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Fostering Vocational Students' Self-Confidence and Learning Interest in Mathematics Through ARCS-Based Instruction

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ABSTRACT

Affective disengagement can limit students' participation in vocational mathematics even when cognitive instruction is adequate. This study examined whether Attention, Relevance, Confidence, and Satisfaction (ARCS)-based instruction improved vocational secondary-school students' self-confidence and interest in learning mathematics. A quasi-experimental nonequivalent control-group pretest-posttest design was conducted in January 2026 at an anonymized vocational secondary school in Eastern Indonesia. The study involved 47 students, with 25 in the ARCS group and 22 in the control group. Two 17-item four-point Likert questionnaires measured self-confidence and mathematics learning interest. Data were analysed using baseline equivalence tests, multivariate analysis of variance on change scores, independent-samples t tests, Hedges' g, and analysis of covariance. The groups did not differ significantly at baseline for self-confidence (p = .622) or learning interest (p = .691). The joint change in both outcomes was significant, Pillai's trace = .410, F (2, 44) = 15.27, p < .001. Self-confidence increased more in the ARCS group (M_{change} = 5.12, SD = 4.20) than in the control group (M_{change} = -0.95, SD = 4.04), t (44.61) = 5.05, p < .001, g = 1.45. Learning interest also improved more in the ARCS group (M_{change} = 2.52, SD = 4.69) than in the control group (M_{change} = -3.18, SD = 5.63), t (41.09) = 3.74, p < .001, g = 1.09. ANCOVA confirmed both effects after controlling pretest scores. ARCS-based mathematics instruction therefore showed substantial potential to strengthen affective engagement in vocational education.

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1. INTRODUCTION

Mathematics in Technical and Vocational Education and Training (TVET) serves as a fundamental cognitive tool that underpins quantitative reasoning, spatial modeling, accurate measurement, and domain-specific problem-solving across diverse occupational fields (Denteh & Awuah, 2026; Ye et al., 2024). Despite its instrumental utility, students' active participation in vocational mathematics is dictated not merely by cognitive knowledge, but heavily by affective dimensions—specifically, how competent and interested they feel during the learning process (Muhrman, 2022; Yavuz et al., 2016). Studentsale empirical evidence reveals a concerning trajectory: students' interest, enjoyment, and confidence systematically diminish as they progress through formal schooling, even though mathematics interest remains highly consequential for later educational trajectories and career choices (Campbell et al., 2025; Ferdinand et al., 2024). A high-school survey similarly identified perceived conceptual difficulty and weak real-life relevance as primary drivers of low mathematics motivation (Mengyao et al., 2024). In vocational environments, these affective conditions are particularly crucial because learners must continuously connect abstract mathematical concepts with practical, professional workflows.

In this study, student self-confidence is operationalized as the belief in one's capacity to actively participate, communicate mathematical ideas, make autonomous analytical decisions, and complete mathematics tasks responsibly. While conceptually related to task-specific self-efficacy, it represents a distinct construct of overall academic self-assurance. Social cognitive theory posits that beliefs of personal competence are continuously constructed through mastery experiences, interpretable feedback, and a clear sense of perceived control (Bandura, 2023). Recent empirical investigations further demonstrate that supportive learning environments predict mathematics self-efficacy, which in turn significantly contributes to academic achievement, and that structured self-regulated learning can effectively elevate students' confidence during mathematics instruction (Bütüner et al., 2025; Han et al., 2025).

Complementing self-confidence, interest in learning mathematics functions as a vital affective mechanism that directs attention, drives persistence, and fosters voluntary engagement with challenging academic tasks. The educational value of mathematical interest extends far beyond momentary classroom enjoyment; it is an enduring psychological orientation linked to enhanced performance, autonomous self-regulation, and long-term STEM-related choices (Asare, 2025; Dai et al., 2025; Ferdinand et al., 2024). Empirical evidence from TVET cohorts also indicates that self-efficacy can partially mediate the impact of contextually meaningful mathematical tasks on student interest, suggesting that learners are far more likely to value mathematics when they both recognize its real-world relevance and believe in their capacity to succeed (Arthur et al., 2026).

