

# Reflective Learning Resource Material in Mathematics

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Students' performance in mathematics is directly shaped by changes in the educational framework and the fidelity of its implementation (Moreno-Guerrero et al., 2020). Teachers play a central role in this process, not only by developing students' mathematical knowledge and skills but also by fostering their ability to connect mathematical concepts to other disciplines and real-world contexts. Through effective guidance, teachers enable learners to discover, share, and apply their understanding (Li et al., 2024). Mathematics education is an inherently active and complex process; thus, well-designed classroom activities are indispensable in cultivating higher-order thinking skills. These activities help students think logically, systematically, and objectively, while also nurturing openness and adaptability in addressing problems (Su et al., 2016). For instance, problem-solving tasks strengthen creativity and critical thinking by engaging learners in progressive and challenging mental processes (Yu, 2024). Despite these potentials, many students continue to experience difficulties in mastering mathematical concepts, resulting in persistently low achievement levels.

Evidence from international large-scale assessments underscores this concern. The 2018 Programme for International Student Assessment

(PISA) reported that the Philippines obtained an average score of 353 points in mathematics, significantly below the global mean of 489. Moreover, only 19% of Filipino students reached Level 2 proficiency or higher, a benchmark for basic mathematical literacy. These findings highlight what Dela Cruz (2019) describes as the “urgency of resolving problems and inequalities in attaining quality basic education in the country.” At the local level, one national high school in Quezon Province recorded a Mathematics Mean Percentage Score (MPS) of 54.87% in school year 2018–2019, with Grade 9 students scoring the lowest at 53.97%. Both figures are well below the national passing standard of 75%, further illustrating students’ substantial struggles with mathematics learning.

The onset of the COVID-19 pandemic exacerbated these learning gaps. The shift to modular distance learning posed significant challenges for both learners and teachers (Castroverde & Acala, 2021). Dangle and Sumaoang (2020) identified three primary barriers to this modality: insufficient funding for module production and distribution, students’ difficulties in managing self-directed learning, and the limited capacity of many parents to provide academic support at home. Despite these constraints, teachers have sought to adopt alternative strategies to address the diverse needs of learners, reaffirming their pivotal role in mitigating barriers to mathematical achievement (Dayagbil et al., 2021).

Improving mathematics learning requires not only effective pedagogy but also the development of high-quality instructional materials. Hendriana (2017) emphasizes that innovative resources should empower students to explore and maximize their abilities. Since learning materials significantly shape the mastery of lessons (Widodo & Jasmadi, 2008), they must be designed with mechanisms for evaluation, timely feedback (Prastowo, 2012), and opportunities for reflection on the learning process

(Hendriana, 2019). Reflection, in particular, has been shown to be a powerful tool for strengthening mathematical understanding and promoting learner autonomy (Attard, 2017). Such reflective practices become especially vital in distance learning environments, where independent learning and self-regulation are crucial for success.

### **Reflective Learning as a Tool for Enhancing Mathematics Performance**

Reflection can be deliberately scaffolded and encouraged to foster professional growth and reflective practice (Hegarty, 2011). For students, reflective learning activates prior knowledge, enables the reconstruction of understanding, and supports learning from personal experience. It also cultivates metacognitive skills, promotes responsibility for one's own learning, and enhances the capacity to restructure and reframe information (McLeod, 2017). From the teachers' perspective, reflective practice serves as a diagnostic tool, helping identify areas for instructional improvement and guiding pedagogical adjustments that lead to stronger learning outcomes (Orias, 2019).

One widely adopted strategy for reflective learning is journal writing, often combined with situational testing and feedback analysis. Research consistently demonstrates its value in mathematics education. Disilio (2019) found that students who engaged in reflective journaling attained higher mean test scores, produced more complex mathematical explanations, and employed discipline-specific academic language more effectively. Similarly, De Leon-Pineda and Prudente (2022) reported that mathematics journals improved students' attitudes, bolstered their confidence, and strengthened their problem-solving skills. Denton (2018)

further observed that reflective journals helped students regulate negative emotions, such as anxiety and frustration, when confronting difficult mathematical tasks.

According to Costa and Kallick (2020), reflection involves connecting present experiences to prior learning (scaffolding), integrating cognitive and emotional insights from multiple sources, and applying these insights to new situations. While traditional journal writing has proven effective in face-to-face mathematics classrooms, integrating digital tools and diverse instructional approaches can further enrich reflective practices. These strategies may include open-ended, self-reflective exercises as well as structured, content-specific assessments such as forced-choice prompts (Choi et al., 2017).

Within education, learning outcomes are understood as measurable achievements that students are expected to demonstrate as a result of instruction. They capture the knowledge, skills, and dispositions acquired through structured learning experiences (Villamis, 2020). In mathematics, these outcomes commonly emphasize higher-order competencies such as analytical reasoning, representation, and problem-solving skills—capacities that are strengthened when reflection is embedded as an integral component of instruction.

