0.430 for Managing Impulsivity to Spearman's r_s = 0.654 for Thinking Flexibly. No single dimension reached the strong threshold in isolation, indicating that although each dimension shares overlapping variance with creativity, none is individually sufficient to account for the overall HoM–MCT correlation.

Multiple linear regression analysis was conducted to examine the unique predictive contribution of each HoM dimension to students' mathematical creative thinking. Prior to interpreting the regression model, assumptions of residual normality, linearity, and homoscedasticity were examined and considered acceptable. The results of the multiple linear regression analysis are presented in the following Table 5.

Table 5. Model Summary of Multiple Linear Regression for Habits of Mind Dimensions Predicting Mathematical Creative Thinking

Model	R	R^2	Adj. R^2	SE Estimate	F	df1	df2	p
1	0.875	0.765	0.728	1.416	20.751	8	51	< .001

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The overall model was significant, $F(8, 51) = 20.75$, $p < .001$, and explained a substantial proportion of variance in MCT scores, $R^2 = 0.765$ (adjusted $R^2 = 0.728$). The model-level effect size was large, Cohen's $f^2 = 3.26$, according to Cohen (1988) conventional benchmarks, indicating that the eight HoM dimensions collectively accounted for a substantial amount of variance in MCT. To determine which HoM dimensions uniquely contributed to MCT after controlling for the other dimensions, the regression coefficients, confidence intervals, effect sizes, and collinearity diagnostics were further examined. The detailed coefficient estimates are presented in Table 6.

Table 6. Coefficients of Multiple Linear Regression for Habits of Mind Dimensions Predicting Mathematical Creative Thinking

Predictor	B	SE	β	t	p	95% CI	Tol.	VIF
(Constant)	-4.921	0.954	—	-5.161	0.000	[-6.835, -3.007]	—	—
D1 Managing impulsivity	0.571	0.440	0.153	1.299	0.200	[-0.311, 1.454]	0.331	3.020
D2 Metacognition	-0.382	0.536	-0.106	-0.713	0.479	[-1.459, 0.694]	0.208	4.809
D3 Persisting	0.478	0.327	0.154	1.463	0.150	[-0.178, 1.135]	0.417	2.400
D4 Striving for accuracy	1.031	0.622	0.205	1.658	0.103	[-0.217, 2.279]	0.301	3.319
D5 Thinking flexibly	1.161	0.890	0.278	1.304	0.198	[-0.626, 2.947]	0.101	9.853
D6 Creating, imagining, innovating	0.508	1.108	0.105	0.459	0.648	[-1.716, 2.733]	0.088	11.360
D7 Remaining open to continuous learning	0.369	0.994	0.075	0.371	0.712	[-1.627, 2.364]	0.112	8.961
D8 Applying past knowledge to new situations	1.412	0.583	0.324	2.420	0.019	[0.240, 2.583]	0.257	3.894

Examination of individual coefficients revealed that only Applying Past Knowledge to New Situations emerged as a statistically significant independent predictor, $B = 1.412$, $SE = 0.583$, $\beta = 0.324$, $t(51) = 2.42$, $p = 0.019$, 95% CI [0.240, 2.583]. The remaining seven dimensions did not emerge as significant independent predictors in the simultaneous regression model (all $p > 0.10$), even though Thinking Flexibly, Striving for Accuracy, and Creating, Imagining, Innovating showed the largest unstandardized coefficients among the non-significant predictors. Collinearity diagnostics indicated some cause for caution: tolerance values ranged from 0.088 to 0.417 and VIF values ranged from 2.40 to 11.36, with Thinking Flexibly, Creating, Imagining, Innovating, and Remaining Open to Continuous Learning showing the highest VIFs (9.85, 11.36, and 8.96, respectively). Because several predictors approached or exceeded the conventional VIF threshold of 10, the individual regression coefficients, apart from the well-estimated Applying Past Knowledge coefficient, should be interpreted with caution, as shared variance among the eight HoM dimensions may have

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inflated some standard errors and suppressed the detectability of otherwise meaningful unique effects.

To clarify the difference between the zero-order associations and the unique contribution of each HoM dimension in the simultaneous regression model, bivariate Spearman correlations and partial f^2 values were examined together. Several HoM dimensions showed moderate-to-strong bivariate associations with MCT, yet their unique effects became smaller once shared variance was controlled; comparing bivariate ρ with partial f^2 makes this gap visible. The results are summarized in Table 7.