To systematically address these complex affective mechanisms, the Attention, Relevance, Confidence, and Satisfaction (ARCS) model provides a comprehensive instructional design framework grounded in human motivation theory (Fang et al., 2024; Mei et al., 2025; Wang et al., 2025). The model operates through four structured dimensions: Attention captures curiosity via novel stimuli, instructional variation, and purposeful cognitive conflict; Relevance explicitly links learning objectives to students' personal goals and practical experiences; Confidence cultivates realistic expectations of success and perceived locus of control; and Satisfaction consolidates long-term engagement through meaningful accomplishment and equitable reinforcement. A recent systematic review highlights that the ARCS model has been widely adopted in mathematics education as an instructional design framework, theoretical lens, and evaluation structure, with cognitive and affective outcomes evaluated predominantly through experimental and quasi-experimental designs (Li & Moore, 2018; Zhou & Zhang, 2025).

Recent empirical studies in mathematics education generally support the efficacy of ARCS-oriented instruction, although individual interventions vary substantially in their design and implementation media. For instance, an ARCS-based informational model demonstrated superior improvements in student motivation and mathematics performance compared to conventional instruction (Fang et al., 2024; Hu, 2024). Interactive GeoGebra e-books generated significantly higher attention-relevance and confidence-satisfaction scores than static digital formats (Yorganci & Subasi, 2025), while immersive geometry platforms and gamified mobile learning enhanced overall confidence, satisfaction, interest, and task engagement (Atin et al., 2022; Su et al., 2022). Furthermore, problem-based instruction framed around the Sustainable Development Goals successfully elevated all four ARCS dimensions in secondary mathematics classrooms (Mengyao & Ismail, 2025). However, critical synthesis indicates that these studies predominantly evaluate aggregate motivation, general performance, or technology acceptance, leaving the simultaneous development of self-confidence and interest relatively unexamined.

Consequently, a twofold research gap emerges from existing literature. First, limited intervention evidence addresses self-confidence and interest in learning mathematics together as dual outcomes, despite their potential reciprocal role in sustaining long-term engagement. Second, remarkably few ARCS studies have focused specifically on vocational high school students, whose perception of instructional relevance relies heavily on explicit connections between abstract mathematics and concrete occupational contexts. This limitation is compounded by expert-derived insights in gamified mathematics environments, which warn that motivational outcomes depend strictly on how specific design elements are implemented rather than on the mere inclusion of attractive activities (Mayrhofer et al., 2026).

To address these gaps, the present study examined the empirical effect of ARCS-based mathematics instruction on vocational students' self-confidence and interest in learning mathematics. Unlike prior studies that often report an aggregate ARCS motivation score or embed ARCS within a specific technology, game, or problem-based package, this study treated self-confidence and learning interest as theoretically distinct but jointly modeled outcomes of deliberate classroom motivational design. Three specific hypotheses were tested: (1) the joint change in both outcomes would significantly differ between the ARCS intervention group and the control group; (2) self-confidence would improve to a greater extent in the ARCS group; and (3) interest in learning mathematics would show significantly greater gains in the ARCS group. Ultimately, the intended contribution is both contextual and explanatory: to provide robust intervention evidence from vocational secondary education and to determine whether ARCS produces symmetrical or differentiated changes across distinct affective domains.

2. METHOD

This study employed a quantitative quasi-experimental research design using a nonequivalent control-group pretest–posttest architecture. Because individual random assignment was not feasible within the existing school structure, two intact vocational secondary-school classes in Eastern Indonesia were assigned to different instructional conditions, maintaining institutional confidentiality. Data collection was conducted in January 2026 during the 2025/2026 academic year as part of the scheduled mathematics curriculum. The study sample comprised 47 students, distributed between the experimental group (n=25), which received ARCS-based mathematics instruction, and the control group (n=22), which received regular instruction. The study strictly adhered to ethical principles for educational research: formal administrative approval was secured from school leadership, participation was entirely voluntary, and participants were assured of data confidentiality. All student names were anonymized using numeric identifiers prior to statistical analysis, and the specific identity of the participating institution remains withheld.

