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Peer Scaffolds for Mathematical Confidence and Academic Persistence

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ABSTRACT

This study investigated how peer scaffolds contributed to mathematical confidence and academic persistence among Grade 6 learners in Santa Maria, Isabela. Using a predictive path-modeling cross-sectional design, data were obtained from 180 learners selected through proportionate stratified random sampling. A validated 36-item questionnaire measured peer scaffolds, mathematical confidence, and academic persistence, while partial least squares structural equation modeling was employed to test direct, indirect, and predictive relationships among the constructs. Results showed that peer scaffolds received the highest mean, while academic persistence emerged as the comparatively weaker learner outcome. The measurement model demonstrated satisfactory reliability, convergent validity, and discriminant validity. Structural analysis revealed that peer scaffolds strongly predicted mathematical confidence ($\beta = .612$, $p < .001$) and had a smaller but significant direct effect on academic persistence ($\beta = .208$, $p = .003$). Mathematical confidence significantly predicted academic persistence ($\beta = .447$, $p < .001$) and partially mediated the relationship between peer scaffolds and persistence, with an indirect effect of $\beta = .274$. The model explained 37.5% of the variance in mathematical confidence and 35.7% in academic persistence, with predictive assessment confirming useful out-of-sample performance. The findings indicate that peer support becomes more consequential when it strengthens learners' belief in their own mathematical capability. Structured peer scaffolding that gradually transfers responsibility to learners is therefore recommended to promote confident and sustained mathematical engagement.

Keywords: *academic persistence; mathematical confidence; mathematics education; peer scaffolds; PLS-SEM; upper elementary learners*

INTRODUCTION

Mathematics learning involves more than acquiring procedures and arriving at correct answers. Learners also need the confidence to attempt unfamiliar tasks, recover from mistakes, and continue working when solutions are not immediately apparent. These qualities are especially important during the upper elementary years, when mathematical tasks become more demanding and require greater independence in reasoning. The need to strengthen these foundations is evident in Philippine mathematics education. Results from the Programme for International Student Assessment showed that only 16% of Filipino students reached at least Level 2 proficiency in mathematics in 2022, indicating continuing concerns about learners' capacity to apply mathematical knowledge to basic problem situations (OECD, 2023).

One classroom resource that may help address these difficulties is the support learners receive from their peers. Peer scaffolds may take the form of explanations, guiding questions, hints, demonstrations, checking of solutions, or encouragement offered while learners work through mathematical tasks. Such assistance can make difficult activities more manageable without removing the learner's responsibility for solving the problem. A systematic review of peer tutoring in primary mathematics found that most of the studies examined reported favorable educational outcomes, with 75% showing medium to very large effect sizes. The findings suggest that structured peer interaction can serve as a meaningful support for mathematics learning in the elementary grades (Alegre et al., 2019).

The value of peer support may extend beyond performance to how learners view their own mathematical capability. Mathematical confidence reflects a learner's belief that he or she can understand mathematical ideas, perform required tasks, and deal with increasing levels of difficulty. Street et al. (2022) found that mathematics self-efficacy was closely associated with engagement, persistence, and academic performance, while also showing that these beliefs can change even across short sequences of classroom lessons. This suggests that confidence is not a fixed learner characteristic. It can develop through classroom experiences that allow students to receive assistance, experience progress, and gradually perform tasks with greater independence.

Confidence also matters because learning mathematics often requires sustained effort. Learners may encounter incorrect answers, confusing procedures, or problems that require several attempts before a solution becomes clear. Academic persistence therefore reflects the willingness to remain engaged and continue working despite such difficulties. Philippine research on academic self-efficacy has likewise recognized persistence as an important component of learners' beliefs about their capacity to manage academic demands (Dullas, 2018). These ideas provide a basis for examining whether peer scaffolds can contribute not only to how learners approach mathematics but also to their confidence and willingness to persist. Hence, this study examined Peer Scaffolds for Mathematical Confidence and Academic Persistence among upper elementary learners in Santa Maria, Isabela, with the aim of generating evidence that may guide supportive and learner-responsive mathematics instruction.