Table 7. Bivariate and Partial Effect Sizes for the Eight HoM Dimensions Predicting MCT (n = 60)

Dimension	r_s	Partial f^2	Category f^2
D1 – Managing impulsivity	0.430	0.033	Small
D2 – Metacognition	0.478	0.010	Negligible
D3 – Persisting	0.532	0.042	Small
D4 – Striving for accuracy	0.646	0.054	Small
D5 – Thinking flexibly	0.654	0.033	Small
D6 – Creating, imagining, innovating	0.636	0.004	Negligible
D7 – Remaining open to continuous learning	0.544	0.003	Negligible
D8 – Applying past knowledge to new situations	0.597	0.115	Small

As shown in Table 7, all HoM dimensions showed positive bivariate associations with MCT, with the strongest zero-order associations found for Thinking Flexibly, Striving for Accuracy, and Creating, Imagining, Innovating. However, the partial f^2 values indicated that their unique contributions became small or negligible after the other dimensions were controlled. Applying Past Knowledge to New Situations showed the largest partial f^2 value (0.115), although it still fell within Cohen's small-effect range. Much of the predictive information carried by the other dimensions therefore overlapped with one another in the simultaneous model.

To further examine the incremental contribution of Applying Past Knowledge to New Situations relative to the other HoM dimensions, a three-block hierarchical regression analysis was conducted. This block order was conceptually guided by the functional proximity of the HoM dimensions to mathematical creative performance: D1–D4 represent regulatory and accuracy-oriented habits, D5–D7 represent creative-generative and openness-related habits, and D8 represents knowledge-transfer ability, which was theoretically closest to the demands of solving novel integral calculus tasks. This is a grouping used solely to structure the hierarchical analysis, not to redefine the original HoM dimensions as new latent constructs. In Block 1, Managing Impulsivity, Metacognition, Persisting, and Striving for Accuracy were entered as the first set of predictors (D1–D4). In Block 2, Thinking Flexibly, Creating, Imagining, Innovating, and Remaining Open to Continuous Learning were added (D5–D7). Finally, Applying Past Knowledge to

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New Situations was entered in Block 3 (D8) to examine whether this dimension added explanatory power beyond the other seven HoM dimensions. The hierarchical regression results are presented in Table 8.

Table 8. Hierarchical Regression Models Predicting Mathematical Creative Thinking

Model	Predictors entered	R^2	ΔR^2	F change	df1	df2	p
Block 1	D1–D4	0.596	0.596	20.320	4	55	< 0.001
Block 2	D5–D7 Added	0.738	0.142	9.367	3	52	< 0.001
Block 3	D8 Added	0.765	0.027	5.855	1	51	= 0.019

As shown in Table 8, Block 1 was statistically significant and explained 59.6% of the variance in MCT scores, $R^2 = .596$, F change $(4, 55) = 20.320$, $p < .001$. Adding the creative-generative dimensions in Block 2 significantly increased the explained variance to 73.8%, $\Delta R^2 = .142$, F change $(3, 52) = 9.367$, $p < .001$. The addition of Applying Past Knowledge to New Situations in Block 3 produced a further significant, although smaller, increase in explained variance, $\Delta R^2 = .027$, F change $(1, 51) = 5.855$, $p = .019$, resulting in a final model R^2 of .765. Consistent with the simultaneous regression analysis, Applying Past Knowledge contributed unique incremental explanatory power to MCT beyond the other seven dimensions.

Discussion

This study addressed which Habits of Mind (HoM) dimensions contribute to students' Mathematical Creative Thinking (MCT). This question arises from the theoretical assumption that all HoM dimensions, such as managing impulsivity, metacognition, persisting, striving for accuracy, thinking flexibly, creating, imagining, innovating, remaining open to continuous learning, and applying past knowledge to new situations, should be closely related to mathematical creative thinking ability. This theoretical assumption aligns with the view that HoM represents a set of thinking skills supporting fluency, flexibility, and originality as the core of creative thinking, consistent with empirical findings demonstrating a positive relationship between HoM level and students' mathematical creative thinking ability (Altakhyneh & Aburiash, 2018).

Overall, this study's findings show that while habits of mind, as a composite construct, form a strong positive association with mathematical creative thinking, disaggregating the construct through multiple regression reveals a far more selective pattern: only the capacity to apply prior knowledge to novel situations emerged as a unique predictor once shared variance among dimensions was accounted for. The gap between the aggregate and disaggregated results is itself informative. It suggests HoM's practical value for predicting creativity here may lie less in cultivating all eight dispositions uniformly and more in strengthening knowledge-transfer capacity specifically.

The strong bivariate association between total HoM and MCT ($r_s = 0.775$) reinforces the theoretical premise that productive thinking dispositions underpin

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creative mathematical performance (Desti et al., 2020; Dwirahayu, Kustiawati, & Bidari, 2017; Hidayati & Idris, 2020). Prior work has similarly linked HoM to mathematical creativity through structured problem-solving interventions and ethnomathematics-based learning (Hafni, Sari, & Nurlaelah, 2018; Suherman & Vidákovich, 2024). However, because the present design is correlational–predictive rather than experimental, this association should be interpreted as evidence of a systematic relationship between thinking habits and creative performance, not as evidence that HoM causes creativity gains. The direction and mechanism of this association warrant confirmation through longitudinal or intervention designs.

