

# Realistic Mathematics Education (RME) Approach on the Students' Mathematical Skills and Performance

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**Abstract**—The main purpose of this study is to assess the effect of the Realistic Mathematics Education (RME) approach on students' mathematical skills and performance. Specifically, it aims to determine the level of the RME approach and students' mathematical skills and performance; the significant difference between diagnostic and summative tests results; and the significant effect of the RME approach on students' mathematical skills and performance. The descriptive method was used to assess the impact of the RME approach on students' mathematical skills and performance. The respondents included 80 Grade 11 students from Dayap National Integrated High School, Calauan, Laguna. A Purposive Sampling technique were used to select the respondents of the study. Data were collected using a self-made questionnaire and test questions. Analysis reveals that the level of RME Approach in terms of modeling abstract, student strategies, collaborative learning, and interdisciplinary connections was highly accepted, while the concrete concept was less accepted. Students were rated as highly skilled in analytical, application, and creativity, and as skilled in critical thinking and problem-solving. Likewise, their mathematical performance improved from fairly satisfactory in the diagnostic to very satisfactory in the summative test. The RME approach showed a significant effect on students' mathematical skills, while no significant effect on their mathematical performance. It is concluded that the students' mathematical performance on diagnostic and summative tests results shows a significant difference and the RME approach has a significant effect on students' mathematical skills; therefore, the hypothesis was rejected. On the other hand, the RME approach has no significant effect on students' mathematical performance in terms of diagnostic test and summative test; thus, the hypothesis was accepted. It is recommended to adopt a holistic RME framework in a longer-term study, with the aim of integrating mathematical skills aligned with Bloom's Taxonomy cognitive domain into the test questions.

**Keywords**— RME Approach, Modeling Abstract, Realistic Mathematics, Real-life Context, Abstract Concept.

## I. INTRODUCTION

Mathematics is a unique subject that nurtures learners' intellectual development. It is also a tool for equipping students with various mathematical skills essential for academic success across disciplines. As it enhances their ability to analyze, organize, and apply knowledge in both educational and real-life contexts, it is often seen as difficult due to its abstract nature. Since mathematical concepts are used in daily life, acquiring these skills can lead to the development of 21st-century skills that are connected with academic achievement.

Traditional practices are already proven to be inadequate in meeting the demands of the learning process that's why

numerous teaching practices were introduced by the Department of Education, especially in Mathematics, as we still observe below-average performances in this discipline according to the Programme for International Student Assessment (PISA) in 2023. Therefore, by developing students' mathematical skills and improving their performance, teachers can adopt innovative solutions. They should enrich the learning environment by applying new teaching approaches.

To align with the curriculum goals, Realistic Mathematics Education (RME) approach has emerged as one of the innovative instructional models that emphasize active learning, contextualization and student engagement. The goal of this approach is to make mathematics more engaging and meaningful, that can help students to recognize practical uses in everyday life (Ericko & Musdi, 2018). Although RME approach was developed in the Netherlands during 1970s, limited studies are focusing on its significance in the learners' mathematical skills and performance, especially in viewing how RME approach works on the concrete improvements in learners' achievement also by applying RME approach with sub elements in teaching the mathematics subject.

This research aimed to bridge this gap by exploring the effects of RME Approach in the learners' mathematical competences that can also leads to their success in academic. In particular, this study aims to determine the effect of RME Approach on the Students' Mathematical Skills and Performance.

### 1.1 Statement of the Problem

*Problem/s which were addressed by the research*

This study aimed to determine the effect of the Realistic Mathematics Education (RME) Approach on the Students' Mathematical Skills and Performance.

Specifically, it sought to answer the following questions:

1. What is the level of Realistic Mathematics Education (RME) Approach in terms of:
  - 1.1 Concrete Concepts,
  - 1.2 Modeling Abstracts,
  - 1.3 Student Strategies,
  - 1.4 Collaborative Learning, and
  - 1.5 Interdisciplinary Connections?
2. What is the level of Students' Mathematical Skills relative to:
  - 2.1 Analytical Skills,
  - 2.2 Application Skills,
  - 2.3 Creativity Skills,

- 2.4 Critical Thinking Skills, and
- 2.5 Problem-Solving Skills?
- 3. What is the level of Students' Mathematical Performance with regards to:
  - 3.1 Diagnostic Test, and
  - 3.2 Summative Test?
- 4. Is there a significant difference between the Diagnostic Test and the Summative Test results?
- 5. Does the Realistic Mathematics Education (RME) Approach have a significant effect on the students' mathematical skills?
- 6. Does the Realistic Mathematics Education (RME) Approach have a significant effect on the students' mathematical performance in terms of:
  - 6.1 Diagnostic Test and
  - 6.2 Summative Test?