Literature Review

Peer Scaffolding in Mathematics Learning

Peer scaffolding places learners in situations where mathematical understanding can be developed through guided interaction with classmates. Rather than simply providing answers, peers may clarify procedures, ask questions, demonstrate solution strategies, and offer cues that allow another learner to move forward independently. Thurston et al. (2020) examined reciprocal peer tutoring among 487 elementary learners aged 10 to 12 and found significant improvement in mathematics attainment, with the quality of peer relationships also influencing learning outcomes. Their findings indicate that peer support works through both academic assistance and the social conditions created during shared problem solving. Such evidence supports the use of structured peer scaffolds in upper elementary mathematics, where learners increasingly encounter tasks that require explanation, reasoning, and sustained engagement.

Mathematical Confidence and Self-Efficacy

Mathematical confidence concerns how strongly learners believe that they can understand mathematical ideas and successfully perform mathematics tasks. These beliefs can influence whether learners attempt difficult problems, participate in discussions, and continue after committing errors. Using nationally representative assessment data from Grades 4, 8, and 12, Yang et al. (2024) found mathematics self-efficacy to be a robust predictor of mathematics achievement across all three grade levels. The association was already evident among Grade 4 learners, suggesting that confidence develops as an important element of mathematics learning before students reach secondary education. Classroom experiences that provide manageable challenges and opportunities for successful participation may therefore help learners form stronger beliefs about their mathematical capability.

Academic Persistence in Mathematics

Persistence becomes particularly important when learners face mathematical tasks that cannot be completed through immediate recall or a single procedure. A persistent learner remains engaged, revises an unsuccessful approach, seeks appropriate assistance, and continues working despite uncertainty. Granello et al.

(2026) studied Year 6 and Year 7 learners and found that a self-regulated learning intervention produced improvements in mathematics perseverance as well as mathematics performance. The intervention emphasized planning, monitoring, and self-evaluation, showing that perseverance can be strengthened through learning experiences rather than treated as a fixed personal trait. For upper elementary learners, this finding is significant because persistence may determine whether difficulty becomes an opportunity to refine mathematical thinking or a reason to disengage from the task.

Linking Peer Scaffolds, Confidence, and Persistence

Peer assistance may become especially meaningful when its academic and motivational effects are considered together. Learners who receive useful explanations or guidance from classmates may experience successful problem solving, and these experiences can reinforce their belief that difficult mathematical tasks are manageable. Asare (2025) found that peer-assisted learning had a significant positive effect on self-efficacy and mathematics performance, with self-efficacy partially mediating the relationship between peer-assisted learning and performance. Although the participants were senior high school students, the identified relationship provides a useful basis for examining whether similar processes operate earlier in schooling. Evidence remains needed on how peer scaffolds are associated simultaneously with mathematical confidence and the willingness to persist among upper elementary learners, which gives the present study in Santa Maria, Isabela a clear empirical direction.

METHODS

Research Design

The study employed a predictive path-modeling cross-sectional design to examine how peer scaffolds contributed to mathematical confidence and academic persistence among upper elementary learners. The design went beyond describing associations by specifying a structural pathway in which peer scaffolds served as the exogenous construct, mathematical confidence functioned as an explanatory mechanism, and academic persistence served as the principal outcome. This approach was appropriate because the study sought to determine both direct and mediated relationships among constructs measured at a single period. Partial least squares structural equation modeling was selected because of its suitability for prediction-oriented educational models involving latent constructs (Hair & Alamer, 2022).

Research Locale

The study was conducted in the public elementary education setting of Santa Maria, Isabela. The municipality provided an appropriate setting because learners were exposed to regular classroom mathematics activities that involved individual work, paired interaction, and peer-supported problem solving. The study covered public elementary learners within the municipality without identifying individual schools in the reporting of findings. DepEd records confirmed the presence of established public elementary education provision within Santa Maria.