Experimental studies suggest that learning designs that explicitly incorporate habits of mind can support students' mathematical creative thinking. For example, a habits-of-mind training program improved students' mathematical creative thinking compared with a control group, and the integration of Mathematical Habits of Mind into mathematics learning was reported to enhance students' creative thinking performance (Altakhyneh & Aburiash, 2018; Mellawaty, Sudirman, Waluya, & Rochmad, 2019).

The unique predictive role of Applying Past Knowledge to New Situations can be interpreted through the lens of creative mathematical reasoning and transfer. Jonsson, Granberg, & Lithner (2020) conceptualize creative mathematical reasoning as students' construction of solution methods original to themselves, even if modest, not necessarily as exceptional novelty. Their findings also show that practicing with creative mathematical reasoning tasks supports students' performance on transfer tasks, where a solution idea developed in one task must be adapted to a different task with a similar underlying structure. Thus, Applying Past Knowledge to New Situations may capture students' capacity to adapt prior mathematical knowledge or solution ideas to unfamiliar problem situations.

School mathematics often affords template-based problem solving: across twelve countries, most textbook tasks could be solved by mimicking available templates, with relatively few requiring students to construct their own solution methods (Jäder, Sidenvall, & Sumpter, 2017). Even on non-routine tasks explicitly designed to require more than algorithmic imitation, some students still fell back on imitative reasoning and failed to solve the task (Jäder et al., 2017), suggesting that creative variation emerges specifically when students move beyond template imitation and adapt prior knowledge to new problem structures.

Several methodological and distributional factors likely explain why the remaining seven dimensions did not emerge as significant independent predictors, and these explanations are not mutually exclusive. First, substantial overlapping variance among the eight HoM dimensions, evident in the elevated VIF values for Thinking Flexibly, Creating, Imagining, Innovating, and Remaining Open to Continuous Learning (VIF > 8), means that once shared variance is partitioned out, individual dimensions may retain little unique explanatory power even where their bivariate correlations with MCT were moderate. Second, restriction of range may have suppressed detectable associations for dimensions with uniformly low scores across the sample, particularly Creating, Imagining, Innovating (52.75%) and

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Remaining Open to Continuous Learning (47.00%). When most students score similarly low on a dimension, interindividual variation is too limited for regression to detect a reliable unique contribution, even where the dimension is theoretically relevant. Third, the modest sample size (n = 60) relative to eight simultaneously entered predictors constrains the statistical power available to detect smaller unique effects and raises some risk of overfitting to the specific sample, which would undermine the generalizability of population-level coefficients. This concern is somewhat tempered by the significant incremental contribution of Applying Past Knowledge observed in the hierarchical analysis, but it nonetheless warrants replication with a larger sample.

These methodological cautions are consistent with regression literature showing that multicollinearity can inflate standard errors, widen uncertainty intervals, and reduce the statistical power of tests of individual regression coefficients. Under such conditions, a predictor may fail to reach statistical significance even when it is theoretically or empirically related to the outcome, because its unique contribution is estimated with limited precision after shared variance with other predictors has been partialled out (Al-Essa, Ebrahim, & Mergiaw, 2024; Vanhove, 2021). Similar simulation evidence in regression-like structural models also shows that high correlations among predictors can produce unstable parameter estimates and reduced statistical power, particularly under less favorable sample and measurement conditions (Scharf, Pförtner, & Nestler, 2021). The nonsignificant coefficients for several HoM dimensions therefore offer only limited evidence of unique predictive effects in this sample; they do not indicate that these dimensions are unrelated to MCT.

These statistical patterns are echoed in students' written responses and the follow-up conversations described in the Method section. Although rated Fair descriptively, the Persisting dimension did not translate into a significant predictive contribution. Figure 2 presents a representative example: the student persisted through an extended sequence of substitution and algebraic manipulation steps, but the strategy was inconsistently applied, and the process did not converge on a mathematically correct result. This pattern is consistent with prior work reporting that students often provide lengthy but poorly reasoned responses, with frequent errors in interpreting the problem, applying formulas, and executing calculations (Payadnya, Suwija, & Wibawa, 2021). One student's explanation offers a plausible account for why sustained effort did not translate into predictive value: "If I do as much as I can, maybe there is some kind of 'writing reward,' so I can still get points even if it's wrong." This suggests that, for at least some students, persistence functioned as a strategy for accumulating partial credit rather than as a vehicle for reflective, strategy-driven problem-solving. That is, persistence here reflected quantitative effort (completing as many steps as possible) rather than qualitative effort (producing a correct or original solution). Interpreted this way, the absence of a significant unique coefficient for Persisting is consistent with, rather than contradictory to, its fair descriptive rating.

