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TEACHERS' SCAFFOLDING DESIGN SKILLS AND COGNITIVE LOAD REGULATION IN ARAKAN DISTRICT, NORTH COTABATO

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2. ABSTRACT

This quantitative study examined the level of teachers' scaffolding design skills and cognitive load regulation, and tested the relationship and influence between these variables among public school teachers in Arakan West, Arakan East, and Arakan North Districts, North Cotabato, Philippines for School Year 2025–2026. Using a descriptive-correlational design, 285 teachers were selected through random sampling from a total population of 405. Scaffolding design skills were assessed across structure, adaptability, and feedback support using an instrument adapted from Nickl et al. (2024) and Michalsky (2024; Cronbach's α = 0.93). Cognitive load regulation was measured across intrinsic load management, extraneous load control, and germane load enhancement using an adapted instrument from Seufert et al. (2024) and Evans et al. (2024; Cronbach's α = 0.91). Results revealed that scaffolding design skills were Highly Skilled overall (WM = 4.50), with adaptability and feedback support rated highest (WM = 4.51 each). Cognitive load regulation was Highly Regulated overall (WM = 4.51), with extraneous load control and germane load enhancement highest (WM = 4.52 each). Spearman rho analysis revealed that only adaptability showed a significant relationship with cognitive load regulation—specifically with germane load enhancement (r = 0.138, p = 0.016). Multiple regression confirmed that only adaptability significantly predicted germane load enhancement (β = 0.159, t = 2.786, p = 0.006; F = 2.735, R^2 = 0.026). Scaffolding design skills did not significantly influence intrinsic load management or extraneous load control. These findings affirm that teachers' flexibility in adjusting instruction to learner needs is the critical scaffold dimension connecting to meaningful cognitive processing.

3. KEYWORDS: *Scaffolding design skills; cognitive load regulation; adaptability; germane load enhancement; descriptive-correlational; Arakan District; North Cotabato.*

4. INTRODUCTION

Teachers' capacity to design effective scaffolding is directly linked to their ability to regulate cognitive load—both their own and their students'—during classroom instruction. Instructional scaffolding provides structured support that guides learners through complex tasks while reducing unnecessary cognitive burden, enabling students to progress from supported to independent performance. As Sweller et al. (2019, 2020) established through Cognitive Load Theory (CLT), working memory limitations make it essential that teachers organize content to manage intrinsic load, minimize extraneous demands, and direct effort toward germane processing. Three scaffolding dimensions are particularly central to this process: structure (organizing tasks coherently), adaptability (adjusting support to learner needs), and feedback support (guiding learners through corrective and reflective responses).

Despite growing evidence of scaffolding's importance for learning outcomes, local research examining how Filipino teachers' scaffold design skills relate to their cognitive load regulation practices remains scarce (Hernandez & Ong, 2023; Villanueva et al., 2022). Teachers in the Arakan District of North Cotabato—a predominantly rural and diverse educational context—face particular pressures in balancing lesson complexity, student readiness variability, and instructional pacing. Understanding which scaffold design skills most effectively support cognitive load regulation among teachers in this context is essential for designing targeted professional development interventions.

Grounded in Cognitive Load Theory (Sweller et al., 2019) and guided by conceptual frameworks linking scaffold design to load regulation (Patel & Wetzels, 2024), this study quantitatively determined the levels of teachers' scaffolding design skills and cognitive load regulation, and tested the relationship and influence between these two constructs.

5. MATERIALS AND METHODS

Research Design. A descriptive-correlational design was employed to describe current variable levels and determine relationships and predictive influence between teachers' scaffolding design skills and cognitive load regulation without experimental manipulation (Creswell & Creswell, 2023).

Locale and Respondents. The study was conducted in selected schools within Arakan West District (n = 85), Arakan East District (n = 98), and Arakan North District (n = 102), for a

total sample of 285 teachers out of a total population of 405. A 70% random sampling rate was applied to ensure representativeness and minimize selection bias.

