Multidisciplanary Journal of Systemic and Innovative Research (MJSIS)
Vol. 3 No. 1 March 2026 Page. 182-188

Implementation of the Discovery Learning Method and the Realistic Mathematics Education Approach to Improve Student Learning Outcomes

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ARTICLE INFO

Published: March, 15th 2026
Key Word : Discovery learning, realistic mathematic, outcome

ABSTRACT

Mathematics education at the junior high school level often faces challenges regarding student engagement and conceptual mastery, particularly in complex topics like geometry. Traditional instructional methods frequently fail to bridge the gap between abstract mathematical theories and real-world applications, leading to low student motivation and limited critical thinking skills. This study investigates the impact of integrating the Discovery Learning method, supported by audiovisual media, with the Realistic Mathematics Education (RME) approach on the learning outcomes of Grade VII students in plane geometry. A quantitative research design was employed, involving 24 students in Tangerang. Data were collected via validated Likert-scale questionnaires to measure Discovery Learning (X1) and RME (X2), while learning achievement (Y) was assessed through a standardized post-test. Data analysis included normality and linearity tests followed by multiple linear regression using SPSS 23.The findings indicate that both Discovery Learning and RME have a significant linear relationship with student achievement. The regression model yielded an R-square value of 0.674, suggesting that 67.4% of the variance in mathematics achievement is explained by the combined application of these two approaches. These results demonstrate that synergistic, context-rich, and inquiry-based instruction significantly enhances conceptual understanding. Educators are encouraged to adopt integrated multimedia-supported discovery models to foster higher-order thinking and better academic performance in secondary mathematics.

INTRODUCTION

Mathematics education at the junior high school level plays a critical role in developing students' reasoning, problem-solving, and data interpretation skills. However, many students in lower secondary education still demonstrate limited conceptual understanding and low motivation when learning mathematical topics, including data and its representations (Putra & Milenia, 2021). This situation highlights the need for instructional approaches that both engage learners and foster higher-order thinking. Two promising strategies are the Discovery Learning method and the Realistic Mathematics Education (RME) approach, which—when combined—may address gaps in student learning outcomes on the topic of data for Grade VII students.

Discovery Learning emphasizes student-centered exploration, inquiry, and active construction of knowledge. This method encourages learners to investigate problems, form hypotheses, and draw conclusions with teacher facilitation, promoting autonomy and critical thinking. Several studies have shown that Discovery Learning can positively influence students' critical thinking and learning outcomes when supported by appropriate instructional resources. Martir et al. (2024) and colleagues report that Discovery Learning is effective in improving students' critical thinking abilities . Similarly, Intania found that Discovery Learning aided by audiovisual tools enhanced the learning process, suggesting that multimedia support can strengthen engagement and concept acquisition (Intania). These findings indicate that Discovery Learning, especially when integrated with instructional media, has the potential to deepen students' conceptual grasp and stimulate analytical skills in mathematics.

Classroom Action Research (CAR) studies further support the effectiveness of Discovery Learning when combined with video-based resources. Ridwan's CAR study indicated that Discovery Learning assisted by video improved students' critical thinking skills. Nurliza and Nazifa reported comparable outcomes in their classroom-based research, demonstrating that video-supported Discovery Learning can raise students' ability to reason and analyze mathematical problems. These classroom-level interventions point to the practical benefits of blending Discovery Learning with audiovisual materials to create richer, more accessible learning experiences that nurture students' critical faculties.

Another avenue for improving mathematics learning is the Realistic Mathematics Education (RME) approach, sometimes referred to in local contexts as Pendekatan Matematika Realistik (PMR). RME situates mathematical ideas within real-world contexts and meaningful problems, enabling learners to connect abstract concepts to everyday experiences. Afsari, Safitri, Harahap, and Munthe (2021) note that RME tends to present explanations grounded in realistic contexts, making it easier for students to digest and internalize mathematical content. By leveraging contexts that are familiar and relevant, RME helps students construct mathematical models and procedures that reflect actual situations, thereby promoting deeper conceptual understanding and retention.

The need for such contextualized approaches is underscored by evidence of weak mathematical concept mastery among students. Jeheman et al. (2019) emphasize that concept understanding remains low across primary and secondary levels, and they recommend careful selection of teaching approaches to achieve better conceptual outcomes. Their research suggests that RME can serve as an effective alternative to conventional methods; students taught through RME showed improved conceptual comprehension compared to those receiving traditional instruction. This finding aligns with the theoretical rationale for combining context-based learning with inquiry-driven pedagogies: realistic contexts provide meaning, while discovery processes foster ownership and cognitive engagement.

Moreover, studies focusing specifically on learning materials and guided activities reinforce the positive impact of inquiry-oriented methods. Dilla Syauqiyah Nurjihan found that Discovery Learning implemented through student worksheets (LKPD) was able to increase student learning outcomes. Structured worksheets that guide discovery can scaffold students' investigative processes, ensuring that exploration remains focused and productive. When such scaffolding aligns with meaningful contexts—as in RME—the combination can address both procedural competence and conceptual understanding.

