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MEDIATING EFFECT OF MATHEMATICS SELF-EFFICACY ON THE RELATIONSHIP BETWEEN DIGITAL LEARNING ENGAGEMENT AND PROBLEM-SOLVING SKILLS OF GRADE 8 STUDENTS

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ABSTRACT
The purpose of this study is to investigate the mediating effect of mathematics self-efficacy on the relationship between digital learning engagement and problem-solving skills of grade 8 students. The quantitative approach, specifically a descriptive and correlational design with mediation analysis was used in the study. The respondents of the study were 232 grade 8 students in selected private schools in Panabo City S.Y. 2025-2026. Mean, Pearson-r, standard deviation and Regression Analysis were used in interpreting the data gathered. The results of this study revealed that there is no significant relationship between digital learning engagement and problem-solving skills and no significant relationship between mathematics self-efficacy and problem-solving skills. However, there is a significant relationship between digital learning engagement and mathematics self-efficacy. Further, the mediation analysis revealed that mathematics self-efficacy did not significantly mediate the relationship between digital learning engagement and problem-solving skills. Moreover, the results revealed that the level of digital learning engagement and mathematics self-efficacy are high, while the level of students' problem-solving skills in terms of percentage test scores is low. Based on the findings, it would serve as an eye-opener to the Department of Education, school administrators, and other stakeholders to prioritize targeted interventions that directly improve students' problem-solving skills in Mathematics, leading to better academic performance and overall educational outcomes.

KEYWORDS: *Problem-solving skills, Digital learning engagement, Mathematics self-efficacy, Philippines*

INTRODUCTION
Problem-solving skills are essential in developing critical thinking, creativity, and logical reasoning, which are necessary for success in Mathematics and lifelong learning (Amalina, 2023). However, many students continue to struggle in solving mathematical problems, often resulting in poor academic performance and weakened mathematical competence (Mabansag et al., 2022). International assessments further highlight this issue. The Programme for International Student Assessment (PISA) 2022 reported a decline in mathematics performance across OECD countries, with an average decrease of 15 points compared to 2018, where more than 60% of students failed to meet expected proficiency levels (OECD, 2023). This indicates that difficulties in mathematical problem-solving remain a widespread global educational concern (OECD, 2023).

In the Philippine context, poor Mathematics performance continues to be a major challenge among learners. PISA 2022 results revealed that Filipino students obtained an average score of 355, which is significantly below the OECD average of 472, with only 16% reaching at least minimum proficiency in Mathematics (OECD, 2023). This reflects the continued difficulty of students in basic mathematical problem-solving tasks (Ines, 2023). At the local level, studies in Davao del Norte revealed very low problem-solving skills among junior high school students, indicating limited readiness for more complex mathematical tasks (Enerosa & Abuzo, 2024). Despite the integration of digital learning in education, challenges in Mathematics performance persist (Loeb et al., 2025). Studies suggest that digital learning engagement enhances Mathematics learning outcomes and self-efficacy, while mathematics self-efficacy improves problem-solving skills (Kiany et al., 2023). However, these variables are often examined separately, and limited research has explored their combined relationships among junior high school learners (Oppong et al., 2023). In response to this gap, this study investigates the mediating effect of mathematics self-efficacy on the relationship between digital learning engagement and problem-solving skills among Grade 8 students, with the aim of providing evidence-based insights for improving Mathematics instruction and student performance (Oppong et al., 2023).

OBJECTIVES
1. To determine the level of digital learning engagement of students in terms of emotion, behavior, participation, cognitive and skills.
2. To determine the level of problem-solving skills of students in terms of test scores.
3. To determine the level of mathematics self-efficacy in terms of mastery experience, vicarious experience, social persuasion and physiological state.
4. To determine the significant relationship between digital learning engagement and problem-solving skills,

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digital learning engagement and mathematics self-efficacy, and mathematics self-efficacy and problem-solving skills.

5. To investigate if mathematics self-efficacy significantly mediates the relationship between digital learning engagement and problem-solving skills.

METHODOLOGY

This study used a quantitative approach, specifically a descriptive and correlational design with mediation analysis. Quantitative research is grounded in objectivity, measurement, and empirical validation, allowing researchers to generate generalizable findings through structured instruments and statistical procedures (Creswell & Creswell, 2018). The descriptive research design was used to describe the characteristics, conditions, or phenomena as they naturally occur without manipulation of variables (Fraenkel et al., 2019). Meanwhile, the correlational research design was used to establish the strength and direction of relationships between variables (Creswell, 2014). In this study, it was specifically used to examine the relationships between digital learning engagement, mathematics self-efficacy, and problem-solving skills.