The intervention was delivered over an equivalent timeframe during regular instructional hours, ensuring both groups covered identical mathematical topics. In the experimental condition, instructional delivery was systematically structured around Keller's ARCS principles: Attention was stimulated via concise cognitive prompts, varied representations, and curiosity-driven problem scenarios; Relevance was established by explicitly grounding mathematical concepts in daily applications and domain-specific vocational tasks; Confidence was cultivated through clear learning objectives, scaffolded task difficulty, guided practice, and process-oriented feedback; and Satisfaction was reinforced via reflective progress evaluations, practical application opportunities, and performance-contingent recognition. Conversely, the control group was instructed through the school's standard teacher-led approach, comprising direct concept explanations, worked examples, interactive question-and-answer sessions, and individual practice without systematic motivational design. Implementation fidelity was continuously monitored using a structured session checklist tracking the execution of intended ARCS strategies across all four dimensions.

To evaluate the intervention, self-confidence and interest in learning mathematics were measured using two distinct 17-item questionnaires utilizing a 4-point Likert scale, yielding a theoretical score range of 17 to 68 per construct. The self-confidence instrument assessed perceived mathematical capability, task persistence, classroom participation, analytical decision-making, and communication; whereas the learning-interest measure evaluated cognitive attention, task enjoyment, voluntary engagement, and sustained effort. Both instruments were administered before and immediately following the intervention, and data was screened for completeness prior to statistical modeling. Because the primary research archive provided verified aggregate scores without item-level wording, development records, or reverse-scoring keys, the analysis utilized the supplied total scores directly rather than recomputing item-level psychometric coefficients. This reporting decision avoids unsubstantiated validity and reliability claims and is acknowledged as a methodological constraint; future replications should explicitly report instrument blueprints, adaptation protocols, scoring keys, and target-population validation evidence (Rosenthal et al., 2026). Figure 1 summarizes the overall procedural workflow of the study.

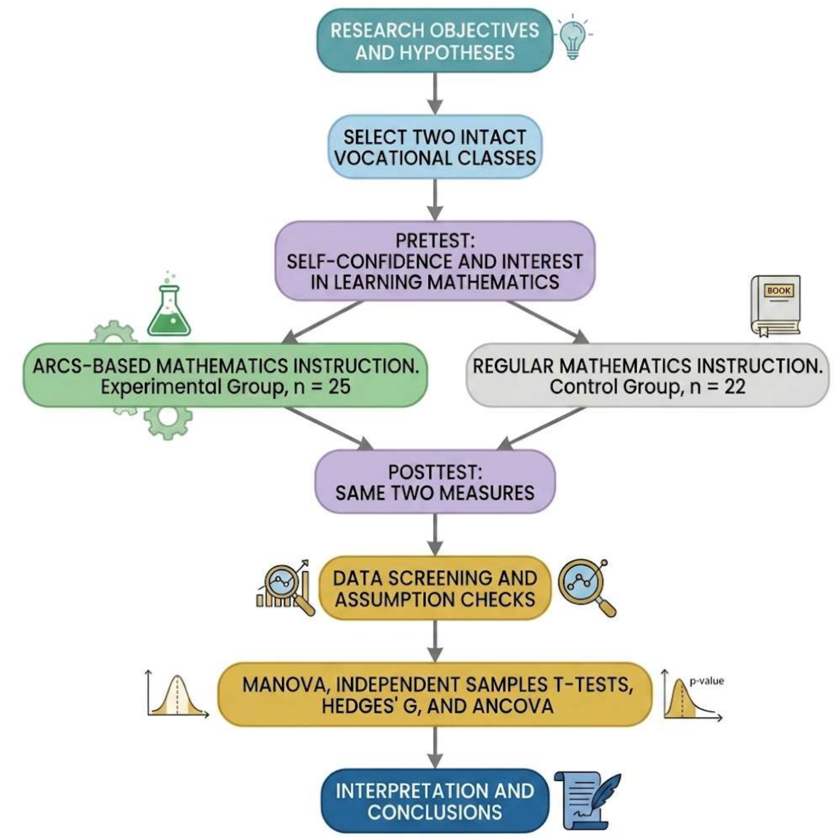

Figure 1. Research procedure

Analyses used verified total scores for each outcome. Descriptive statistics included the mean, standard deviation, median, interquartile range, and change score calculated as posttest minus pretest. Independent-samples t tests evaluated baseline equivalence. Shapiro-Wilk tests assessed the normality of change scores within each group, and Levene tests assessed homogeneity of variances. Within-group change was examined with paired-samples t tests and Cohen's dz. A positive-change responder was defined as a student whose posttest score exceeded the corresponding pretest score; responder proportions were compared using Fisher's exact test. A multivariate analysis of variance (MANOVA) tested the joint group effect on changes in self-confidence and learning interest. Follow-up Welch independent-samples t tests compared change scores, and Hedges' g with 95% confidence intervals quantified standardised effects. Separate ANCOVAs compared posttest scores while controlling for the corresponding pretest score; group-by-pretest interactions tested homogeneity of regression slopes. Mann-Whitney tests provided nonparametric sensitivity checks, and Pearson correlations examined whether changes in self-confidence and interest covaried. Statistical significance was set at alpha = .05.