Participants and Sampling Technique

The participants were Grade 6 learners, who were selected because this level represented the culminating stage of elementary mathematics and required learners to manage increasingly complex mathematical tasks. The official Grade 6 testing roster for School Year 2024-2025 recorded 680 public Grade 6 learners in Santa Maria, Isabela. From this population, a sampling target of 180 learners was established. This exceeded the minimum power requirement of 107 cases for a model with two principal predictors, a medium effect size of $f^2 = .15$, an alpha level of .05, and statistical power of .95. Proportionate stratified random sampling was applied so that learner representation followed the relative enrollment size of participating school groups while preserving the anonymity of individual institutions.

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Research Instrument

Data were gathered through a researcher-adapted Peer Scaffolds, Mathematical Confidence, and Academic Persistence Questionnaire consisting of 36 statements divided equally among the three constructs. Peer scaffolds contained 12 items covering explanatory assistance, prompting, collaborative checking, and supportive feedback. Mathematical confidence included 12 statements addressing perceived capability, willingness to attempt mathematical tasks, and confidence in problem solving. Academic persistence contained 12 statements measuring sustained effort, recovery after errors, task continuation, and willingness to try alternative strategies. Responses were recorded using a five-point scale ranging from 1, strongly disagree, to 5, strongly agree.

Content validation was undertaken by five specialists in mathematics education, educational psychology, measurement, and research methodology. The instrument obtained an S-CVI/Ave of .94, while the item-level content validity indices ranged from .80 to 1.00, indicating strong content validity. The revised questionnaire was pilot-tested with 30 Grade 6 learners who were comparable with the intended participants but were excluded from the main study. Reliability analysis produced Cronbach's alpha coefficients of .891 for Peer Scaffolds, .903 for Mathematical Confidence, and .879 for Academic Persistence, with an overall Cronbach's alpha of .932. McDonald's omega coefficients were .895, .907, and .884, respectively. These values demonstrated strong internal consistency and supported the use of the instrument for the full-scale data collection.

Data Gathering

Permission to conduct the study was secured from the appropriate education authorities before data collection commenced. After administrative approval, parental consent and learner assent were obtained because the participants were minors. The questionnaires were administered during an agreed period that did not interfere with major classroom assessments. Standard instructions were read before administration, and participants completed the instrument independently. Completed questionnaires were checked for missing responses, coded without learner names, and transferred to an electronic dataset for screening and analysis. Responses with substantial missing information were excluded before model estimation.

Data Analysis

The study used partial least squares structural equation modeling with predictive assessment rather than relying only on correlations or multiple regression. The measurement model was examined through indicator loadings, Cronbach's alpha, composite reliability, rho_A, and average variance extracted. Discriminant validity was assessed using the heterotrait-monotrait ratio. The structural model was then evaluated through variance inflation factors, standardized path coefficients, R^2, f^2 effect sizes, and predictive relevance. Statistical significance of the direct and indirect pathways was determined through 10,000 bootstrap resamples. Mathematical confidence was tested as a mediator between peer scaffolds and academic persistence. The model's capacity to predict unseen observations was further examined using PLSpredict, comparing prediction errors through RMSE and MAE. This procedure allowed the analysis to address both explanation and predictive usefulness rather than statistical significance alone (Hair et al., 2022; Shmueli et al., 2019).

Ethical Considerations

Participation was voluntary and proceeded only after parental consent and learner assent had been obtained. No learner names, grades, or identifying school information were included in the analytical dataset. Participants were informed that refusal or withdrawal would not affect their academic standing. Data were stored securely, accessed only for research purposes, and reported in aggregated form to protect the privacy and welfare of the participating learners.

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RESULTS AND DISCUSSION

Table 1. *Descriptive Results for the Study Constructs*

Construct	Mean	SD	Rank
Peer Scaffolds	3.61	0.64	1
Mathematical Confidence	3.42	0.68	2
Academic Persistence	3.28	0.72	3

Table 1 presents the overall responses of the 180 Grade 6 learners. Peer scaffolds obtained the highest mean of 3.61, suggesting that learners generally experienced explanations, hints, checking, and encouragement from classmates during mathematics activities. Mathematical confidence followed with a mean of 3.42. Academic persistence received the lowest mean of 3.28 and the largest standard deviation of 0.72. This pattern points to an important concern. Although peer assistance was relatively evident in mathematics classrooms, learners were less consistent in continuing difficult tasks, recovering from unsuccessful attempts, and trying alternative strategies. The findings therefore suggest that access to peer support did not automatically translate into equally strong persistence.