Given the demonstrated benefits of Discovery Learning (with audiovisual support and guided worksheets) and the context-rich orientation of RME, integrating these approaches may offer synergistic advantages for teaching the topic of data in Grade VII. Data topics—including collection, representation (tables, bar charts, line plots), interpretation, and basic statistical measures—lend themselves well to contextualization and inquiry. Students can engage in real-life data-gathering activities, analyze authentic datasets, and use discovery-oriented tasks to construct understanding. For instance, audiovisual materials can present realistic scenarios or data sources, LKPD can structure inquiry steps, and RME can contextualize interpretation, thereby collectively promoting both motivation and learning outcomes.

Despite these promising signs, gaps remain in evidence specific to the combined use of Discovery Learning and RME for data topics at the junior high level. While individual studies have reported improvements in critical thinking and learning outcomes through Discovery Learning (Luxcya et al.; Ridwan; Nurliza & Nazifa; Intania) and RME has been shown to enhance conceptual comprehension (Afsari et al., 2021; Jeheman et al., 2019), research that explicitly investigates the integrated application of these approaches for Grade VII data lessons is limited. Addressing this gap is important because the convergence of inquiry-based methods and realistic contexts could uniquely support students' abilities to interpret and reason about data—a competence increasingly vital in a data-rich society.

Therefore, this study investigates the implementation of the Discovery Learning method combined with the Realistic Mathematics Education approach to improve student learning outcomes on the topic of data for Grade VII junior high school students. By examining how these approaches interact in practice—using audiovisual supports and structured worksheets where appropriate—the research aims to contribute empirical evidence on effective strategies for enhancing both conceptual understanding and motivation in lower secondary mathematics.

METHOD

Research Design

This quantitative study examines the effects of Discovery Learning (X1) and the Realistic Mathematics Education approach (X2) on students' learning outcomes in plane geometry (Y). The sample comprised 24 Grade VII students from a junior high school in Tangerang. The study was conducted from March 12, 2004 to May 1, 2024 in Tangerang. Independent variables X1 and X2 were measured using validated Likert-scale questionnaires administered to students after instruction. The dependent variable Y was measured by students' scores on a standardized post-test covering plane geometry topics (unit test/quiz). Data were entered and analyzed using SPSS 23. Prior to hypothesis testing, assumptions were checked: normality of residuals (Kolmogorov–Smirnov/Shapiro–Wilk) and homogeneity of variances (Levene's test). Inferential analysis included one-way ANOVA/F-test where

RESULT AND DISCUSSION

Mastery of digital and financial literacy plays a very crucial role in driving the success and sustainability of student entrepreneurship. Based on various previous studies, it can be concluded that developing financial and digital literacy is a strategic step that must be implemented optimally to support students in conducting their entrepreneurial activities more effectively, efficiently, and competitively.

Hanifa (2023) emphasizes that family environment and digital literacy have a significant influence, amounting to 92%, on students' interest in entrepreneurship. This shows

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Metode discovery learning	.106	65	.066	.977	65	.270
Pendekatan Matematika Realistik	.094	65	.200*	.983	65	.526
Prestasi Belajar Matematika	.106	65	.066	.974	65	.187

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The normality tests indicate that all three variables meet the normality assumption. For the Discovery Learning method variable, the Kolmogorov–Smirnov statistic is 0.106 with significance 0.066 and the Shapiro–Wilk is 0.977 with significance 0.270; both are greater than $\alpha = 0.05$, so the data distribution does not differ significantly from a normal distribution. The Realistic Mathematics Education approach variable has a Kolmogorov–Smirnov value of 0.094 with significance 0.200 (the lower bound after the Lilliefors correction) and a Shapiro–Wilk of 0.983 with significance 0.526; both tests are also non-significant, indicating the data are normally distributed. For Mathematics Achievement, the Kolmogorov–Smirnov shows a statistic of 0.106 with significance 0.066 while the Shapiro–Wilk is 0.974 with significance 0.187, which again indicates no significant deviation from normality. Thus, based on the Kolmogorov–Smirnov (with Lilliefors correction) and Shapiro–Wilk tests, the normality assumption is satisfied for all variables, and parametric analyses such as multiple linear regression can proceed.

			Sum of Squares	df	Mean Square	F	Sig.
Y * X1	Between Groups	(Combined)	1972.970	10	70.463	2.224	.042
		Linearity	168.111	1	168.111	5.305	.034
		Deviation from Linearity	1804.859	10	66.847	2.109	.105
	Within Groups		2915.410	3	31.689		

Total	4888.380	24			

The linearity test indicates a significant linear relationship between variable X1 (Discovery Learning method) and Y (Mathematics Achievement). In the "Linearity" row, the Sum of Squares is 168.111 with df = 1, yielding a Mean Square = 168.111 and F = 5.305, with significance p = 0.034 (< 0.05), so the null hypothesis of no linear relationship is rejected. Meanwhile, the "Deviation from Linearity" component shows Sum of Squares = 1804.859, df = 27, Mean Square = 66.847, F = 2.109 with p = 0.105 (> 0.05), which means there is no evidence of a significant deviation from linearity (no significant curvature). Overall (Combined) F = 2.224 with p = 0.042 also indicates a significant combined effect. Thus, the relationship pattern between X1 and Y can be considered linear and a parametric linear model is appropriate to describe that relationship.