II. METHODOLOGY

The descriptive method was used to assess the impact of the RME approach on students' mathematical skills and performance. The respondents included 80 Grade 11 students from Dayap National Integrated High School, Calauan, Laguna. A Purposive Sampling technique were used to select the respondents of the study. Data were collected using a self-made questionnaire and test questions.

III. RESULTS AND DISCUSSION

This part presents the analysis and interpretation of data collected from selected grade 11 students of Dayap National Integrated High School. It focuses on their observations regarding the implementation of the Realistic Mathematics Education (RME) approach, including concrete concepts, modeling abstracts, student strategies, collaborative learning, and interdisciplinary connections related to the students' mathematical skills such as analytical, application, creativity, critical thinking, and problem-solving skills. It also covers their performance on diagnostic and summative tests.

*Level of Realistic Mathematics Education (RME) approach*

In this study, RME approach is the adopted approach to teach the mathematical concepts into real-world context.

The level of RME approach, such as concrete concepts, modeling abstracts, student strategies, collaborative learning, and interdisciplinary connections, was measured by getting the mean and standard deviation.

The following tables present the level of the Realistic Mathematics Education (RME) approach according to their order and sequence.

Table 1 shows the level of the RME approach regarding concrete concepts, which refers to the student learning process involving real-world problems or contexts. The extent to which learning through experiencing how mathematical ideas are applied in real-life situations enhances students' understanding is examined by this component of the RME approach. The mean score is (M=4.29), indicating that students can always evaluate whether a real-life problem involves mathematical concepts. At the same time, they can always use realistic examples to apply mathematical reasoning

(M=4.23). Respondents generally agreed that realistic situations help them recall, explain, and apply mathematical concepts.

Table 1. Level of Realistic Mathematics Education (RME) approach in terms of Concrete Concepts

Statements	Mean	SD	Remarks
I can recall mathematical concepts when they are connected to real-life situations.	4.05	0.78	Sometimes
I can explain a mathematical concept better when it starts from similar experiences.	3.98	0.84	Sometimes
I can use realistic examples to apply mathematical reasoning.	4.23	0.84	Always
I can examine patterns in real-life situations related to specific mathematical concepts.	4.03	0.87	Sometimes
I can evaluate whether a real-life problem effectively represents a mathematical concept.	4.29	0.73	Always
Weighted Mean	4.11		
SD	0.82		
Verbal Interpretation			Accepted

The level of the Realistic Mathematics Education (RME) approach in terms of concrete concepts is relatively accepted, with a weighted mean of 4.11 and a standard deviation of 0.82. In summary, this means that students effectively assess mathematical concepts by firmly grounding lessons in real-world situations. This indicates that adding meaningful and real-world scenarios enhances students' conceptual understanding of mathematics.

Table 2 shows the level of RME approach in terms of modeling abstracts. Modeling abstract refers to the models that used informal knowledge and strategies that is relevant with the given problem, it is a tool in RME approach component that supports the process of learning

Table 2. Level of Realistic Mathematics Education (RME) approach in terms of Modeling Abstracts

Statements	Mean	SD	Remarks
I can recall different types of mathematical models learned in class.	4.36	0.68	Always
I can explain how a model represents the parts of a problem.	4.61	0.65	Always
I can use sketches or models to help me solve mathematical problems.	4.41	0.81	Always
I can analyze patterns in a problem by examining the model used.	4.36	0.70	Always
I can evaluate whether the model I used was effective in solving the problem.	4.19	0.78	Sometimes
Weighted Mean	4.39		
SD	0.73		
Verbal Interpretation			Highly Accepted

The students can always explain how a model can represent parts of a problem (M=4.61). However, sometimes they can evaluate whether the model they used was effective in solving the problem (M=4.19). This indicates that visual tools as a learning aid for mathematical concepts are approved by the respondents, who state that they can use sketches or models to analyze patterns of problems.