Table 2. *Reliability and Convergent Validity of the Measurement Model*

Construct	Loading Range	Cronbach's α	rho_A	Composite Reliability	AVE
Peer Scaffolds	.719 to .852	.893	.896	.912	.576
Mathematical Confidence	.734 to .871	.907	.910	.924	.604
Academic Persistence	.705 to .846	.884	.889	.907	.553

Table 2 shows that the indicators adequately represented their intended constructs. Outer loadings ranged from .705 to .871, while Cronbach's alpha values ranged from .884 to .907. Composite reliability values exceeded .90 for all three constructs, and rho_A values showed the same pattern of internal consistency. The AVE values of .576, .604, and .553 indicated that each construct accounted for more than half of the variance in its indicators. These results supported the reliability and convergent validity of the measurement model and allowed the structural relationships to be examined.

Table 3. *Heterotrait-Monotrait Ratio of Correlations*

Construct	Peer Scaffolds	Mathematical Confidence	Academic Persistence
Peer Scaffolds	1.000		
Mathematical Confidence	.704	1.000	
Academic Persistence	.594	.681	1.000

Table 3 indicates that the HTMT coefficients ranged from .594 to .704. The values showed that peer scaffolds, mathematical confidence, and academic persistence remained empirically distinguishable rather than functioning as different labels for the same learner characteristic. Peer scaffolds were related to confidence and persistence, but each retained sufficient conceptual independence. This distinction was essential because the proposed model treated classroom peer support as an external learning resource, confidence as a learner belief, and persistence as a behavioral disposition toward sustained mathematical effort.

Table 4. *Structural Path Estimates*

Structural Path	β	SE	t	p	95% CI	VIF	f^2
Peer Scaffolds → Mathematical Confidence	.612	.056	10.929	<.001	[.498, .716]	1.000	.600
Peer Scaffolds → Academic Persistence	.208	.071	2.930	.003	[.069, .347]	1.599	.044
Mathematical Confidence → Academic Persistence	.447	.064	6.984	<.001	[.321, .570]	1.599	.194

Note. Bootstrap estimates were based on 10,000 resamples.

Table 4 presents significant positive paths across the structural model. Peer scaffolds had their strongest direct influence on mathematical confidence, $\beta = .612$, $p < .001$, with a large effect size of $f^2 = .600$. Learners who experienced stronger peer explanations, prompts, feedback, and collaborative checking therefore tended to express greater confidence in handling mathematics. This finding is consistent with evidence that structured peer tutoring can strengthen learners' mathematics-related self-perceptions because students gain opportunities to explain, observe strategies, receive support, and experience successful participation (Moliner & Alegre, 2020).

Peer scaffolds also had a significant direct effect on academic persistence, $\beta = .208$, $p = .003$, although its effect size was small. Mathematical confidence produced a stronger effect on persistence, $\beta = .447$, $p < .001$. This difference is important. Peer assistance appeared helpful, but its direct contribution to persistence was limited when compared with learners' own belief that they could manage mathematical demands. The result helps explain why persistence remained the weakest construct in Table 1. Providing classmates who can help may not be sufficient when learners have yet to develop confidence in their own capacity to continue without immediate assistance.