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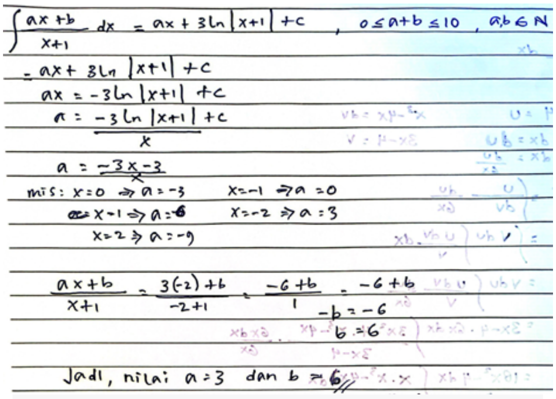

Figure 2. Example of a Student Response Illustrating the Persisting Dimension

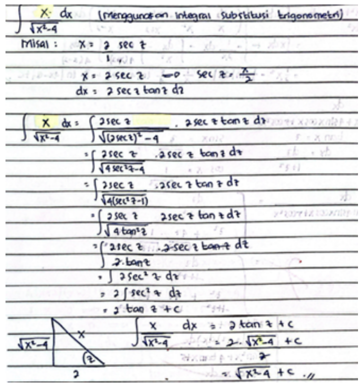

Figure 3. Example of a Student Response Illustrating Applying Past Knowledge to New Situations

A related pattern is evident in students constructed problems for the open-ended items, most of which were minor variations of previously encountered tasks rather than genuinely novel formulations. Figure 3 illustrates this tendency: the student successfully constructed an indefinite integral problem solvable by trigonometric substitution, correctly transferring a procedure introduced during instruction to a self-generated problem. This response demonstrates competent Applying Past Knowledge to New Situations, but it also illustrates the limited exploration of Thinking Flexibly and Creating, Imagining, Innovating, as the student reproduced a familiar structure rather than designing an original problem. In a follow-up conversation, the student explained: “I remember being asked to solve this problem in several ways, and one was by trigonometric substitution. So I just wrote this problem again.” This account reinforces the interpretation that knowledge transfer, rather than flexible or original problem construction, was the dominant process underlying students’ creative output in this sample, consistent with the low unique regression contribution of Thinking Flexibly and Creating, Imagining, Innovating despite their theoretical relevance and moderate bivariate associations with MCT (Table 7). Taken together, these illustrative examples support the broader interpretation that students’ creative output in this sample was driven primarily by successful knowledge transfer rather than by flexible or original problem construction.

The hierarchical regression provides a complementary, rather than corrective, perspective on these results. Entering the dimensions in theoretically motivated blocks, a foundational block (D1–D4), followed by dimensions more closely tied to creative-generative processes (D5–D7), followed by the knowledge-transfer dimension (D8); showed that each block added significant explanatory power, with the addition of Applying Past Knowledge producing a small but statistically significant increment ($\Delta R^2 = 0.027$, $p = 0.019$) even after the other seven dimensions were already in the model. The block-level result reinforces the simultaneous regression finding, confirming that knowledge transfer explains variance in MCT not already captured by the other dimensions. It does not, however, eliminate the underlying multicollinearity among the blocks themselves;

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the substantial jump in explained variance from Block 1 to Block 2 ($\Delta R^2 = 0.142$) suggests that dimensions D5–D7 collectively carry meaningful shared explanatory content that should not be dismissed on the basis of their non-significant individual coefficients in the full model alone.

Taken together, HoM does not appear to function as a uniform construct with respect to mathematical creativity in this Integral Calculus context. Rather, its contribution to MCT appears to be domain-sensitive, with knowledge transfer carrying disproportionate unique weight relative to other theoretically important dimensions such as flexibility and imagination. Creativity research suggesting that creativity involves both domain-general and domain-specific components supports this reading. In particular, mathematical creativity has been shown to depend not only on general creative thinking, but also on mathematical ability and the capacity to combine and reorganize existing mathematical concepts when generating new solutions (Schoevers, Kroesbergen, & Kattou, 2020). Similarly, broader creativity research indicates that some creative dispositions and processes may be relatively general, whereas the evaluation and expression of creativity are shaped by the standards, needs, and cultures of particular domains (van Broekhoven, Cropley, & Seegers, 2020).

The present study extends this domain-general/domain-specific discussion by examining whether different dimensions of Habits of Mind contribute equally to mathematical creative thinking in a specific higher-mathematics context. Whereas prior studies have emphasized the combined role of general creativity and mathematical ability in mathematical creativity, the present findings suggest that, within Integral Calculus, the HoM dimension most directly related to transferring prior knowledge to new situations may be especially important for explaining students' MCT.

These findings carry several practical implications for teaching mathematical creative thinking. Because Applying Past Knowledge to New Situations showed the strongest unique association with creative performance, learning activities should provide students with opportunities to adapt previously learned concepts, procedures, and solution ideas to new mathematical situations. Such an approach aligns with research showing that contextual and open-ended mathematical tasks require students to recognize relevant mathematical content, apply appropriate procedures, and generate multiple possible strategies (Kolar & Hodnik, 2021; Tanudjaya & Doorman, 2020). Moreover, modelling-oriented tasks can support mathematical creativity because they are often open-ended, allow diverse approaches, and require useful and original mathematical reasoning (Lu, Kaiser, Zhu, Ma, & Yan, 2025). Accordingly, the low attainment in Thinking Flexibly, Creating, Imagining, Innovating, and Remaining Open to Continuous Learning should not be interpreted as instructional irrelevance, but as evidence that these dimensions need more deliberate cultivation through open-ended problem solving, metacognitive reflection, and feedback that values strategic reasoning and mathematical validity.