*Analysis.* Analytical skills denote the deductive capacity to solve mathematical problems (Indriati et al., 2020). In mathematics, analysis entails breaking down material into its fundamental components and understanding the relationships among these parts within a larger structure or purpose (Ariyanto, 2020). Given the abstract nature of mathematical concepts, students must develop the ability to think analytically by applying not only single theories but also multiple, interconnected ideas to construct meaning and solutions (Khusna, 2020). At this level of cognitive

engagement, learners demonstrate their capacity to differentiate, organize, and characterize information in ways that deepen their mathematical reasoning and problem-solving proficiency (Ariyanto, 2020).

*Representation.* Mathematical representation can be expressed in both visual and non-visual forms. Visual representations include graphs, tables, sketches, and diagrams, whereas non-visual forms involve numerical expressions, equations, and symbolic models (Minarni et al., 2016). As a cognitive process, representation is central to developing conceptual understanding, particularly in solving problems that involve ratios, proportions, and percentages. By translating abstract ideas into more concrete forms, it enables learners to reason logically and to structure knowledge through the systematic use of signs, symbols, and objects (Widakdo et al., 2017). In geometry, for example, the ability to generate and interpret representations is indispensable for accurate problem-solving and for fostering deeper conceptual clarity (Utami et al., 2019).

*Problem-solving skills.* The overarching goal of mathematics education is to equip students with the capacity to apply mathematical knowledge and skills to real-life challenges (Phonapichat et al., 2014). Central to this aim are problem-solving skills, which require learners to comprehend problems, select appropriate approaches, and adapt strategies to arrive at effective solutions (Surya et al., 2017). These skills involve a range of cognitive processes, including exploration, interpretation, reasoning, prediction, evaluation, and reflection (Anderson, 2009). Beyond their academic significance, problem-solving skills are highly transferable and essential for addressing everyday situations (Pinter, 2012). Teachers play a pivotal role in developing these competencies by structuring learning materials and guiding students in applying problem-solving strategies to diverse mathematical and real-world contexts (Simamora et al., 2019).

## **Effects of Reflective Learning Resource Material on Achievement of Mathematics Learning Outcome: A Case Study**

This study investigates the impact of a reflective learning resource material on the mathematics performance of Grade 9 students. Specifically, it explores students' perceptions of the resource, assesses their performance through pretests and posttests in analytical, representational, and problem-solving skills, and examines whether significant differences exist between pretest and posttest scores. Furthermore, it seeks to determine the relationship between students' evaluations of the resource and their overall performance in mathematics.

### *Methodology*

The study employed a descriptive research design to examine the impact of a reflective learning resource material on students' performance in Mathematics 9. This approach was selected to provide a systematic description and analysis of the material's effectiveness in improving learning outcomes.

A cluster sampling technique was utilized to identify the study participants. From the four Grade 9 sections in a national high school, with a total population of 147 students, one section was selected as the sample. Due to the large population, time constraints, and limited financial resources, the Grade 9 section Cattleya, comprising 35 students, was chosen. The class consisted of 27 girls and 8 boys who served as respondents.

Data collection employed three researcher-developed instruments: (a) the reflective learning resource material, (b) a pretest and posttest designed to measure analytical, representational, and problem-solving

skills, and (c) a survey questionnaire capturing students' reflective learning experiences.

*Reflective learning resource material.* The reflective learning material was developed using the ICARE model proposed by Hidayat (2017), which comprises five core learning elements: Introduction, Connection, Application, Reflection, and Extension. The material was aligned with Quarter 2 lessons in Mathematics 9, covering key topics such as variations, integral and zero exponents, rational exponents, radical expressions, simplifying radical expressions, operations on radicals, and radical equations. It incorporated the Most Essential Learning Competencies (MELCs) and clearly defined lesson objectives to ensure alignment with curriculum standards. To facilitate deeper learning, mathematics journal templates were integrated into the material, enabling students to articulate, explain, and organize their thinking in written form. A sequence of exercises was also included, progressing from basic to more complex tasks to promote mastery. Each session concluded with a structured reflective activity, designed to help students evaluate their understanding, consolidate insights, and internalize key mathematical concepts.

*Pretest and Posttest.* Both tests were constructed using a table of specifications aligned with the curriculum goals, the Most Essential Learning Competencies (MELCs), and the Department of Education's self-learning modules for Quarter 2. They were designed to assess students' analytical, representational, and problem-solving skills in equal measure. Content validation was undertaken by subject experts, including an editorial manager, who evaluated the instruments for clarity, comprehensiveness, grammar, and content accuracy. Based on their recommendations, revisions were made to improve question stems, regroup items according to specific

performance indicators in mathematics, and refine the final pool of test items.