Mediation analysis is a statistical procedure for assessing whether the effect of an independent variable on a dependent variable is mediated by a third variable, which is called the mediator (Baron & Kenny, 1986). In this study, mediation analysis was conducted to determine whether mathematics self-efficacy mediates the relationship between digital learning engagement and problem-solving skills. This statistical procedure offers in-depth understanding of the effect of one variable on another, including the identification of the direct and indirect effect of one variable on another (MacKinnon, 2012).

This study was conducted in selected private schools in Panabo City. The respondents consisted of 38 Grade 8 students from School A, 81 from School B, and 113 from School C, with a total of 232 respondents. The questionnaires were distributed after securing permission from the school administrators and were administered following the instructions provided by the researcher with the assistance of the adviser or designated gatekeeper.

RESULTS

The level of digital learning engagement among the respondents was high, indicating that engagement in digital learning was evident. All indicators also obtained a high descriptive equivalent. Among the indicators, *cognitive engagement* obtained the highest mean, followed by *emotional engagement, skills engagement*, and *behavior* and *participation.* This finding suggests that students are particularly active in higher-order thinking processes such as analyzing information, interpreting concepts, thinking critically, and applying learned knowledge.

This finding aligns with the study of Macario et al. (2026), who reported that students demonstrated a high level of engagement in digital learning platforms, with cognitive engagement emerging as the highest dimension. Similarly, Saliao and Cajandig (2025) revealed that Grade 8 students exhibited high levels of engagement in digital platforms, with cognitive engagement obtaining the highest mean among all engagement dimensions. In the same way, Sayco (2025) found that cognitive and emotional engagement were the strongest dimensions of students' engagement in digital classrooms, with overall digital learning engagement rated at a high level.

In addition, the level of students' problem-solving skills in mathematics is low. The results show that all three raters; the researcher, Expert 1, and Expert 2 consistently rated the students under the low descriptive equivalent. This indicates that the students demonstrate poor performance in mathematical problem-solving skills and suggests that they experience difficulties across the different stages of the problem-solving process, specifically Polya's problem-solving steps. This finding highlights the need for structured and explicit instruction anchored on Polya's problem-solving process to strengthen students' mathematical competence, particularly in developing their problem-solving skills.

This finding is consistent with the study of Mangilala and Cajandig (2025), who assessed students' problem-solving skills using Polya-aligned indicators and found that all dimensions were categorized as "did not meet expectations" or at a low level. Similarly, Bayarcal and Tan (2023) reported that students' problem-solving skills remain low, particularly when instruction does not provide sufficient opportunities to explore strategies and solve problems independently. Furthermore, Gahi et al. (2023) found that low performance in problem-solving is often associated with inadequate conceptual understanding and limited familiarity with problem-solving strategies.

Moreover, the level of mathematics self-efficacy is moderate, indicating that it is fairly evident among the respondents. Among the indicators, *vicarious experience* obtained the highest mean, suggesting that students tend to develop self-efficacy by observing peers, teachers, or models successfully perform mathematical tasks. In contrast, *mastery experience, social persuasion*, and *physiological state* obtained comparatively lower mean scores, all of which fall under the moderate descriptive equivalent. These results imply that students may not consistently experience successful task completion, receive strong verbal encouragement, or effectively manage emotional and physiological responses during mathematics-related tasks.

This finding aligns with the study conducted by Ganapin (2025), which reported an average level of mathematics self-efficacy among students. Similarly, Paudel and Ghimire (2024) concluded that secondary-level learners demonstrate a moderate level of mathematics self-efficacy. In addition, Pendon (2022) also found that the level of mathematics self-efficacy among respondents is moderate.