The weighted mean of 4.39 and standard deviation of 0.73 indicate a highly accepted level of RME approach, especially regarding Modeling Abstracts. This finding shows that students believe using modeling abstracts as a tool is a way to analyze mathematical problems.

Table 3 revealed the level of RME approach in terms of student strategies; it stated that student strategies refer to the in-depth thinking in developing their own way to produce solutions on a given problem.

Table 3. Level of Realistic Mathematics Education (RME) approach in terms of Student Strategies

Statements	Mean	SD	Remarks
I can recall strategies I previously learned to solve math problems.	4.49	0.76	Always
I can explain a problem using my own words or method.	4.51	0.80	Always
I can use my preferred strategy to solve math tasks.	4.45	0.83	Always
I can compare different strategies to see which one works best.	4.29	0.97	Always
I can assess the effectiveness of my chosen strategy.	4.50	0.80	Always
Weighted Mean	4.45		
SD	0.83		
Verbal Interpretation	Highly Accepted		

With the help of the RME approach, student can always explain a problem using their own words or methods (M=4.51). They can also compare different strategies to see which one works best (M=4.29).

A highly accepted level of RME approach in terms of student strategies Revealed in the table above with a weighted mean of 4.45 and a standard deviation of 0.83, this result indicates that students can develop new plans when solving problems.

Table 4 illustrates the level of the RME approach in terms of collaborative learning. Collaborative learning is a common method to engage students in learning mathematics. In this study, it refers to interactions between teachers and students as well as among students, especially through group activities.

Table 4. Level of Realistic Mathematics Education (RME) approach in terms of Collaborative Learning

Statements	Mean	SD	Remarks
I can remember ideas shared by group members during discussion.	4.48	0.86	Always
I can understand a problem better after hearing peers' explanations.	4.33	0.99	Always
I can use group discussion to apply different ways of solving problems.	4.45	0.78	Always
I can analyze different viewpoints shared during group activities.	4.28	0.97	Always
I can evaluate how group collaboration improves my learning.	4.30	0.96	Always
Weighted Mean	4.37		
SD	0.91		
Verbal Interpretation	Highly Accepted		

This reveals that the students can always remember ideas shared by group members during the discussion (M= 4.48), they can also analyze different viewpoints shared during group activities (M= 4.28).

The table above shows the level of the RME approach in terms of collaborative learning, with a total mean score of 4.37 and a standard deviation of 0.91, interpreted as Highly Accepted. Collaborative learning, as perceived by students, is a fun and engaging way to learn as they share ideas and analyze different viewpoints.

Table 5 presents the level of RME approach in terms of interdisciplinary connections. This component of the RME approach refers to the structuring and collaborative process of addressing topics together, emphasizing interconnectedness. It focuses on how mathematical concepts can be linked to other disciplines to strengthen students' holistic and conceptual understanding of knowledge, rather than viewing subjects as isolated. In this regard, students can always see the usefulness of mathematics in understanding real-world issues across subjects (M= 4.39), while they sometimes apply mathematical concepts to solve problems in other subject areas (M=4.15). The level of the RME approach regarding interdisciplinary connections is highly accepted, with a weighted mean score of 4.29 and a standard deviation of 0.90.

Table 5. Level of Realistic Mathematics Education (RME) approach in terms of Interdisciplinary Connections

Statements	Mean	SD	Remarks
I can recall situations where math connects with other subjects.	4.26	0.82	Always
I can explain how math supports learning in subjects like science or art.	4.34	0.93	Always
I can apply math concepts to solve problems in other subject areas.	4.15	0.94	Sometimes
I can examine how math ideas interact with concepts from other fields.	4.33	0.99	Always
I can judge the usefulness of math in understanding real-world issues across subjects.	4.39	0.80	Always
Weighted Mean	4.29		
SD	0.90		
Verbal Interpretation	Highly Accepted		

#### Level of Mathematical Skills

Herein, the mathematical skills are consisted of analytical skills, application skills, creativity skills, critical thinking skills and problem-solving skills, they are measured by getting the mean and standard deviation. The following tables present the level of Mathematical skills according to their order and sequence.