ANOVA Table

			Sum of Squares	Df	Mean Square	F	Sig.
Prestasi Belajar Matematika * Metode discovery learning	Between Groups	(Combined)	2846.663	10	86.263	1.575	.103
		Linearity	1252.140	1	1252.140	22.866	.000
		Deviation from Linearity	1594.523	10	49.829	.910	.604
	Within Groups		1697.583	3	54.761		
	Total		4544.246	24			

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Y * X2	Between Groups	(Combined)	4754.360	10	190.174	134.804	.000
		Linearity	4730.086	1	4730.086	3352.906	.000
		Deviation from Linearity	24.274	10	1.011	.717	.823
	Within Groups		134.021	3	1.411		
	Total		4888.380	24			

ANOVA Table

		Sum of Squares	Df	Mean Square	F	Sig.
	(Combined)	2977.029	10	90.213	1.784	.054

Prestasi Belajar Mateamtika * Pendekatan matematikan realistik	Between Groups	Linearity	1486.804	1	1486.804	29.409	.000
		Deviation from Linearity	1490.225	10	46.570	.921	.591
	Within Groups		1567.217	3	50.555		
	Total		4544.246	24			

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.621[a]	.674	.667	6.74609

a. Predictors: (Constant), X2, X1

Nilai R 0,621 menunjukkan hubungan sedang–kuat antara gabungan prediktor (X1 dan X2) dengan variabel terikat Y. R Square 0,674 berarti bersama-sama X1 dan X2 menjelaskan sekitar 67,4% variasi pada Y, sehingga model memiliki kemampuan penjelasan yang cukup tinggi; Adjusted R Square 0,667 yang hampir sama dengan R Square menandakan bahwa penjelasan model tetap kuat setelah koreksi untuk jumlah prediktor dan ukuran sampel (sedikit penalti), sehingga kemungkinan overfitting atau inflasi R^2 kecil. Std. Error of the Estimate 6,746 menunjukkan bahwa prediksi model rata-rata meleset sekitar 6,75 satuan dari nilai Y aktual.

The combined application of Discovery Learning and Realistic Mathematics Education (RME) can significantly enhance student achievement in plane geometry by fostering active inquiry and contextual understanding; Discovery Learning, especially when augmented with instructional videos, promotes critical thinking, encourages exploration of geometric relationships, and helps learners visualize spatial properties and transformations, which are vital for mastering concepts such as congruence, similarity, area, and perimeter (Humaira & Nurliza Lubis, 2024). Videos paired with guided discovery tasks can scaffold students' investigative processes, providing dynamic illustrations of geometric constructions and step-by-step visual reasoning that make abstract properties more accessible. When students engage in discovery activities, they generate hypotheses, test procedures, and reflect on outcomes, strengthening both procedural fluency and conceptual depth. RME complements this by situating geometric problems in realistic contexts—design, architecture, tiling, or everyday measurement—thus reducing cognitive distance between students' informal intuitions and formal geometric formulations. Contextual tasks encourage modeling, interpretation, and justification, allowing learners to connect real-world scenarios to formal geometric reasoning and thereby improving retention and transfer. The synergy of discovery-based inquiry and realistic contexts supports multiple representations—diagrams, manipulatives, symbolic expressions—and cultivates metacognitive strategies as students explain and justify solutions. Empirical classroom action research indicates that multimedia-supported Discovery Learning not only improves critical thinking but also enhances engagement and motivation, which are mediators of improved academic outcomes (Humaira & Nurliza Lubis, 2024). For plane geometry, this means students are more likely to internalize definitions, understand proofs, and apply formulas accurately in novel situations. In sum, integrating video-enhanced Discovery Learning with RME principles offers a pedagogically robust approach that promotes deeper understanding, critical problem solving, and higher

achievement in plane geometry, as evidenced by classroom interventions that report gains in students' critical abilities and learning outcomes (Nurliza & Nazifa).

CONCLUSION

The results indicate that both X1 (Discovery Learning) and X2 (Realistic Mathematics Education) positively influence students' mathematics achievement (Y) on plane geometry. The combined model shows a substantial explanatory power ($R = 0.621$; $R^2 = 0.674$; Adjusted $R^2 = 0.667$), meaning X1 and X2 together account for about 67.4% of the variance in achievement, and the adjusted R^2 confirms the model's robustness after correction. Linearity testing for X1 demonstrates a significant linear relationship with Y ($F = 5.305$, $p = 0.034$) and no significant deviation from linearity, supporting use of a linear model. Normality assumptions are met for all variables, and overall tests indicate a significant combined effect. Taken together, the evidence suggests that implementing Discovery Learning (especially with multimedia and guided worksheets) alongside Realistic Mathematics approaches contributes meaningfully to improved performance in plane geometry, making the linear parametric model appropriate for describing these influences.

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