3. RESULTS AND DISCUSSION

Results

Data completeness, baseline equivalence, and score distributions

All 47 participants provided complete pretest and posttest datasets with no missing cases or imputed values. Baseline comparability was established, as no statistically significant differences were observed between the two groups prior to the intervention regarding either self-confidence, Welch's t (39.84) =-0.50, p=.622, or learning interest, Welch's t (43.62) =-0.40, p=.691. Specifically, initial self-confidence scores ranged from 34 to 50 in the ARCS group and 33 to 50 in the control group (posttest ranges: 39–51 and 34–46, respectively), while pretest learning-interest scores spanned from 31 to 49 for the ARCS group and 31 to 52 for the control group (posttest ranges: 34–51 and 30–43, respectively). These overlapping baseline distributions, coupled with the nonsignificant statistical tests, confirm that subsequent group contrasts were not confounded by initial performance disparities in favor of the experimental cohort.

Table 1. Descriptive statistics for Self-Confidence and Interest in Learning Mathematics

Outcome	Group	n	Pretest M (SD)	Posttest M (SD)	Change M (SD)	95% CI for change
Self-confidence	ARCS	25	40.44 (3.36)	45.56 (3.18)	5.12 (4.20)	3.39 to 6.85
Self-confidence	Control	22	41.00 (4.25)	40.05 (2.97)	-0.95 (4.04)	-2.75 to 0.84
Learning interest	ARCS	25	40.32 (4.53)	42.84 (3.35)	2.52 (4.69)	0.58 to 4.46
Learning interest	Control	22	40.86 (4.74)	37.68 (3.44)	-3.18 (5.63)	-5.68 to -0.69

Within-group change and responder patterns

The trajectory of change differed clearly between instructional conditions. In the ARCS group, self-confidence increased by 5.12 points, 95% CI [3.39, 6.85], paired t (24) = 6.10, $p < .001$, Cohen's dz = 1.22; 21 of 25 students (84.0%) recorded a positive change. Learning interest increased by 2.52 points, 95% CI [0.58, 4.46], paired t (24) = 2.69, $p = .013$, dz = 0.54; 18 students (72.0%) improved. The control group showed a small, nonsignificant reduction in self-confidence, Mchange = -0.95, paired t (21) = -1.11, $p = .280$, but a significant reduction in learning interest, Mchange = -3.18, paired t (21) = -2.65, $p = .015$, dz = -0.57. Only 31.8% of control students improved self-confidence and 22.7% improved in learning interest. Fisher's exact tests confirmed that positive-change responders were more common under ARCS for self-confidence, $p < .001$, and learning interest, $p = .001$.

Table 2. Within-Group Changes and Positive-Change Responder Profiles

Outcome	Group	Positive change n (%)	Median change (IQR)	Paired t (df)	p	Cohen's dz
Self-confidence	ARCS	21 (84.0)	5.00 (2.00 to 8.00)	6.10 (24)	< .001	1.22
Self-confidence	Control	7 (31.8)	-1.00 (-3.75 to 1.00)	-1.11 (21)	.280	-0.24
Learning interest	ARCS	18 (72.0)	3.00 (-2.00 to 6.00)	2.69 (24)	.013	0.54
Learning interest	Control	5 (22.7)	-3.00 (-7.00 to 0.00)	-2.65 (21)	.015	-0.57

Figure 2 shows that the confidence intervals for ARCS change were entirely above zero for both outcomes, whereas the control-group interval was centred near zero for self-confidence and entirely below zero for learning interest. Thus, the between-group effect reflected both improvement under ARCS and, particularly for interest, deterioration under regular instruction.