Table 6 shows the level of mathematical skills relative to of analytical skills in which refers on how the students dissect a problem's structure through structural analysis. It is perceived by the students as a way to break down a complex problem into steps and with that they can also examine relationships between parts of a problem (M=4.61), also they can remember important elements of a mathematical problem (M=4.49).

Table 6. Level of Mathematical Skills relative to Analytical Skills

Statements	Mean	SD	Remarks
I can remember the important elements of a mathematical problem.	4.49	0.66	Always
I can extract the relevant information needed to solve a problem.	4.56	0.65	Always
I can apply analysis to break down a complex problem into steps.	4.61	0.61	Always
I can examine relationships between parts of a problem.	4.61	0.72	Always
I can evaluate which solution structure is most appropriate.	4.53	0.67	Always
Weighted Mean	4.56		
SD	0.66		
Verbal Interpretation	Highly Skilled		

The level of mathematical skills relative to analytical skills achieved a weighted mean of 4.56 and a standard deviation of 0.66, which is interpreted as highly skilled. This indicates that students can break down complex problems, leading them to extract relevant information needed for solving.

Table 7 highlighted the level of mathematical skills relative to application skills that pertain to how students find solutions and make sense of the world. In this study, application skills also involve transferring abstract concepts to real-world contexts.

A mean score of 4.55 indicated that students can explain how mathematical concepts relate to real-life situations. However, they sometimes evaluate whether the method they used is appropriate for real-life problems (M=4.06).

Table 7. Level of Mathematical Skills relative to Application Skills

Statements	Mean	SD	Remarks
I can easily recall mathematical concepts I used in real-life situations.	4.24	0.83	Always
I can explain how mathematical concepts relate to real-life situations.	4.55	0.71	Always
I can apply mathematical concepts to real-life situations and other subjects.	4.31	0.87	Always
I can analyze patterns when applying math in real contexts.	4.14	0.79	Sometimes
I can evaluate whether the method I used is appropriate for the real-life problem.	4.06	0.88	Sometimes
Weighted Mean	4.26		
SD	0.83		
Verbal Interpretation			Highly Skilled

The level of mathematical skills relative to application skills revealed that students are highly skilled, with a weighted mean of 4.26 and a standard deviation of 0.83. This indicates that, on average, students in this study can demonstrate how a mathematical concept relates to real-world situations.

Table 8 showed the level of mathematical skills in relation to creativity skills; it refers to higher-order mathematics that involves developing original solutions or being innovative. Students can always explain strategies they used to create new ways of solving problems (M=4.59), and they sometimes apply new strategies when solving open-ended problems (M=4.15).

Table 8. Level of Mathematical Skills relative to Creativity Skills

Statements	Mean	SD	Remarks
I can recall different strategies for creating solutions.	4.20	0.86	Sometimes
I can explain how strategies can create new way in solving problems.	4.59	0.79	Always
I can apply new strategies in solving open-ended problems.	4.15	0.97	Sometimes
I can examine different ways of combining concepts to generate new solutions.	4.24	1.05	Always
I can create new strategies in solving problems.	4.55	0.98	Always
Weighted Mean	4.35		
SD	0.95		
Verbal Interpretation			Highly Skilled

This table shows that the level of mathematical skills relative to creativity skills has a weighted mean of 4.35 and standard deviation of 0.95 which is interpreted as highly

skilled. Students' creativity is visible on this study, in a way that they can create new way in solving problems

Table 9 presented the mathematical skills relative to critical thinking skills. These skills refer to the evaluation and judgement of solutions in a problem that assess the accuracy, validity and reliability.