The validated instruments, each consisting of 40 items, were administered as pretests and posttests. The pretest was conducted on the first day of the second quarter during the module distribution schedule, with students submitting their responses after four days. The posttest was administered following six consecutive weeks of using the reflective learning material as a supplemental resource, and students returned their completed tests four days after administration.

*Survey questionnaire.* A researcher-developed survey questionnaire was employed to capture students' perceptions of the impact of the reflective learning resource material. The instrument consisted of six indicators, each represented by five statements measured on a five-point Likert scale. The survey was administered during the eighth week of the second quarter, with clear instructions provided to ensure that students understood its objectives and responded accurately.

### *Results*

Table 1 presents students' evaluation of the reflective learning resource material across six dimensions: positive feelings, obstructing feelings, association, integration, validation, and appropriation. Overall, the results indicate students' agreement with the indicators, reflecting a generally positive appreciation of the material.

In terms of positive feelings, students expressed agreement on all criteria, yielding a general mean of 3.34. This suggests that the reflective learning resource material fostered positive experiences through reflective writing and enabled learners to harness constructive emotions in order to deepen their understanding of mathematical lessons. This result is

consistent with the findings of Guce (2017), who emphasized that opportunities for students to recognize how writing enriches their mathematical learning can cultivate positive emotions and a greater sense of fulfillment.

**Table 1**

*Students' evaluation of the reflective learning resource material*

<b>Indicators</b>	<b>Mean</b>	<b>SD</b>	<b>VI</b>
Positive Feelings	3.34	0.71	Agree
Obstructing Feelings	3.20	0.74	Agree
Association	3.27	0.64	Agree
Integration	3.33	0.67	Agree
Validation	3.35	0.68	Agree
Appropriation	3.37	0.67	Agree

*Legend:* 3.50-4.00- Strongly Agree, 2.50-3.49- Agree; 1.50-2.49 – Disagree; 1.00-1.49 – Strongly Disagree

In terms of obstructing feelings, students also expressed agreement, with an overall mean of 3.20. This indicates that they were able to manage potential negative emotions while using the material. The integration of journal writing and guided prompts appeared to help students regulate affective barriers, sustain a positive attitude toward mathematics, and remain engaged with the topic. As a result, learners had more opportunities to articulate their thoughts, generate new ideas, and strengthen their conceptual understanding.

For association, the overall mean of 3.27 suggests that students were able to connect ideas and emotions from their initial experiences with both prior and current knowledge. Similarly, the other indicators received consistent agreement ratings: integration (M = 3.33, SD = 0.67), validation (M = 3.35, SD = 0.68), and appropriation (M = 3.37, SD = 0.67). These

results demonstrate that the reflective writing tasks embedded in the learning material effectively supported students in linking new concepts to real-life applications, formulating solutions, and re-evaluating experiences within authentic contexts.

Table 2 presents the pretest and posttest results of Grade 9 students.

**Table 2**

*Pretest and Posttest scores of the students*

Scores	Pretest		Posttest		Remarks
	F	%	F	%	
<b>Analysis</b>					
12-14	2	5.7	19	54.3	Advanced
9-11	6	17.1	6	17.1	Proficient
6-8	15	42.9	7	20.0	Approaching Proficiency
3-5	11	31.4	2	5.7	Developing
0-2	1	2.9	1	2.9	Beginning
<b>Representation</b>					
12-14	0	1.00	18	51.4	Advanced
9-11	3	8.6	11	31.4	Proficient
6-8	10	28.6	4	11.4	Approaching Proficiency
3-5	17	48.6	2	5.7	Developing
0-2	5	14.3	0	0	Beginning
<b>Problem Solving</b>					
12-14	1	2.9	8	22.9	Advanced
9-11	3	8.6	10	28.6	Proficient
6-8	11	31.4	13	37.1	Approaching Proficiency
3-5	18	51.4	4	11.4	Developing
0-2	2	5.7	0	0	Beginning

In terms of analysis, most students' pretest scores ranged from 6 to 8 points, with the highest frequency (15 students or 42.9%) falling under the approaching proficiency level. Eleven students (31.4%) were classified as developing. These results indicate that prior to the use of the reflective learning resource material, students demonstrated only an average ability to scrutinize and deconstruct mathematical facts. Following the

implementation, most students scored between 12 and 14 points, which corresponds to the advanced level, while seven students remained at the approaching proficiency level. This progression suggests that the material enhanced students' capacity to apply effective strategies for analyzing questions, resulting in more accurate responses and greater mastery of key concepts.

With respect to representation, no student reached the exceptional level in the pretest. Instead, most were within the approaching proficiency to developing range, reflecting only a minimal ability to restate mathematical concepts or expressions in equivalent forms. In the posttest, however, the majority advanced to the proficient and advanced levels, demonstrating marked improvement in their ability to represent and translate mathematical ideas.