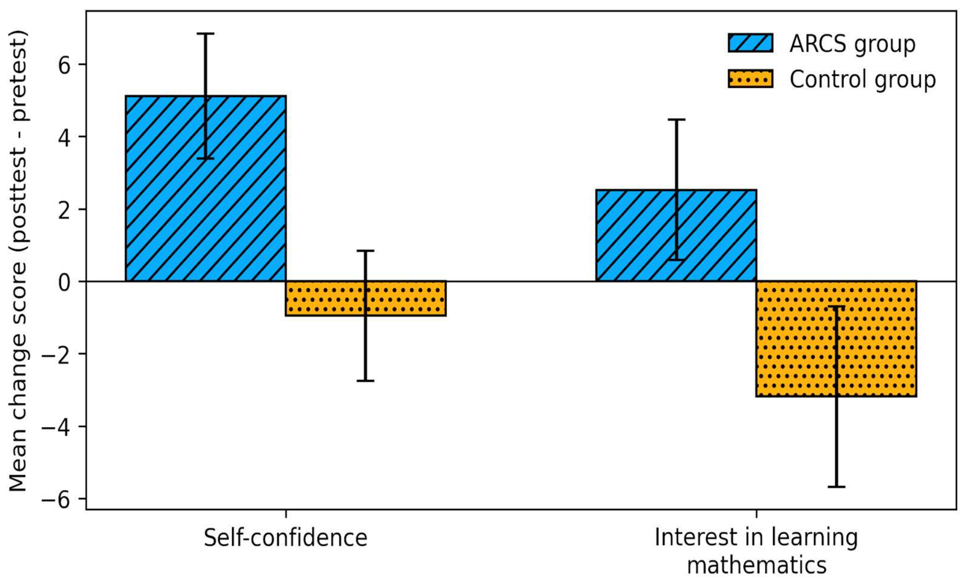

Figure 2. Mean Changing Scores by Instructional Group

Multivariate, outcome-specific, and adjusted effects

Preliminary diagnostic checks confirmed that all parametric assumptions were satisfied, with Shapiro–Wilk tests indicating normal distributions for change scores across both the ARCS ($p=.941$ for self-confidence, $p=.144$ for interest) and control groups ($p=.311$ for self-confidence, $p=.784$ for interest), while homogeneity of variances (Levene's tests: $p=.478$ and $p=.417$) and homogeneity of regression slopes (group-by-pretest interactions: $p=.600$ and $p=.419$) were successfully met. At the multivariate level, instructional group assignment exerted a statistically significant effect on the combined change in self-confidence and learning interest, Pillai's trace = .410, $F(2,44) =15.27$, $p<.001$. Subsequent univariate evaluations revealed that the

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ARCS-based instruction yielded substantially greater gains than the control approach for both self-confidence, Δ=6.07, 95%" CI " [3.65,8.50], Welch's t(44.61)=5.05, p<.001, Hedges' g=1.45, 95%" CI " [0.81,2.09], and learning interest, Δ=5.70, 95%" CI " [2.63,8.78], Welch's t(41.09)=3.74, p<.001, g=1.09, 95%" CI " [0.48,1.70], demonstrating a large overall experimental effect that was particularly pronounced and precisely estimated for self-confidence.

Table 3. Between-Group Effects and Baseline-Adjusted Estimates

Outcome	Change difference [95% CI]	Welch's t (df)	p	Hedges' g [95% CI]	Adjusted posttest difference [95% CI]	Partial η²
Self-confidence	6.07 [3.65, 8.50]	5.05 (44.61)	< .001	1.45 [0.81, 2.09]	5.65 [3.89, 7.41]	.488
Learning interest	5.70 [2.63, 8.78]	3.74 (41.09)	< .001	1.09 [0.48, 1.70]	5.24 [3.26, 7.22]	.392

To further evaluate intervention effectiveness while controlling baseline levels, analysis of covariance (ANCOVA) was conducted. The adjusted posttest means for self-confidence were 45.62 in the ARCS group and 39.97 in the control group, whereas the corresponding adjusted posttest means for learning interest were 42.88 and 37.64, respectively. These adjusted group effects remained statistically significant for both self-confidences, F (1,44) =41.92, p<.001, η_p^2=.488, and learning interest, F (1,44) =28.37, p<.001, η_p^2=.392, indicating substantial variance explained by the instructional model. Complementary nonparametric sensitivity analyses corroborated these findings (self-confidence: U=474.50, p<.001; learning interest: U=432.50, p=.001), confirming that the observed intervention effects were robust across parametric and distribution-free analytical frameworks.

