Video-Based Instruction and Academic Achievement in Mathematics Correlation: The Mediating Role of Self-Efficacy among Senior High School Students

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Abstract

Poor academic achievement is a crisis in mathematics education. This study examined the mediating role of mathematics self-efficacy on the relationship between video-based instruction and academic achievement in mathematics among senior high school students. Through predictive research design, data from 197 respondents selected through simple random sampling were analyzed using mediation analysis. Mathematics self-efficacy does not mediate the predictor-criterion correlation, denying Social Cognitive Theory. Future studies may examine other mediating variables and employ qualitative approach to generate themes which may be considered as potential variables. Education practitioners may focus resources on strengthening students' self-efficacy, engagement, and problem-solving skills to improve academic performance.

Keywords: Video-based instruction; academic achievement in mathematics; mediating role of self-efficacy, senior high school students.

1. Introduction

Poor academic achievement in mathematics remains a global educational concern that continues to challenge learners, educators, and policymakers worldwide (Chand et al., 2021). Poor academic achievement has become a pressing global concern, as recent OECD, TIMSS 2023, and PISA 2022 assessments consistently reported substantial declines in student achievement, particularly in mathematics, cross numerous countries (Coe, 2023; Crato & Patrinos, 2024; Dang, 2024). These widespread reductions in mathematical achievement highlight persistent systemic challenges in education that extend beyond the impacts of COVID-19 and signal an intensifying worldwide learning crisis.

International studies consistently indicate that diverse, context-specific challenges influence poor mathematics achievement. A systematic review in West Africa further revealed that mathematics underachievement arises from interconnected personal, instructional, familial, institutional, societal, and governmental factors (Bah, 2021). Similar patterns are observed in other contexts, including Tanzania, where high failure rates are linked to cultural perceptions of mathematics and policy constraints, and in Ecuador and China, where environmental and behavioral factors such as school climate and prosocial difficulties affect achievement (Mazana et al., 2020; Mendoza-Peñrrieta et al., 2022; Yu et al., 2022). In Ghana, limited curriculum coverage and negative teacher–student interactions have contributed to widespread "mathophobia" among learners (Fokuo et al., 2022; Newman-Naami, 2023). Additional evidence from Nepal and Nigeria highlighted that weak foundational skills, low motivation, ineffective teaching, and the combined influence of students, parents, and educational authorities further hinder mathematics achievement (Gnawali, 2024; Awofala & Fatade, 2023).

In the Philippine context, mathematics underachievement reflects global trends. Results from the 2018 PISA indicated that more than half of Filipino students performed below the minimum achievement level (Bernardo et al., 2022). Existing research attributed this persistent low achievement to a combination of psychological, environmental, and instructional factors, including a low growth mindset and diminished valuing of school among learners in Manila (Lapinid et al., 2022). Studies across regions further revealed that mobile phone overuse in the Visayas, weak foundational skills in Leyte and Oriental Mindoro, and student-related factors, such as interest, prior knowledge, effort, study habits, and mathematics anxiety in Cebu, significantly

hinder achievement (Igcasama, 2023; Cabuquin & Abocejo, 2023; Ragaza, 2024; Brinosa et al., 2025). Moreover, findings from Misamis Oriental indicated that modular learning during remote instruction was associated with lower mathematics achievement due to financial constraints, limited resources, insufficient family support, and negative learning attitudes (Layar et al., 2024).

Poor mathematics achievement carries serious consequences, including limited access to higher education, restricted employment opportunities, increased vulnerability to social issues, and reduced national productivity and competitiveness (Bah, 2021; Malipot, 2023). Research consistently showed that while technology-enhanced approaches are increasingly adopted to improve engagement, the lack of empirical evidence poses challenges for educators seeking to understand effective pedagogy (Duterte, 2024). Despite the global shift toward video-based instruction, there remains insufficient published information on the mediating role of self-efficacy in the Philippine local context. Hence, this research was conducted to address this gap among senior high school students and contribute to technology-enabled learning.