Several limitations should temper the interpretation of these findings. Restricted to 60 students at a single institution, the sample limits generalizability

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and, combined with eight simultaneously entered predictors, raises the possibility of overfitting, replication with a larger, multi-institution sample is needed. Meaningful multicollinearity is also evident in the elevated VIF values for several HoM dimensions, meaning individual coefficients for the non-significant dimensions should not be read as evidence that those dimensions are unimportant, only that their unique contribution could not be statistically isolated in this model.

Instrumentation adds a further constraint: the HoM questionnaire used only 15 statements covering eight of Costa & Kallick (2008) sixteen original dimensions, and the MCT test comprised three open-ended items that may not have fully elicited students' imaginative capacity. Larger samples, more extensive instruments, longitudinal or quasi-experimental designs capable of supporting stronger causal inference, and structural equation modeling or exploratory factor analysis are needed to better disentangle the shared and unique variance among HoM dimensions.

Future research should also give greater attention to the measurement and structural modeling of HoM and MCT. Ubaidillah et al. (2022) demonstrated that Habits of Mind instruments can be examined using exploratory factor analysis and the Rasch model, and their findings indicate that the empirical structure of HoM may differ from its initial theoretical dimensions. Similar to recent mathematical creativity studies that have used structural equation modeling to examine complex relationships among the latent factors influencing MCT, among them creative self-efficacy, attitudes toward mathematics, creative style, environmental literacy, mathematics self-belief, and problem-solving skills (Asare, Arthur, & Obeng, 2025; Suherman & Vidákovich, 2025). Future studies should first validate the factor structure of the HoM and MCT instruments and then use SEM to test the shared and unique pathways through which specific HoM dimensions contribute to mathematical creativity.

CONCLUSION

This study aimed to examine the relationship between students' Habits of Mind (HoM) and Mathematical Creative Thinking (MCT) in an Integral Calculus course and to identify which HoM dimensions uniquely predict mathematical creative thinking once their shared variance is taken into account. Descriptively, both HoM and MCT scores fell in the poor-to-fair range. Only Metacognition, Persisting, and Thinking Flexibly reached the fair category, while Remaining Open to Continuous Learning recorded the lowest attainment among all dimensions (47%, Very Poor). Overall, thinking habits among the sampled students had not yet developed optimally, providing context for the inferential findings that follow. Bivariate analysis nonetheless revealed a strong positive correlation between total HoM score and MCT ($r_s = .775$; $p < 0.001$), confirming that students with more developed thinking habits overall tend to demonstrate stronger mathematical creative performance.

The eight-dimension regression model was significant and explained a substantial share of the variance in MCT scores, $R^2 = .765$, $F(8, 51) = 20.75$, $p <$

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.001, corresponding to a large effect (Cohen's $f^2 = 3.26$). However, several HoM dimensions were highly intercorrelated, with variance inflation factors reaching 11.36, indicating substantial overlap among predictors. Under these conditions, only applying past knowledge to new situations emerged as a significant unique predictor of mathematical creative thinking ($B = 1.412$, $\beta = .324$, $p = .019$), reflecting its distinct, non-redundant contribution rather than a larger bivariate association with MCT. This interpretation was corroborated by a three-block hierarchical regression, in which the self-regulatory dimensions (Block 1: D1–D4) and the creative-generative dimensions (Block 2: D5–D7) together accounted for most of the explained variance ($R^2 = .738$), while applying past knowledge to new situations (Block 3) contributed a smaller yet statistically significant increment, $\Delta R^2 = .027$, $F(1, 51) = 5.86$, $p = .019$. Other dimensions, including thinking flexibly, creating/imagining/innovating, and metacognition, did not show significant unique effects, suggesting that their influence on creativity is substantially shared with other HoM dimensions rather than absent altogether, and that these areas still warrant attention through appropriate pedagogical interventions.

These results carry a theoretical implication beyond the specific predictor identified. Rather than functioning as a uniform, additive framework, HoM appears to operate as a set of overlapping thinking dispositions whose shared variance, more than any single dimension in isolation, accounts for most of the explained creative performance in this context. This reframes the research problem addressed at the outset, shifting the theoretical question from which dimension of HoM matters most in general to which dimension retains a distinctive, non-redundant role once the shared foundation contributed by the others is taken into account. Within the domain of integral calculus, that role belongs to applying past knowledge to new situations, consistent with knowledge-transfer accounts of mathematical creativity in which generating new solutions often builds on adapting previously mastered procedures rather than inventing entirely novel ones.