Table 9. Level of Mathematical Skills relative to Critical Thinking Skills

Statements	Mean	SD	Remarks
I can recall steps needed to check the accuracy of a solution.	4.05	1.32	Sometimes
I can explain my answers using logical reasoning.	4.28	1.18	Always
I can assess the assumptions made in the problem.	3.95	1.36	Sometimes
I can analyze the restrictions of the methods used in solving problem.	4.49	0.99	Always
I can evaluate of the answer is logical or realistic.	4.24	1.22	Always
Weighted Mean	4.20		
SD	1.23		
Verbal Interpretation			Skilled

In this, students tend to consistently analyze the limitations of the methods used to solve problems (M=4.49), and they sometimes evaluate the assumptions made in the problem (M=3.95). The level of mathematical skills relative to critical thinking skills indicates that students are skilled, with a weighted mean of 4.20 and a standard deviation of 1.23. This demonstrates that students in this study are proficient critical thinkers, showcasing their ability to evaluate problems using logical or realistic reasoning.

Table 10 illustrated the mathematical skills related to problem-solving skills. Problem-solving skills are defined as students' ability to understand a problem logically, develop strategies, and implement solutions in procedural routines. Herein, they can always analyze their work using methods like trial-and-error or working backward (M=4.54); they can also sometimes evaluate whether their final answer is accurate and reasonable (M=4.05).

Table 10. Level of Mathematical Skills relative to Problem-Solving Skills

Statements	Mean	SD	Remarks
I can identify the "What is asked" of the given problem.	4.11	0.98	Sometimes
I can explain possible strategies before answering the problem.	4.15	0.87	Sometimes
I can apply proper method in solving the problem.	4.30	0.77	Always
I can analyze my work using methods like trial-and-error or working backward.	4.54	0.83	Always
I can evaluate whether my final answer is accurate and reasonable.	4.05	1.02	Sometimes
Weighted Mean	4.16		
SD	0.90		
Verbal Interpretation			Skilled

The weighted mean of 4.16 and a standard deviation of 0.90 for the level of mathematical skills relative to problem-solving skills indicate that the students are considered skilled. This shows that students are capable of solving problems when various learning strategies are employed.

Level of Students' Performance

The students' performance in this study is composed of diagnostic test and summative test, and was usually treated statistically using frequency and percentage.

Table 11. Level of Students' Performance with regards to Diagnostic Test

Scores	Frequency	Percentage	Verbal Interpretation
41 – 50	0	0%	Outstanding
31 – 40	5	6%	Very Satisfactory
21 – 30	24	30%	Satisfactory
11 – 20	50	63%	Fairly Satisfactory
0 – 10	1	1%	No Improvement
Total	80	100%	

Weighted Mean = 19.54

SD=5.87

Verbal Interpretation = Fairly Satisfactory

The table presents the level of students' performance in this study based on the results of the diagnostic test. The diagnostic test is the initial assessment that students take before the implementation begins. It includes score ranges, frequency, percentage, and corresponding remarks. Meanwhile, the summative test refers to the evaluation conducted afterward, serving as evidence of the learners' mastery and progress.

Most of the 80 respondents (50, or 63%) scored Fairly Satisfactory were scores ranged from 11 to 20. 24 students (30%) with scores in the range of 21–30 and ranked as Satisfactory followed. Five students (6%) achieved a grade 31–40, or Very Satisfactory. 1 student (1%) was in the 0–10 category which is defined as No Improvement. Notably, no student earned a score between 41–50, indicating that none were classed under the outstanding category.

The overall weighted mean score was 19.54, with a standard deviation of 5.87. These results indicate that students' performance in the diagnostic test was generally at the Fairly Satisfactory level, indicating that prior to the instructional intervention; most students had a limited mastery of the concepts assessed in the test.

Table 12 shows the level of students' performance in regards to summative test. The summative test refers to the evaluation that serves as evidence of the learner's mastery and progress. It also includes the score ranges, frequency, percentage, and corresponding remarks.

Out of 80 respondents during the summative test, 35 students (44%) scored as Very Satisfactory, with scores ranging from 31 to 40. Twenty-nine students (36%) had scores in the range of 21–30 and were ranked as Satisfactory. Fifteen students (19%) achieved a grade of 41–50, marked as Outstanding. One student (1%) fell into the 11–20 category, which is defined as Fairly Satisfactory. Lastly, no students (0%) scored between 0–10, indicating that none showed No Improvement.