Instrument. Part 1 measured scaffolding design skills through structure (5 items), adaptability (5 items), and feedback support (4 items) using a five-point Likert scale adapted from Nickl et al. (2024) and Michalsky (2024; Cronbach's $\alpha = 0.93$). Part 2 measured cognitive load regulation through intrinsic load management (5 items), extraneous load control (5 items), and germane load enhancement (5 items) using a five-point scale adapted from Seufert et al. (2024) and Evans et al. (2024; Cronbach's $\alpha = 0.91$). Descriptive levels for both instruments ranged from Least/Very Slightly Skilled/Regulated (1.00–1.80) to Very Highly Skilled/Regulated (4.21–5.00).

Statistical Analysis. Weighted means described variable levels. Spearman rho correlation coefficients identified significant relationships between scaffolding design skill dimensions and cognitive load regulation dimensions. Multiple linear regression analysis determined the predictive influence of scaffolding design skills on each dimension of cognitive load regulation at $\alpha = 0.05$.

6. RESULTS AND DISCUSSION

Level of Teachers' Scaffolding Design Skills

All three scaffolding design skill dimensions were rated Highly Skilled, with an overall weighted mean of 4.50. Adaptability and feedback support posted the highest categorical means (WM = 4.51 each), indicating teachers were strongest in flexibly adjusting instruction to learner needs and providing timely, corrective feedback. Structure was rated 4.49, reflecting highly organized task sequencing and progressive lesson design. Among individual items, 'using different materials when necessary to support diverse learning needs' (M = 4.58) and 'giving timely feedback that tells students what to improve next' (M = 4.53) received the highest ratings. These findings align with Nickl et al. (2024), who affirmed that adaptive scaffolding strengthens teacher decision-making, and with Jin et al. (2024), who linked scaffolded feedback to enhanced metacognitive regulation and feedback literacy.

Table 1. Summary of Teachers' Scaffolding Design Skills.

Dimension	Weighted Mean	Description
Structure	4.49	Highly Skilled
Adaptability	4.51	Highly Skilled
Feedback Support	4.51	Highly Skilled
Overall Weighted Mean	4.50	Highly Skilled

Level of Teachers' Cognitive Load Regulation

All three dimensions of cognitive load regulation were rated Highly Regulated, with an overall weighted mean of 4.51. Extraneous load control and germane load enhancement tied for the highest means (WM = 4.52 each), indicating teachers were strongest in reducing unnecessary distractions and promoting deeper knowledge processing. Intrinsic load management (WM = 4.49) was also highly rated, reflecting strong practices in breaking content into steps, activating prior knowledge, and pacing lesson complexity. The highest individual items were 'teaching prerequisite skills before introducing new topics' (M = 4.56) and 'pacing transitions smoothly to protect attention' (M = 4.55). These findings are consistent with Alruwaili and Alasmari (2025), who linked teacher load management to improved engagement, and with Hartelt and Martens (2024), who demonstrated that metacognitive prompting reduces perceived load.

Table 2. Summary of Teachers' Cognitive Load Regulation.

Dimension	Weighted Mean	Description
Intrinsic Load Management	4.49	Highly Regulated
Extraneous Load Control	4.52	Highly Regulated
Germane Load Enhancement	4.52	Highly Regulated
Overall Weighted Mean	4.51	Highly Regulated

Relationship Between Scaffolding Design Skills and Cognitive Load Regulation

Spearman rho correlation analysis revealed that most relationships between scaffolding design skill dimensions and cognitive load regulation dimensions were not significant. Structure showed no significant relationship with intrinsic load management ($r = -.036$, $p = .531$), extraneous load control ($r = .023$, $p = .695$), or germane load enhancement ($r = .043$, $p = .457$). Feedback support was similarly non-significant across all cognitive load dimensions ($r = -.069$ to $.039$, all $p > .05$). The null hypothesis was accepted for these dimensions.