Across the total sample, outcome change scores exhibited a moderate positive relationship, r=.499, p<.001. However, subgroup-specific correlation analyses revealed non-significant associations within both the ARCS group, r=.261, p=.207, and the control group, r=.327, p=.137. Consequently, the overall pooled correlation largely reflects the macro-level separation between the two experimental conditions rather than a direct intra-individual mechanism. This pattern underscores that individual gains in self-confidence cannot be assumed to automatically drive concurrent individual gains in learning interest during the intervention period, highlighting the independent operation of these affective constructs.

Discussion

Differentiated Affective Dynamics and Asymmetric Dual-Pathway Mechanism

Extending beyond conventional confirmations of motivational instruction efficacy, this study elucidates a highly differentiated pattern of affective transformation induced by Keller's Attention, Relevance, Confidence, and Satisfaction (ARCS) model (Lin &

Hsu, 2025; Mei et al., 2025). Specifically, while the ARCS intervention yielded robust positive effects on both affective dimensions, the impact on self-confidence was significantly stronger, more statistically precise, and exhibited higher intra-group consistency compared to learning interest. Although these dual constructs displayed macro-level co-movement at the aggregate level, they exhibited no significant within-condition correlation across individual learners. This empirical divergence supports an asymmetric dual-pathway theoretical framework: ARCS mechanisms directly fortify perceived capability via dedicated Confidence strategies while simultaneously cultivating interest through Attention, Relevance, and Satisfaction, demonstrating that affective growth paths operate independently rather than synchronously within every student (Goksu & Islam Bolat, 2021; Li & Keller, 2018).

Psychological Foundations and Structural Prerequisites of Self-Confidence Growth

The substantial gain in self-confidence aligns closely with Keller's instructional design principles and Bandura's social cognitive account of competence beliefs. Mechanistically, explicit goal setting, scaffolded task difficulty, guided practice, and process-oriented feedback provide learners with concrete mastery experiences and an enhanced internal locus of control over academic success. These structural features directly target the Confidence dimension rather than merely offering superficial pedagogical entertainment. This finding accords with recent evidence indicating that creative learning environments enhance mathematics self-efficacy (Bütüner et al., 2025) and structured intervention strategies safeguard affective domain outcomes (Han et al., 2025; Nokelainen et al., 2025). Conversely, Granello et al. (2026) observed that self-regulated learning interventions improved perseverance and utility value without yielding immediate self-efficacy gains, underscoring that cognitive planning alone is insufficient; efficacy enhancement requires explicit success attributions grounded in controllable competence.

Pedagogy-Driven Interest in Development and Technological Independence

While the observed interest enhancement corroborates past empirical work in mathematics education—such as game-based trigonometry instruction (Egara & Mosia, 2025) and ARCS-integrated digital frameworks including problem-based learning, GeoGebra e-books, immersive geometry, and mobile gamification (Atin et al., 2022; Su et al., 2022; Yorganci & Subasi, 2025)—it delivers a pivotal theoretical extension. Unlike prior investigations wherein ARCS design was inextricably confounded with high-tech media or novel digital platforms; the present findings establish that motivational design can be seamlessly embedded within conventional face-to-face instruction. This demonstrates that ARCS functions fundamentally as an intrinsic pedagogical design logic rather than a media-dependent technological effect, offering critical practical viability for resource-constrained educational environments.

Temporal Progression of Situational Versus Individual Interest

The relatively modest and heterogeneous interest trajectory warrants nuanced theoretical interpretation through the lens of interest development models (Tan et al., 2024). Interest acquisition progresses along a continuum where immediate attention-grabbing stimuli trigger situational interest, but the crystallization of enduring, individual interest demands sustained value internalisation, knowledge accumulation, and repeated re-engagement over extended durations. Consequently, short-term interventions primarily modulate situational engagement without necessarily transforming deeply rooted dispositions toward mathematics. This conceptualization reflects the underlying empirical distribution: whereas 84% of students exhibited self-confidence gains, interest improvement was bounded at 72% alongside instances of negative response trajectories, indicating that Attention and Relevance elements trigger immediate engagement but require temporal extension to consolidate into durable individual interest.