Table 12. Level of Students' Performance with Regards to Summative Test

Scores	Frequency	Percentage	Verbal Interpretation
41 – 50	15	19%	Outstanding
31 – 40	35	44%	Very Satisfactory
21 – 30	29	36%	Satisfactory
11 – 20	1	1%	Fairly Satisfactory
0 – 10	0	0%	No Improvement
Total	80	100%	

Weighted Mean = 33.61

SD=7.15

Verbal Interpretation = Very Satisfactory

The overall weighted mean score was 33.61, with a standard deviation of 7.15. These data indicate that the students' performance during the summative test was found to be at a Very Satisfactory level, reflecting that most students' mastery of the concepts improved after the implementation of the instructional intervention.

*Test of Significant Difference on the Students' Performance*

The significant difference between students' performance on diagnostic and summative tests was analyzed statistically using Real Statistics Data Analysis Tools with a t-test for paired samples.

A paired-samples t-test was conducted to compare students' mathematical performance on the diagnostic and summative tests.

Results Summative test scores (M = 33.78, SD = 7.03) were significantly larger than diagnostic test scores (M = 19.66, SD = 5.81),  $t(78) = 56.39$ ,  $p < .001$ . The strength of effect (Cohen's  $d = 6.34$ ) is extraordinarily strong, indicating a significant increase in students' performance.

Table 13. Significant Difference of Diagnostic Test and Summative Test

Measure	Mean	SD	t	df	p	Cohen's d
Diagnostic	19.66	5.81	56.39	78	<.001	6.34
Summative	33.78	7.03				

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ ; Cohen's  $d$ : 0.20 (Small); 0.50 (Medium); 0.80 (Large)

This indicates that applying the RME Approach is effective in achieving students' learning outcomes. The significant improvement in scores shows that problem solving and the use of RME activities connected to real life and student-centered experiences can substantially enhance students' conceptual understanding and mathematical development.

*Test of Significant Effect of Realistic Mathematics Education (RME) on Students' Mathematical Skills*

The significant effect of Realistic Mathematics Education (RME) on students' mathematical skills—focusing on concrete concepts, modeling abstracts, student strategies, collaborative learning, and interdisciplinary connections—was analyzed statistically using Real Statistics Data Analysis Tools with multiple regression analysis.

A multiple regression analysis was performed on the components of Realistic Mathematics Education (RME) to determine the effect on students' overall mathematical ability, where the five components include complete conceptual understanding, model abstract ideas, student strategy, group work, and interdisciplinary connection of math to other subject matters.

The regression analysis revealed that the five components of RME were indeed statistically significant in predicting the development of students' mathematical skills ( $F(5, 74) = 3.11$ ,  $p = .010$ ), indicating that the RME variables collectively affect the development of a student's mathematical ability.

When considering the effect of each component of RME on students' mathematical ability, abstract modeling was the only statistically significant predictor ( $B = 0.31, t = 3.51, p < .001$ ). This result indicates that a student who engaged more fully in the abstract modeling of math concepts was likely to have a higher level of overall math ability. However, the other RME components where (concrete concepts:  $B = 0.02, p = .870$ ), (student strategies:  $B = 0.01, p = .890$ ), (collaborative learning:  $B = -0.02, p = .840$ ), and (interdisciplinary connections:  $B = -0.07, p = .420$ ) did not demonstrate statistical significance in predicting students' overall development of mathematical skills.

Table 14. Significant Effect of RME Approach on the Students' Mathematical Skills

a. Dependent Variable: STUDENTS' MATHEMATICAL SKILLS OVERALL

ANOVA<sup>a</sup>

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	2.16	5	0.43	3.11	0.010**
Residual	10.27	74	0.14		
Total	12.43	79			

a. Dependent Variable: STUDENTS' MATHEMATICAL SKILLS OVERALL

b. Predictors: CONCRETE\_ONCEPTS, MODELING\_ABSTRACTS, STUDENT\_STRATEGIES, COLLABORATIVE\_LEARNING, INTERDISCIPLINARY\_CONNECTIONS

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients			
	B	Std. Error	t	Sig.
1 (Constant)	3.23	0.69	4.68	0.000**
Concrete_Concepts	0.02	0.10	0.16	0.870
Modeling_Abstracts	0.31	0.09	3.51	<.001***
Student_Strategies	0.01	0.08	0.14	0.890
Collaborative_Learning	-0.02	0.08	-0.20	0.840
Interdisciplinary_Connections	-0.07	0.09	-0.81	0.420

The findings show that the RME Approach has an effect on improving students' skills in mathematics. This illustrates that the use of modeling and representation in mathematics is a tool to assist learners in progressing from more concrete to more abstract understanding of the subject, as well as enhancing their analytical and problem-solving skills.