This study is significant because it identifies mathematics self-efficacy as the key mechanism through which video-based instruction improves learning, directly addressing low confidence and engagement that contribute to poor mathematics achievement. This aligns with Sustainable Development Goal (SDG) 4, which aims to ensure inclusive, equitable, and high-quality education. For learners, understanding this relationship can strengthen effective learning behaviors and numeracy skills (Targets 4.4 and 4.6), while educators may gain insights into integrating video-based instruction to foster confidence, engagement, and equitable participation (Target 4.8). At the institutional level, the findings may support schools and the Department of Education (DepEd) in improving technology-enhanced instructional policies that promote effective and inclusive learning outcomes in mathematics (Target 4.1). At the broader level, this study may provide a valuable foundation for researchers and policymakers seeking evidence-based interventions that enhance mathematics self-efficacy, optimize technology integration, and advance SDG 4's commitment to quality education for all.

The general purpose of the study is to determine the mediating effect of mathematics self-efficacy on the relationship between Video-Based Instruction and academic achievement in mathematics among senior high school students. Specifically, it sought to answer the following: 1.) to determine the levels of mathematics self-efficacy among senior high school students in terms of mastery experience, vicarious experience, social persuasions, and physiological state; video-based instruction in terms of usefulness, ease of use, and satisfaction; and the academic achievement in mathematics of senior high school students; 2.) to determine the significance of the correlation between video-based instruction, mathematics self-efficacy and academic achievement in mathematics; 3.) to determine the significance of the direct effect of video-based instruction on academic achievement in mathematics, controlling for mathematics self-efficacy; 4.) to determine the significance of the indirect effect of video-based instruction on academic achievement in mathematics through mathematics self-efficacy; and 5.) to determine the significance of the total effect of video-based instruction on academic achievement in mathematics.

Hypotheses

$H_0$1: Video-based instruction and mathematics self-efficacy do not significantly correlate with academic achievement in mathematics.
$H_0$2: The direct effect of video-based instruction on academic achievement in mathematics, controlling for mathematics self-efficacy, is not significant.
$H_0$3: The indirect effect of video-based instruction on academic achievement in mathematics through mathematics self-efficacy is not significant.
$H_0$4: The total effect of video-based instruction on academic achievement in mathematics is not significant.

2. Methodology

2.1. Research Design

This study employed a predictive research design. It focuses on identifying relationships among variables and developing models that estimate future behaviors, performances, or conditions based on existing data (Toma & Wei, 2023). This method is suitable for research that aims to forecast future outcomes, estimate trends, or

determine the influence of predictor variables on a dependent variable. It helps researchers identify significant predictor variables, improve planning and intervention strategies, and generate models that can guide future actions or policies (Aithor, 2024).

2.2. Locale of the Study

The study was conducted within national public government school in Davao Oriental, Caraga North District. The researcher identified a specific government school within the district, where the study was conducted. Hence, the educational setting reflects how instructional practices, curriculum innovations, and technology integration are implemented in a typical rural public-school context. Moreover, the researcher conducted the study at the institution, where potential respondents were identified, as the school has begun incorporating video-based and technology-enhanced instructional materials as part of its ongoing curriculum innovation initiatives. This makes it an appropriate locale for examining the effectiveness of video-based instruction and its relationship to students' mathematics self-efficacy and academic achievement, as well as understanding how technology-mediated learning approaches can enhance student engagement and performance in mathematics.

2.3. Sample and Sampling

The respondents in the study consisted of 197 students from a national public school in the Caraga North District senior high school, aged below 18 years. The respondents were enrolled in national public government school in one Division. The Taro Yamane formula was applied to determine the minimum sample size, resulting in the selection of 197 respondents, thereby providing a practical approach to maintain survey results within acceptable margins of random error (Adam, 2020). To ensure equal chances of participation, the simple random sampling technique was employed, in which each student had an equal chance of being selected, making the selection process entirely based on chance (Noor et al., 2022).