Contextualized Vocational Relevance and Dynamic Reciprocal Causality

In Technical and Vocational Education and Training (TVET) contexts, establishing authentic relevance is paramount. While Arthur et al. (2026) demonstrated that historical and contextualized mathematics directly and indirectly predicts interest through self-efficacy, this study advances beyond correlational mediation by illustrating that embedding vocational contexts directly into mathematical tasks can actively alter both constructs pre-to-post intervention. Crucially, true relevance demands deep task-level integration—modifying problem contexts, representations, decision criteria, and solution benchmarks—rather than superficial occupational mentions. Furthermore, regarding causal priority, while Arthur et al. (2026) positioned self-efficacy as an antecedent to interest, Dai et al. (2025) and Çelik Demirci et al. (2026) supported alternative mediation pathways; the loss of within-group change correlation in this study indicates that confidence and interest operate through reciprocally compatible yet functionally distinct pathways rather than linear mediation.

Attenuation Dynamics, Prevention Effects, and Outcome-Specific Sensitivity

The marked between-group effect sizes were driven not only by ARCS-induced growth but also by a pronounced affective decline within the control condition, reflecting broader systemic trends of diminishing mathematics enjoyment and confidence across formal schooling (Campbell et al., 2025). Thus, ARCS serves a dual function: promoting active psychological growth while simultaneously buffering against standard instructional attrition. Furthermore, these findings challenge the widespread practice in ARCS literature of reporting unidimensional, aggregated motivation scores (Mengyao et al., 2025). The observed outcome-specific sensitivity proves that individual ARCS components operate via distinct cognitive-affective mechanisms, necessitating future component-dismantling studies (e.g., isolating Relevance-Confidence from Attention-Satisfaction) to map specific instructional inputs to distinct psychological outcomes.

Strategic Alignment for Practice and Methodological Directives for Future Inquiry

For pedagogical translation, the evidence advocates for rigorous instructional alignment over cosmetic motivational add-ons (Mayrhofer et al., 2026; Zhang et al., 2023). Vocational mathematics instruction must systematically anchor Attention in cognitive conflict, Relevance in authentic workplace decision-making, Confidence in transparent evaluation criteria, and Satisfaction in validated competence. Nevertheless, these insights must be contextualized within key methodological limitations, including intact non-randomized sampling, single-site implementation, lack of complete psychometric invariance testing, checklist-based fidelity assessments, and immediate post-test reliance. Future research should implement pre-registered, multi-site designs utilizing validated construct-specific scales, independent fidelity observations, longitudinal cross-lagged tracking, and structural mediation models to rigorously map the dual-pathway framework across diverse learner demographics.

4. CONCLUSION

ARCS-based mathematics instruction produced significantly more favourable changes in vocational students' self-confidence and interest in learning mathematics than regular instruction. The effect was not uniform across outcomes: self-confidence showed the larger and more consistent response, whereas interest improved more modestly and heterogeneously. Baseline-adjusted and nonparametric analyses supported the main findings, but the absence of significant within-group correlations between the two change scores indicates that confidence and interest should not be treated as interchangeable or assumed to follow a single causal sequence. The study's novel contribution is therefore an asymmetric dual-pathway interpretation of ARCS in vocational mathematics: Confidence-oriented strategies may directly strengthen perceived capability, while Attention, Relevance, and Satisfaction may initiate interest through a partly independent route. Because the study used intact classes at one school and relied on incompletely documented self-report instruments, the findings require replication with validated measures, component-specific fidelity evidence, larger multisite samples, and longitudinal tests of the relationship between confidence and interest.

To address the demonstrated asymmetric dual-pathway effects of ARCS-based mathematics instruction, educators and instructional designers should move away from treating motivational interventions as a single undifferentiated strategy and instead implement targeted component alignments: directly embedding structured goal-setting, progressive difficulty, and process-focused feedback to fortify self-confidence, while anchoring attention and vocational relevance in authentic workplace decision-making to cultivate learning interest. Simultaneously, educational researchers must conduct multi-site, pre-registered longitudinal experiments utilizing fully validated, construct-specific instruments and independent fidelity monitoring to execute component-dismantling studies and empirically evaluate the reciprocal causal dynamics between self-confidence and interest over extended durations.

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