The only significant relationship found was between adaptability and germane load enhancement (r = .138, p = .016), leading to rejection of the null hypothesis for this specific pairing. This finding indicated that teachers who more flexibly adjusted their instruction, materials, and pacing according to learner needs were more likely to engage in practices that promoted deeper processing, schema formation, and meaningful understanding. This is consistent with Faber et al. (2024) and Junker et al. (2025), who found that adaptive scaffolding was linked to germane cognitive effort and deeper knowledge processing.

Table 3. Spearman Rho Correlation: Scaffolding Design Skills and Cognitive Load Regulation.

Scaffolding Dimension	Intrinsic Load Mgt.	Extraneous Load Ctrl.	Germane Load Enh.
Structure	r = −.036, p = .531	r = .023, p = .695	r = .043, p = .457
Adaptability	r = −.087, p = .131	r = .028, p = .626	r = .138*, p = .016
Feedback Support	r = −.069, p = .230	r = .039, p = .494	r = −.004, p = .949

*Significant at $p < .05$

Influence of Scaffolding Design Skills on Cognitive Load Regulation

Multiple regression analyses showed that scaffolding design skills did not significantly influence intrinsic load management ($F = 1.543$, $p = .203$; $R^2 = 0.015$) or extraneous load control ($F = 0.510$, $p = .676$; $R^2 = 0.005$). For intrinsic load management, no individual dimension was a significant predictor: structure ($\beta = -.028$, $p = .620$), adaptability ($\beta = -.093$, $p = .108$), and feedback support ($\beta = -.078$, $p = .175$). For extraneous load control, all predictors were similarly non-significant: structure ($\beta = .043$, $p = .453$), adaptability ($\beta = .036$, $p = .530$), feedback support ($\beta = .046$, $p = .428$).

Scaffolding design skills significantly influenced germane load enhancement ($F = 2.735$, $p = .044$; $R^2 = 0.026$), with adaptability emerging as the sole significant predictor ($\beta = .159$, $t = 2.786$, $p = .006$). Structure ($p = .375$) and feedback support ($p = .775$) were not significant predictors. These findings indicated that when teachers showed greater flexibility in adapting instruction to learner readiness, they demonstrated stronger tendencies to promote deeper processing, reflection, and schema formation. The finding is supported by van Nooijen et al. (2024) and Herold et al. (2025), who showed that scaffolding becomes most effective for germane load when it directs mental effort toward conceptual understanding rather than surface completion.

Table 4. Summary of Regression Results: Influence of Scaffolding Design Skills on Cognitive Load Regulation.

Cognitive Load Dimension	R^2	F-value	Probability	Decision
Intrinsic Load Management	0.015	1.543	0.203 (NS)	Not Significant
Extraneous Load Control	0.005	0.510	0.676 (NS)	Not Significant
Germane Load Enhancement	0.026	2.735*	0.044	Significant

*Significant at $p < .05$; NS = Not Significant

7. CONCLUSION

Teachers in Arakan West, East, and North Districts demonstrate Highly Skilled scaffolding design across structure, adaptability, and feedback support, and Highly Regulated cognitive load regulation across all three dimensions. Among all scaffold design skill dimensions, only adaptability showed a significant relationship with and influence on cognitive load regulation—specifically germane load enhancement. This finding establishes teacher flexibility as the critical scaffold dimension that supports deeper knowledge processing and schema formation. Structure and feedback support, while highly practiced, did not demonstrate significant predictive relationships with cognitive load regulation, suggesting that other instructional and environmental factors account for the bulk of variance in intrinsic and extraneous load management. Professional development programs should prioritize building teachers' adaptive scaffolding capacity—including real-time adjustment of materials, pacing, and support based on learner readiness—to strengthen their ability to promote meaningful learning and cognitive regulation in diverse classroom contexts.

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