2.4. Data Gathering Technique

To quantify the three constructs of the study, the researcher utilized modified survey questionnaires to collect the data. The academic grit questionnaire was adapted from Clark and Malecki (2019) with indicators of determination, resilience, and focus. It contained 30 items and was tested for reliability, yielding a Cronbach's alpha of 0.904. Additionally, the perceived teacher support questionnaire was adapted from Wu et al. (2024) with indicators of instrumental, emotional, informational, and appraisal support. It consisted of 25 items and underwent reliability testing, yielding a Cronbach's alpha of 0.945. Lastly, the mathematics engagement measure was adapted from Wang et al. (2016) with indicators of behavioral, cognitive, emotional, and social engagement. It consisted of 33 items and was subjected to reliability testing, obtaining a Cronbach's alpha of 0.929.

2.5. Data Analysis Technique

The survey technique was used in gathering data. This collects primary data from a representative sample using standardized questionnaires, allowing for reliable, consistent, and comparable insights into attitudes, behaviors, motivations, and perceptions (Survey Techniques, 2025). This offers advantages such as quick, cost-effective, and flexible tools that can be administered remotely to large groups, allowing for standardized, reliable data collection that is easy to compare, analyze, and use for both factual and attitudinal insights (DeFranzo, 2025).

In this study, two adapted and modified survey questionnaires, and a researcher-designed test were used. The first instrument, the Video-Based Instruction Questionnaire, was adapted from Rivera's (2022) study. It consists of 16 items designed to assess students' experience with video-based instruction in mathematics. A

four-point Likert scale was used to describe the degree level of students' perceptions of video-based instruction. This adapted instrument was pilot-tested for reliability, with the STRS achieving a Cronbach's alpha of 0.946.

The second instrument, which measured mathematics self-efficacy and was adapted from Usher and Pajares (2009). It comprises 24 items designed to assess students' confidence in performing various mathematical tasks and overcoming mathematical challenges. This questionnaire also utilized a four-point Likert scale to assess students' mathematics self-efficacy. Pilot testing revealed a Cronbach's alpha of 0.875.

The third instrument, which assessed academic achievement in mathematics, was a research-made test designed to measure the performance of senior high school students. It consists of 35 items designed to evaluate students' understanding and mastery of key mathematical concepts and skills. Similar to the previous tools, this instrument employed five ordered scale, based on total scores, to measure academic achievement in mathematics among senior high school students, with a Cronbach's alpha of 0.887.

2.6. Ethical Considerations

Respondents were fully informed about the study's purpose, procedures, and their rights, including the freedom to withdraw at any time, with informed consent and, for minors, assent obtained prior to data collection. Participation was voluntary, with clear explanations of methods, intended uses, and potential risks and benefits. The respondents' identities were protected through anonymity or confidentiality, with data securely stored and access limited to the researcher unless explicit consent for disclosure is given. The study adhered to principles of social responsibility, aiming to maximize benefits while minimizing harm, with safeguards such as support resources and adherence to institutional policies for sensitive disclosures. Integrity and transparency were maintained through careful documentation of all stages, including research design, data collection, coding, and analysis. Ethical approval was secured from the Holy Cross of Davao College – Society for Moral Integrity and Legal Ethics (HCDC-SMILE), and permission to conduct the study was respectfully requested and granted by the Department of Education (DepEd). All efforts have been made to uphold fairness, protect respondents' rights, report findings transparently, and disclose any potential conflicts of interest.

3. Results and Discussions

3.1 Descriptive Analysis

Shown in Table 1 are the descriptive statistics of the study. The table presents the variables involved, namely, self-efficacy, video-based instruction, and academic achievement in Mathematics among Senior High School students, together with their corresponding number of samples, standard deviation, mean, and descriptive level.