Table 5. *Mediation Analysis for Mathematical Confidence*

Effect	β	SE	t	p	95% CI
Direct: Peer Scaffolds → Academic Persistence	.208	.071	2.930	.003	[.069, .347]
Indirect: Peer Scaffolds → Confidence → Persistence	.274	.050	5.480	<.001	[.181, .376]
Total Effect	.482	.057	8.456	<.001	[.368, .590]

Variance Accounted For = 56.8%
Mediation Type: Complementary Partial Mediation

Table 5 reveals one of the central findings of the study. Peer scaffolds had an indirect effect of $\beta = .274$ on academic persistence through mathematical confidence. The indirect pathway was stronger than the remaining direct effect of $\beta = .208$, while both remained statistically significant. Mathematical confidence therefore partially mediated the relationship between peer scaffolds and persistence, accounting for 56.8% of the total effect. Peer support appeared to matter most when the assistance learners received was translated into a stronger belief that they themselves could handle mathematics.

This result gives the model an important instructional meaning. Explanations or hints from classmates may resolve an immediate difficulty, but their longer value lies in helping learners develop a sense of capability. A systematic review by Zakariya (2022) showed that mathematics self-efficacy can be strengthened through instructional approaches that draw upon mastery experiences, social persuasion, and supportive learning processes. The present results follow this pattern by indicating that peer interaction became more consequential for persistence when it strengthened mathematical confidence first.

Table 6. *Explained Variance, Predictive Relevance, and PLSpredict Results*

Endogenous Construct	R^2	Adjusted R^2	Q^2	PLS RMSE	LM RMSE	PLS MAE	LM MAE
Mathematical Confidence	.375	.371	.238	.652	.681	.512	.535
Academic Persistence	.357	.350	.219	.688	.716	.541	.563

Note. RMSE = root mean square error; MAE = mean absolute error; LM = linear model benchmark.

Table 6 shows that peer scaffolds explained 37.5% of the variance in mathematical confidence, while peer scaffolds together with mathematical confidence explained 35.7% of the variance in academic persistence. The positive Q^2 values of .238 and .219 further indicated predictive relevance. In PLSpredict, the PLS-SEM model produced lower RMSE and MAE values than the linear-model benchmark for both endogenous constructs, indicating useful out-of-sample predictive performance.

The model nevertheless left approximately 64% of the variance in academic persistence unexplained. This reinforces the problem identified in the descriptive findings. Persistence in mathematics cannot be accounted for by peer scaffolding and confidence alone. Learners may also differ in task interest, prior achievement, frustration tolerance, classroom climate, teacher support, and the difficulty of the mathematical problem. DiNapoli and Miller (2022) demonstrated that perseverance during mathematics problem solving can be strengthened through carefully designed scaffolds, particularly when learners are helped to reconsider a problem after reaching an impasse. Thus, peer support in Santa Maria may be more useful when it is deliberately structured to encourage another attempt, alternative reasoning, and eventual independent problem solving rather than simple answer sharing.

Overall, the structural model showed that peer scaffolds were a strong predictor of mathematical confidence but only a modest direct predictor of academic persistence. The strongest practical finding was the mediating role of confidence. Peer support appeared to foster persistence largely by helping learners believe that they were capable of dealing with mathematical difficulty. The results therefore favor peer scaffolding practices that gradually transfer responsibility back to the learner. The goal is not merely to make difficult mathematics easier through classmates, but to use peer interaction as a bridge toward confident and sustained independent effort.

CONCLUSION

Peer scaffolds contributed meaningfully to mathematical confidence and academic persistence among Grade 6 learners, with mathematical confidence serving as an important pathway through which peer support strengthened persistence. Learners benefited most when peer interaction involved explanations, prompts, feedback, and collaborative checking that helped them develop greater belief in their own mathematical capability. However, the lower level of academic persistence showed that peer assistance alone was insufficient to sustain effort during difficult mathematical tasks. It is therefore recommended that Mathematics teachers structure peer scaffolding activities so that support is gradually reduced as learners gain competence, while classroom tasks should provide opportunities for repeated attempts, strategy revision, and independent problem solving. Schools may also incorporate peer-assisted learning approaches into mathematics enrichment and intervention programs, with particular attention to building learner confidence and perseverance. Future studies may examine other factors associated with persistence, such as teacher support, task difficulty, prior achievement, and classroom climate, to further explain why some learners continue working through mathematical challenges while others disengage.

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