*Test of Significant Effect of Realistic Mathematics Education (RME) on Students' Mathematical Performance*

The significant effect realistic mathematics education (RME) on students' performance in terms of diagnostic test and summative was treated statistically using Real Statistics Data Analysis Tools using multiple regression analysis.

In Table 15, a multiple regression analysis was used to determine if each of the five RME components (concrete-conceptual representation, modeling for abstract concepts, student strategies, collaborative learning, and interdisciplinary connections) could statistically predict students' performance on a diagnostic test. Results of the regression indicated that the overall regression model was not statistically significant:  $F(5, 74) = .93, p = .469$ . Therefore, the combination of the five RME components did not statistically significantly predict

students' performance on the diagnostic test. Based upon the results of this study, it appears that prior to the instructional intervention, the RME components do not yet affect students' performance on the diagnostic test. This is expected given that the diagnostic test provides a baseline measure of what students know before they receive instruction using an RME approach.

Table 15. Significant Effect of RME Approach on the Students' Mathematical Performance in terms of Diagnostic Test

a. Dependent Variable: STUDENTS' MATHEMATICAL PERFORMANCE IN TERMS OF DIAGNOSTIC TEST

ANOVA<sup>a</sup>

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1.85	5	0.37	0.93	0.469
Residual	29.54	74	0.40		
Total	31.39	79			

a. Dependent Variable: STUDENTS' MATHEMATICAL PERFORMANCE IN TERMS OF DIAGNOSTIC TEST

b. Predictors: CONCRETE\_CONCEPTS, MODELING\_ABSTRACTS, STUDENT\_STRATEGIES, COLLABORATIVE\_LEARNING AND INTERDISCIPLINARY\_CONNECTIONS

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients			
	B	Std. Error	t	Sig.
1 (Constant)	3.71	1.17	3.17	0.002*
CONCRETE CONCEPTS	0.07	0.16	0.41	0.682
MODELING ABSTRACTS	-0.30	0.15	-2.03	0.046*
STUDENT STRATEGIES	-0.04	0.14	-0.29	0.773
COLLABORATIVE LEARNING	-0.04	0.13	-0.31	0.754
INTERDISCIPLINARY CONNECTIONS	0.03	0.15	0.17	0.866

When looking at each single predictor on its own, we found that modeling abstracts are significantly related to a mathematic student's performance on a pre-intervention diagnostic test ( $B = -0.30, t = -2.03, p = .046$ ); however, the inverse relationship indicated by the negative coefficient means that students with higher scores on the perceived modeling abstract variable had lower scores on the diagnostic test prior to intervention. Concrete concept ( $B = 0.07, p = .682$ ), student strategies ( $B = -0.04, p = .773$ ), collaborative learning ( $B = -0.04, p = .754$ ), and interdisciplinary connections ( $B = 0.03, p = .866$ ) were not statistically significant in predicting a student's pre-intervention diagnostic test performance.

Overall, the findings implies that students' performance prior to RME instruction was largely unrelated to the implementation of RME instructional components and that the results of the diagnostic test primarily reflect students' prior knowledge before instruction and not the outcome of their instruction. Therefore, these results strongly support the necessity of using the RME instructional approach to improve products of instruction and ultimately, students' mathematical

understanding and performance after the completion of instruction.

Table 16 presented that a multiple regression analysis was used to determine if each of the five RME components (concrete-conceptual representation, modeling for abstract concepts, student strategies, collaborative learning, and interdisciplinary connections) could statistically predict students' performance on a summative test.