Furthermore, result of the study revealed that digital learning engagement and problem-solving skills have no significant relationship. This suggests that students' level of engagement in

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digital learning does not directly translate into improved problem-solving skills. This result is consistent with Kong et al. (2021) and Zhao et al. (2021), who reported that digital engagement alone does not necessarily enhance problem-solving skills, as it is also influenced by factors such as instructional quality and prior knowledge. In terms of digital learning engagement and mathematics self-efficacy, the results show a significant positive relationship. This implies that higher engagement in digital learning is associated with higher levels of mathematics self-efficacy among students. This finding is supported by Zheng et al. (2020) and Bond et al. (2020), who reported that engagement in digital or online learning environments contributes to learners' self-efficacy in mathematics. Lastly, the relationship between mathematics self-efficacy and problem-solving skills is not significant. This indicates that students self-efficacy in mathematics does not necessarily improve problem-solving skills in mathematcis. This finding aligns with Velez and Abuzo (2023) and Sapulete et al. (2023), who found no significant relationship between self-efficacy and problem-solving skills.

In terms of mediation analysis, the study showed that mathematics self-efficacy does not mediate the relationship between digital learning engagement and problem-solving skills. Although digital learning engagement significantly enhances mathematics self-efficacy, this increased self-efficacy does not translate into improved problem-solving skills. Consequently, both the direct and indirect effects on problem-solving skills are not significant, indicating the absence of a mediation effect in the model.

This implies that while students engagement in digital learning may strengthen their mathematics self-efficacy, such self-efficacy alone is not sufficient to improve their problem-solving performance. This finding aligns with Velez and Abuzo (2023) and Sapulete et al. (2023), who reported that mathematics self-efficacy does not significantly influence problem-solving skills and does not function as a mediating factor.

SUGGESTIONS

After careful consideration of the findings, it is recommended that the Department of Education (DepEd) strengthen mathematics programs by prioritizing the explicit development of problem-solving skills through Polya's problem-solving model. School administrators may support continuous professional development programs for teachers that focus on structured problem-solving instruction, including strategies that guide students in understanding problems, planning solutions, and evaluating answers.

Mathematics teachers are encouraged to integrate Polya's steps in daily instruction and design learning activities that combine digital tools with structured problem-solving tasks to promote deeper cognitive engagement. In addition, teachers should implement interventions that strengthen students' mathematics self-efficacy through scaffolded tasks, mastery experiences, and consistent feedback.

Finally, future researchers may explore other variables that influence students' problem-solving skills and further investigate factors that may explain the relationship between digital learning engagement and problem-solving performance.

CONCLUSIONS

Based on the results of the research objectives, the researcher concluded that Grade 8 students demonstrate a high level of digital learning engagement and a high level of mathematics self-efficacy, indicating that these variables are highly evident among the respondents. However, their problem-solving skills in mathematics remain low, suggesting that students still experience difficulties in performing mathematical problem-solving tasks. The findings further revealed that there is no significant relationship between digital learning engagement and problem-solving skills, as well as between mathematics self-efficacy and problem-solving skills. However, a significant relationship exists between digital learning engagement and mathematics self-efficacy. Moreover, mathematics self-efficacy does not significantly mediate the relationship between digital learning engagement and problem-solving skills, indicating that the mediation effect is not established in the study.

TABLES AND REFERENCES

Table 1. Level of students' digital learning engagement

Indicators	SD	Mean	Descriptive Equivalent
Emotion	0.98	3.63	**High**
Behavior	1.11	3.55	**High**
Participation	0.99	3.54	**High**
Cognitive	0.93	3.80	**High**
Skill	1.16	3.58	**High**
Overall Mean	**1.104**	**3.63**	**High**

Table 2. Level of students' problem-solving skills in mathematics

Variable	Rater	SD	Mean Score Percentage	Descriptive Equivalent
Problem Solving Skills	Researcher	19.52	29.83%	Low
	Expert 1	18.12	28.51%	Low
	Expert 2	18.53	28.94%	Low
Overall Mean Score Percentage		**18.53**	**28.94%**	**Low**

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Table 3. Level of students' problem-solving skills in mathematics

Indicators	SD	Mean	Descriptive Equivalent
Mastery Experience	1.11	3.29	**Moderate**
Vicarious Experience	1.08	3.62	**High**
Social Persuasion	1.17	2.88	**Moderate**
Physiological State	1.28	3.33	**Moderate**
Overall Mean	**1.19**	**3.26**	**Moderate**

Table 4. Significance of the Relationship Between Digital Learning Engagement, Mathematics Self-efficacy and Problem-solving Skills