Practically, these findings point instructors and curriculum developers toward two complementary priorities. First, learning tasks in integral calculus should be deliberately designed to require the transfer of established concepts to unfamiliar problem situations, since this is the dimension shown to carry an independent predictive role. Second, because the remaining dimensions—including thinking flexibly, creating, imagining, innovating, striving for accuracy, and metacognition—remain theoretically important even though their unique statistical contributions could not be isolated in this sample, instructional strategies should continue to cultivate them collectively rather than treating any single dimension as dispensable. Problem-based and open-ended task designs, together with structured opportunities for reflection and self-correction, may help strengthen this broader constellation of habits alongside the specific capacity for knowledge transfer.

These conclusions should be read in light of the study's correlational–predictive design and its sample of 60 students at a single institution, which limits causal inference and generalizability. Future research employing larger, multi-site

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samples and structural equation modeling would help clarify whether the unique contribution of knowledge transfer replicates across contexts. Overall, this study contributes both empirical evidence and a refined theoretical perspective on the relationship between habits of mind and mathematical creativity, indicating that fostering creativity in higher mathematics education requires strategies that target knowledge transfer specifically while continuing to nurture habits of mind as an interconnected whole.

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Authors' Contribution

Hesty Marwani Siregar conceptualized the research, designed the study, conducted the statistical analysis, and prepared the manuscript. Rini Dian Anggraini contributed to the data collection, instrument validation, data analysis support, literature review, and manuscript editing. Both authors reviewed, revised, and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

REFERENCES

Al-Essa, L. A., Ebrahim, E. A., & Mergiaw, Y. A. (2024). Bayesian Regression Modeling and Inference of Energy Efficiency Data: The Effect of Collinearity and Sensitivity Analysis. *Frontiers in Energy Research*, *12*, 1–20. https://doi.org/10.3389/fenrg.2024.1416126

Altakhyneh, B., & Aburiash, H. (2018). Impact of Habits of Mind in Mathematical Creative Thinking at Amman Schools. *An-Najah University Journal for Research - B (Humanities)*, *32*(2), 417–438. https://doi.org/10.35552/0247-032-002-008

Asare, B., Arthur, Y. D., & Obeng, B. A. (2025). Mathematics Self-Belief and Mathematical Creativity of University Students: The Role of Problem-Solving Skills. *Cogent Education*, *12*(1), 1–19. https://doi.org/10.1080/2331186X.2025.2456438

Bicer, A. (2021). A Systematic Literature Review: Discipline-Specific and General Instructional Practices Fostering the Mathematical Creativity of Students. *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, *9*(2), 252–281. https://doi.org/10.46328/ijemst.1254

Buriticá, L. P. M., Sierra, G. M., & Flores, C. D. (2025). Exploring Conceptualisations of the Definite Integral in Mathematics Education: A Systematic Literature Analysis. *Educational Process: International Journal*, *19*, 1–30. https://doi.org/10.22521/edupij.2025.19.537

Corresponding author: Hesty Marwani Siregar (hesty.marwani@lecturer.unri.ac.id)

Caridade, C., & Pereira, V. (2026). Gastronomic Calculus: Integrating STEAM and Flipped Learning in Higher Education Mathematics. *Social Education Research*, *7*(1), 142–157. https://doi.org/10.37256/ser.7120268997

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.)*. New York: Lawrence Erlbaum Associates.

Costa, A. L., & Kallick, B. (2008). *Learning and Leading with Habits of Mind : 16 Essential Characteristics for Success*. Washington DC: Association for Supervision and Curriculum Development.

Danlami, K. B., Zakariya, Y. F., Balarabe, B., Alotaibi, S. B., & Alrosaa, T. M. (2025). Improving Students' Performance in Geometry: An Empirical Evidence of the Effectiveness of Brainstorming Learning Strategy. *Frontiers in Psychology*, *16*, 1–15. https://doi.org/10.3389/fpsyg.2025.1577912

Desti, R. M., Pertiwi, C. M., Sumarmo, U., & Hidayat, W. (2020). Improving Student's Mathematical Creative Thinking and Habits of Mind Using a Problem-Solving Approach Based on Cognitive Thinking Stage. *2nd Internasional Seminar on Applied Mathematics and Mathematics Education (ISAMME) 2020*, 1–8. Cimahi: IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1657/1/012042

Dwirahayu, G., Kustiawati, D., & Bidari, I. (2017). Corresponding Habits of Mind and Mathematical Ability. *International Conference on Mathematics and Science Education (ICMScE)*, 1–6. Bandung: IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/895/1/012013

Eliza, R., Utami, N. P., & Warahma, S. (2022). The Higher Order Thinking Skills of Mathematics Education Students at State Islamic Higher Education in Central Sumatera. *EDUMATIKA: Jurnal Riset Pendidikan Matematika*, *5*(1), 71–84. https://doi.org/10.32939/ejrpm.v5i1.1273

Elsayed, A., Wardat, Y., Alawaed, M., & Albaraami, Y. (2025). The Effect of Employing Project-Web Learning Approach in Teaching Mathematics Instruction Methods Course on Developing the Mind Habits Among Dhofar University Students. *Eurasia Journal of Mathematics, Science & Technology Education*, *21*(2), 1–16. https://doi.org/10.29333/ejmste/15930