The results of this analysis indicated that there was not a statistically significant ( $p = .135$ ), which indicating that when taken in totality, the combined components of RME did not explain a statistically significant amount toward predicting the student's performance on the summative test. While students performed better after this type of intervention, none of the individual RME variables produced a statistically significant amount toward explaining variability in summative test scores

Table 16. Significant Effect of RME Approach on the Students' Mathematical Performance in terms of Summative Test

a. Dependent Variable: STUDENTS' MATHEMATICAL PERFORMANCE IN TERMS OF SUMMATIVE TEST

ANOVA<sup>a</sup>

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	4.73	5.00	0.95	1.75	0.135
Residual	40.07	74.00	0.54		
Total	44.80	79.00			

a. Dependent Variable: STUDENTS' MATHEMATICAL PERFORMANCE IN TERMS OF SUMMATIVE TEST

b. Predictors: CONCRETE CONCEPTS, MODELING ABSTRACTS, STUDENT STRATEGIES, COLLABORATIVE LEARNING AND INTERDISCIPLINARY CONNECTIONS

Coefficients<sup>a</sup>

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
1 (Constant)	6.27	1.36	4.60	0.000
CONCRETE CONCEPTS	-0.22	0.19	1.13	0.262
MODELING ABSTRACTS	-0.41	0.17	2.36	0.021*
STUDENT STRATEGIES	-0.07	0.16	0.46	0.644
COLLABORATIVE LEARNING	0.14	0.15	0.91	0.367
INTERDISCIPLINARY CONNECTIONS	-0.01	0.18	0.07	0.948

The regression coefficients showed that the only significant predictor was modeling of the abstracts ( $B = -0.41$ ,  $t = -2.36$ ,  $p = .021$ ). The results indicated that modeling abstracts and students' performance on the summative test were negatively related in the regression model. Concrete concepts ( $B = -0.22$ ,  $p = .262$ ), student strategies ( $B = -0.07$ ,  $p = .644$ ), collaborative learning ( $B = 0.14$ ,  $p = .367$ ), and interdisciplinary connections ( $B = -0.01$ ,  $p = .948$ ) were not significant predictors of students' performance on the summative test.

The results indicate that although some students improved in achievement after being exposed to RME, as shown by the significant difference between their diagnostic and summative

test results, only one RME component predicted summative performance when examined individually. Despite increased performance with the RME approach, some students still struggled with solving problems (Kempa et al., 2019). This suggests that the effectiveness of RME depends more on how its elements are implemented together in a holistic way rather than as separate components. Additionally, Yuanita et al. (2018) stated in her study that the RME approach successfully increased students' mathematical representation, especially their use of mathematical models. However, it may not be suitable to apply in all learning areas, especially those characterized individually. To explore the RME approach in other aspects, Dinglasan et al. (2023) recommended using a parallel approach across various mathematics disciplines.

#### IV. CONCLUSION AND RECOMMENDATIONS

There is a significant difference between diagnostic and summative tests. Therefore, the null hypothesis is rejected, which means that the implementation of the RME approach was found to be effective in improving students' learning outcomes. This is evident in the scores between the diagnostic test and the summative test, showing that problem solving and the use of RME activities connected to real life and student-centered experiences can substantially enhance students' conceptual understanding and mathematical development.

On the other hand, the RME approach was observed to have significant effect on the students' mathematical skills. Therefore, the null hypothesis is also rejected. This implies that the control of RME lies in how the elements are implemented in a combined and holistic manner rather than as single components.

Moreover, the RME approach was found to have no significant effect on students' performance in both diagnostic and summative tests; therefore, the null hypothesis is accepted. This demonstrates that the instructional intervention reflects actual progress in performance, and a single variable of RME, namely modeling abstract, shows a strong effect. This means that students' improvement in learning outcomes can be achieved through the use of different visual tools.

The following were recommended based on the findings of this study:

Teachers may design lesson plans where real-life connections and abstraction are integrated throughout the entire quarter. They may also adjust the formative assessment of students to reward their mathematical understanding rather than just procedural speed.

Students may embrace visual models like number lines, area models, or diagrams to bridge the gap between real-world problems and abstract math. Engaging deeply in classroom activities can help improve their focus on understanding concepts rather than just getting the right answers.

Future researchers may consider conducting a longer-term study to see if there are changes in students' overall performance. Additionally, they may consider integrating mathematical skills aligned with Bloom's Taxonomy cognitive domain when forming test questions.

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