Variables Correlated	R	p-value	Decision on H_o	Decision on Relationship
Digital Learning and Problem-Solving Skills	0.050	0.454	Do not Reject	**Not Significant**
Digital Learning and Mathematics Self-efficacy	0.507	0.000	Reject	**Significant**
Mathematics Self-efficacy and Problem-Solving Skills	-0.34	0.605	Do not Reject	**Not Significant**

Table 5. Mediating Effect of Mathematics Self-Efficacy on the Relationship Between Digital Learning Engagement and Problem-Solving Skills

Indirect and Total Effects								
				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**Z**	**p**
Indirect	**Digital Learning Engagement ⇒ Mathematics Self-Efficacy ⇒ Problem-Solving Skills**	-1.398	1.271	-4.264	1.010	-0.043	-1.100	0.271
Component	**Digital Learning Engagement ⇒ Mathematics Self-Efficacy**	0.420	0.048	0.314	0.513	0.507	8.839	0.001
	Mathematics Self-Efficacy ⇒ Problem-Solving Skills	-3.332	3.004	-9.726	2.321	-0.085	-1.109	0.267
Direct	**Digital Learning Engagement ⇒ Problem-Solving Skills**	2.844	2.487	-1.613	7.617	0.088	1.143	0.253
Total	**Digital Learning Engagement ⇒ Problem-Solving Skills**	1.631	2.171	-2.180	5.429	0.050	0.751	0.453
Note. Confidence intervals computed with method: Bootstrap percentiles								
Note. Betas are completely standardized effect sizes								

REFERENCES

1. *Bond, M., Bedenlier, S., Marín, V. I., & Händel, M. (2020). Emergency remote teaching in higher education: Mapping the first global online semester. International Journal of Educational Technology in Higher Education, 17(1), 44.*
2. *Bayarcal, J., & Tan, H. (2023). Effects of instructional practices on students' problem-solving skills in mathematics. Journal of Mathematics Education, 16(2), 45–60.*
3. *Gahi, J., Santos, R., & Dela Cruz, M. (2023). Conceptual understanding and problem-solving performance in*

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
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mathematics: A correlational study. International Journal of Educational Studies, 10(1), 25–38.

4. *Ganapin, R. Y. A. (2025). Relationships between Grade 11 students' anxiety and self-efficacy compared to their mastery of rational functions. Asian Research Journal of Mathematics, 21(7), 43–60.*
5. *Kong, S. C., Lai, M., & Sun, D. (2021). Self-regulated learning and cognitive engagement in online mathematics learning environments. Computers & Education, 174, 104338.*
6. *Macario, R. P. B., Tabian, J. R., & Paguigan, J. (2026). Impact of digital learning platforms on senior high school students' engagement in the Philippines. International Journal for Multidisciplinary Research, 8(1).*
7. *Mangilala, B.-L. D., & Cajandig, A. J. S. (2025). Assessing the problem-solving abilities and their difficulties in learning mathematics. International Journal of Research and Innovation in Social Science, 9(3), 4211–4221.*
8. *Paudel, K. C., & Ghimire, S. P. (2024). Mathematics self-efficacy among secondary level students. Pragyaratna, 6(1), 123–130.*
9. *Pendon, R. P. (2022). Self-efficacy and mathematics performance among college students. Journal of Pharmaceutical Negative Results, 13(S1), 1697–1705.*
10. *Sapulete, J., Laurens, T., & Gaspersz, S. (2023). The influence of self-regulated learning and self-efficacy on problem-solving ability. Jurnal Pendidikan Matematika, 6(2), 114–122.*
11. *Saliao, M. D., & Cajandig, A. J. S. (2025). Integration of technology in teaching mathematics. International Journal of Research and Innovation in Social Science, 9(4), 4476–4493.*
12. *Sayco, J. D. T. (2025). Reinvigorating math learning: Exploring student engagement in the digital classroom. Journal of Education and Practice, 16(4).*
13. *Velez, J. A., Santos, R., & Dela Cruz, M. (2023). Difficulties and coping strategies in understanding mathematical concepts in a private higher education in Tagum City. Davao Research Journal, 14(E), 38–52.*
14. *Zhao, Y., Lei, J., Yan, B., Lai, C., & Tan, S. (2021). What makes the difference? A practical analysis of research on student engagement in online learning. The Internet and Higher Education, 50, 100812.*
15. *Zheng, B., Warschauer, M., Lin, C.-H., & Chang, C. (2020). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. Review of Educational Research, 90(4), 1–34.*