For problem-solving, the pretest results showed that most students were at the approaching proficiency to developing levels. After the use of the reflective learning resource material, the majority advanced to the proficient and approaching proficiency levels. This improvement illustrates how the material supported students in becoming more competent and confident in solving mathematical problems.

These findings are consistent with previous studies emphasizing the value of reflective learning strategies. Guce (2017) highlighted that positive emotional engagement fosters deeper understanding, while Kuuk and Arslan (2020) observed that journal writing helps students overcome negative feelings. The favorable evaluation of the reflective learning material also resonates with McCoy's (2013) view that enjoyable learning enhances outcomes, Williams' (2008) finding that it strengthens engagement with new knowledge, and Cowan's (2014) assertion that it provides opportunities for corrective learning. Similarly, Murillo-Llorente

et al. (2021) demonstrated its relevance to real-world applications, Al-Rawahi and Al-Balushi (2015) emphasized its role in problem-solving, Farrah (2012) underscored its capacity to link concepts with experiences, and Habibi et al. (2017) recognized its effectiveness in helping learners organize ideas across levels of understanding.

**Table 3**

*Test of difference between the pretest and posttest on the dependent variable*

<b>Mathematics Learning Outcome</b>	<b>Pretest</b>		<b>Posttest</b>		<b>T</b>	<b>Df</b>	<b>Sig.</b>
	<b>Mean</b>	<b>SD</b>	<b>Mean</b>	<b>SD</b>			
Analysis	6.46	2.66	10.54	3.19	-7.591	34	.000
Representation	4.97	2.36	10.94	2.79	-11.289	34	.000
Problem Solving Skills	5.69	2.23	8.69	2.71	-6.493	34	.000

Based on Table 3, the results reveal a significant difference between the pretest and posttest scores of the student-respondents before and after the use of the reflective learning resource material, with a significance value of 0.000 across all mathematics learning outcomes. This indicates a marked improvement in students' performance, as they advanced from the developing and approaching proficiency levels to the advanced level in analysis and representation. In problem-solving, student-respondents also progressed to the approaching proficiency and proficient levels, further demonstrating the positive effect of the intervention.

The statistical evidence confirms that the reflective learning resource material substantially enhanced students' skills and facilitated the attainment of the targeted mathematics learning outcomes. These findings are consistent with the works of Guce (2017), Kuuk and Arslan (2020), McCoy (2013), Williams (2008), Cowan (2014), Murillo-Llorente et al. (2021), Al-Rawahi and Al-Balushi (2015), Farrah (2012), and Habibi et al.

(2017), all of whom emphasized that reflective learning strategies significantly contribute to improved student performance in mathematics.

**Table 4**

*Test of significant relationship between the evaluation of the learning resource material and the students' mathematics performance*

Reflective Learning Resource Material	Mathematical Learning Outcomes		
	Analysis	Representation	Problem Solving Skills
<b>Returning to Experience</b>			
Using Positive Feelings	.421*	.306	.416*
Removing Obstructing Feelings	.031	.086	.109
<b>Re-evaluate to Experience</b>			
Association	.157	-.068	.073
Integration	.194	.048	.155
Validation	.278	.217	.386*
Appropriation	.257	.180	.187

*Notes:* \*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 presents the significant relationship between students' evaluation of the reflective learning resource material and their test performance results. The data reveal a notable connection between the use of positive feelings and analysis as a mathematical learning outcome, with an r-value of 0.421. Similarly, a significant relationship was observed between positive feelings when engaging with the reflective learning material and problem-solving skills, yielding an r-value of 0.416. In addition, validation in re-evaluating experiences showed a significant relationship with problem-solving skills, reflected in an r-value of 0.386.

These results suggest that students' affective engagement with the reflective learning material particularly in fostering positive emotions and validating learning experiences plays an important role in enhancing their

performance in mathematics. This finding corroborates the work of Viterbo (2019), who demonstrated that the use of more accessible and practical materials, such as learning modules, is significantly associated with learners' attainment of problem-solving skills, particularly in the application of mathematical concepts.

### *Recommendation*

The evaluation results revealed that students responded positively to the use of the reflective learning resource material in their mathematics studies, highlighting its effectiveness in fostering active engagement in learning. Following its integration, students demonstrated substantial improvement, attaining proficient to advanced levels in analysis and representation, and progressing to approaching proficiency and proficient levels in problem-solving skills.

In view of these significant gains in student proficiency, the study strongly recommends the integration of the reflective learning resource material into the Mathematics 9 curriculum. Such integration serves as an effective strategy to enhance student engagement, cultivate higher-order thinking skills, and strengthen overall mastery of mathematical concepts.

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