Elsayed, S. A. M., & Nasef, H. M. (2021). The Effectiveness of a Mathematics Learning Program Based on the Mind Habits in Developing Academic Achievement Motivation and Creative Thinking among Prince Sattam Bin Abdulaziz University Students. *International Journal of Higher Education*, *10*(1), 55–75. https://doi.org/10.5430/ijhe.v10n1p55

Fineldi, R. J., & Hidayati, K. (2023). Students' Difficulties: Mathematical Creative Thinking Skill Questions Based on Habits of Mind. *Jurnal Riset Pendidikan Matematika*, *10*(1), 16–29. https://doi.org/10.21831/jrpm.v10i1.60001

Hafni, R. N., Sari, D. M., & Nurlaelah, E. (2018). Analyzing the Effect of Students' Habits of Mind to Mathematical Critical Thinking Skill. *The 2nd International Conference of Combinatorics, Graph Theory, and Network Topology*, 1–8. Jember: IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1211/1/012074

Hidayati, N., & Idris, T. (2020). Students' Habits of Mind Profiles of Biology

Corresponding author: Hesty Marwani Siregar (hesty.marwani@lecturer.unri.ac.id)

Education Department at Public and Private Universities in Pekanbaru, Indonesia. *International Journal of Instruction*, *13*(2), 407–418. https://doi.org/10.29333/iji.2020.13228a

Huljannah, M., Sa'dijah, C., & Qohar, A. (2018). Profil Berpikir Kreatif Matematis Mahasiswa Pendidikan Guru Sekolah Dasar. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *3*(11), 1428–1433. https://doi.org/10.17977/jptpp.v3i11.11730

Ibrahim, Khalil, I. A., & Prahmana, R. C. I. (2024). Mathematics Learning Orientation: Mathematical Creative Thinking Ability or Creative Disposition? *Journal on Mathematics Education*, *15*(1), 253–276. https://doi.org/10.22342/jme.v15i1.pp253-276

Jäder, J., Sidenvall, J., & Sumpter, L. (2017). Students' Mathematical Reasoning and Beliefs in Non-routine Task Solving. *International Journal of Science and Mathematics Education*, *15*, 759–776. https://doi.org/10.1007/s10763-016-9712-3

Jean-Pierre, H. C., & Jean-Pierre, W. J. (2026). Mathematics: A Vital Tool in Everyday Life. *Revista Científica Foz*, *8*(2), 111–121. https://doi.org/10.69872/revistafoz.v8i2.418

Jonsson, B., Granberg, C., & Lithner, J. (2020). Gaining Mathematical Understanding: The Effects of Creative Mathematical Reasoning and Cognitive Proficiency. *Frontiers in Psychology*, *11*, 1–16. https://doi.org/10.3389/fpsyg.2020.574366

Kolar, V. M., & Hodnik, T. (2021). Mathematical Literacy from the Perspective of Solving Contextual Problems. *European Journal of Educational Research*, *10*(1), 467–483. https://doi.org/10.12973/eu-jer.10.1.467

Lane, J. F., Altan, S., & Franzenc, R. L. (2024). Exploring Habits of Mind Associated with Incremental Learning Theory to Explain Actions of Teachers Integrating Environmental Education. *Environmental Education Research*, *30*(8), 1296–1307. https://doi.org/10.1080/13504622.2024.2326453

Lu, X., Kaiser, G., Zhu, Y., Ma, H., & Yan, Y. (2025). Mathematical Creativity in Modelling: Further Development of the Construct, Its Measurement, and Its Empirical Implementation. *ZDM – Mathematics Education*, *57*, 365–379. https://doi.org/10.1007/s11858-025-01652-9

Madani, A., & Sari, I. P. (2025). Analysis of Students' Mathematical Creative Thinking Ability on Solving Geometry Problems. *(JIML) Journal of Innovative Mathematics Learning*, *8*(4), 671–680. https://doi.org/10.22460/jiml.v8i4.p21383

Mellawaty, M., Sudirman, Waluya, S. B., & Rochmad. (2019). Creative Thinking Ability on the Integrating Mathematical Habits of Mind in Missouri Mathematics Project Learning. *International Seminar on Applied Mathematics and Mathematics Education*, 1–5. Cimahi: IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1315/1/012083

Nugroho, S. W. P., Riyadi, & Triyanto. (2019). The Analysis of Algebra Creative Thinking Skill Based on Strong Mathematical Habit of Mind. *3rd International Conference on Combinatorics, Graph Theory, and Network Topology*, 1–10.

Corresponding author: Hesty Marwani Siregar (hesty.marwani@lecturer.unri.ac.id)

IOP Publishing Ltd. https://doi.org/10.1088/1742-6596/1538/1/012100

Panneerselvam, G., & Priyadharsini, M. (2026). Conceptual Learning of Calculus in Teacher Education: A Time Series Approach to Visualization Over Math Solver in Diverse Learners. *Cognitive Insight in Education*, *2*(1), 1–17. https://doi.org/10.64850/cognitive.v2i1.162

Payadnya, I. P. A. A., Suwija, I. K., & Wibawa, K. A. (2021). Analysis of Students' Abilities in Solving Realistic Mathematics Problems Using "What-If" Ethnomathematics Instruments. *Mathematics Teaching-Research Journal*, *13*(4), 131–149. Retrieved from https://eric.ed.gov/?id=EJ1332339

Rahayuningsih, S., Sirajuddin, S., & Ikram, M. (2021). Using Open-ended Problem-solving Tests to Identify Students' Mathematical Creative Thinking Ability. *Participatory Educational Research (PER)*, *8*(3), 285–299. https://doi.org/10.17275/per.21.66.8.3

Scharf, F., Pförtner, J., & Nestler, S. (2021). Can Ridge and Elastic Net Structural Equation Modeling be Used to Stabilize Parameter Estimates When Latent Factors are Correlated? *Structural Equation Modeling: A Multidisciplinary Journal*, *28*(6), 928–940. https://doi.org/10.1080/10705511.2021.1927736

Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation Coefficients: Appropriate Use and Interpretation. *Anesthesia & Analgesia*, *126*(5), 1763–1768. https://doi.org/10.1213/ANE.0000000000002864

Schoevers, E. M., Kroesbergen, E. H., & Kattou, M. (2020). Mathematical Creativity: A Combination of Domaingeneral Creative and Domain-specific Mathematical Skills. *Journal of Creative Behavior*, *54*(2), 242–252. https://doi.org/10.1002/jocb.361

Seleznyov, S., Adhami, M., Black, A., Hodgen, J., & Twiss, S. (2022). Cognitive Acceleration in Mathematics Education: Further Evidence of Impact. *Education 3-13*, *50*(5), 564–576. https://doi.org/10.1080/03004279.2021.1872678

Sidik, G. T., Herman, T., Prabawanto, S., Riyadi, A. R., & Marji, M. S. (2026). Cognitive Obstacles and Textbook Praxeological Limitations Underlying The Low Mathematical Creative Thinking of Elementary Students. *Jurnal Pendidikan MIPA*, *27*(2), 693–720. https://doi.org/10.23960/jpmipa.v27i2.pp693-720

Solfitri, T., & Siregar, H. M. (2021). Developing integration techniques module to improve mathematical creative thinking ability in Integral Calculus. *Jurnal PAJAR (Pendidikan Dan Pengajaran)*, *5*(2), 296–305. https://doi.org/10.33578/pjr.v5i2.8221

Suherman, S., & Vidákovich, T. (2024). Mathematical Creative Thinking-Ethnomathematics based Test: Role of Attitude toward Mathematics, Creative Style, Ethnic Identity, and Parents' Educational Level. *Revista De Educación a Distancia (RED)*, *24*(77), 1–22. https://doi.org/10.6018/red.581221

Suherman, S., & Vidákovich, T. (2025). Creative Self-Efficacy, Attitudes, Creative Style, and Environmental Literacy: Promoting Mathematical Creative Thinking. *The Journal of Educational Research*, *118*(5), 475–485.

Corresponding author: Hesty Marwani Siregar (hesty.marwani@lecturer.unri.ac.id)

https://doi.org/10.1080/00220671.2025.2495329

Tanudjaya, C. P., & Doorman, M. (2020). Examining Higher Order Thinking in Indonesian Lower Secondary Mathematics Classrooms. *Journal on Mathematics Education*, *11*(2), 277–300. https://doi.org/10.22342/jme.11.2.11000.277-300

Ubaidillah, M., Marwoto, Wiyanto, P., Rusilowati, A., Subali, B., Mindyarto, B. N., & Isnaeni, W. (2022). Development of Habits of Mind Instruments in the Context of Basic Physics Practicum: EFA and Rasch Model. *Journal of Educational, Cultural and Psychological Studies*, *26*, 23–49. https://doi.org/10.7358/ecps-2022-026-ubai

van Broekhoven, K., Cropley, D., & Seegers, P. (2020). Differences in Creativity Across Art and STEM Students: We are More Alike Than Unalike. *Thinking Skills and Creativity*, *38*, 1–13. https://doi.org/10.1016/j.tsc.2020.100707

Vanhove, J. (2021). Collinearity Isn't a Disease that Needs Curing. *Meta-Psychology, 5*, 1–11. https://doi.org/10.15626/MP.2021.2548

Zhu, Y., Lu, H., Wang, X., Ma, W., & Xu, M. (2025). The Relationship Between Perceived Peer Support and Academic Adjustment Among Higher Vocational College Students: The Chain Mediating Effects of Academic Hope and Professional Identity. *Frontiers in Psychology*, *16*, 1–14. https://doi.org/10.3389/fpsyg.2025.1534883

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