Table 1: Descriptive Statistics (n = 197)

Variables	Number of Samples (n)	Standard Deviation	Mean	Descriptive Level
Self-Efficacy	**197**	**0.33**	**3.03**	**High**
Mastery experience		*0.42*	*3.01*	*High*
Vicarious experience		*0.42*	*3.18*	*High*
Social persuasions		*0.42*	*2.88*	*High*
Physiological state		*0.46*	*3.03*	*High*
Video-based instruction	**197**	**0.42**	**2.93**	**High**
Perceived usefulness		*0.52*	*2.89*	*High*
Perceived ease of use		*0.48*	*2.83*	*High*
Satisfaction		*0.86*	*3.07*	*High*
Academic achievement in Mathematics	**197**	**0.65**	**3.03**	**High**

Specifically, the table shows that the mathematics self-efficacy variable obtained a mean of 3.03, described as high. This indicates that the respondent's mathematical self-efficacy is strong across all dimensions. All indicators obtained a high level, with vicarious experience recording the highest mean (M =

3.18). The standard deviation of 0.33 is described as highly consistent, denoting a strong and uniform perception of self-belief among students. Furthermore, the video-based instruction variable obtained a mean of 2.93, described as high. This denotes that the use of video-based tools as a learning medium is good and effective for the respondents. Among its indicators, satisfaction obtained the highest mean (M = 3.07), while all other indicators remained within the high range. The standard deviation of 0.42 signifies a high level of consistency in how students perceive the utility and accessibility of these instructional materials. Finally, the academic achievement in Mathematics variable obtained a mean of 3.03, described as high. Similar to the high behavioral indicators in self-efficacy and instruction, this level suggests that student performance is at a good baseline. The standard deviation of 0.65 indicates a wider spread of scores, signifying a more varied level of academic mastery among the respondents than in their perceptions of efficacy.

Students' mathematics self-efficacy is interpreted as strong, and the benefits of video-based instruction are considered good, indicating generally positive perceptions of both psychological readiness and instructional support. However, academic achievement is not yet interpreted at a very good level, suggesting that while the foundations for learning are strong, further alignment between self-efficacy, instructional methods, and performance outcomes is needed to enhance actual mathematical achievement.

3.2 Correlation Analysis

It is presented in Table 2 the correlational results between self-efficacy and video-based instruction as predictive variables, and the academic achievement of senior high school students in mathematics.

Table 2: Correlational Table (n =197)

Variables	Academic achievement in Mathematics			
	r-value	p-value	Decision on *Ho*	Interpretation
Self-Efficacy	-0.142	0.047	Reject Ho	Low significant correlation
Video-based instruction	-0.004	0.950	Fail to Reject Ho	Low non-significant correlation

Level of Significance: 0.05
Decision Rule: Reject Ho if p < 0.05

Specifically, the table shows that the correlation between self-efficacy and academic achievement in mathematics variables obtained a p-value of 0.047, which is lower than the 0.05 level of significance; hence, the null hypothesis was rejected. This indicates that the correlation is statistically low significant. The r-value of -0.142 reflects a low negative correlation between self-efficacy and achievement. This finding implies that higher levels of self-efficacy among students are slightly associated with lower academic achievement. Similarly, video-based instruction yielded a p-value of 0.950, which is higher than the 0.05 level of significance; hence, the study fails to reject the null hypothesis, indicating a low non-significant correlation. The r-value of -0.004 reflects a low negative, non-significant correlation between video-based instruction and achievement. This implies that the implementation of video-based instruction is not significantly associated with a difference in students' academic achievement levels.

Both variables showed a minimal, negative association with academic performance. Self-efficacy shows a statistically low significant link. In contrast, video-based instruction shows a low non-significant relationship, indicating it does not serve as a meaningful predictor of students' academic achievement in mathematics among this specific group of respondents.

3.3 Regression Analysis

Presented in Table 3 is the statistical analysis examining the mediating effect of mathematics self-efficacy on the relationship between video-based instruction and academic achievement in mathematics.

Table 3. Mediation Table (n =197)

Label	Path / Effect	Estimate (B)	SE	Z-value	p-value	Decision on H_0	Interpretation
A	Video-Based Instruction → Self-Efficacy	0.112	0.05	2.14	0.033	Reject H_0	Significant
B	Self-Efficacy → Academic Achievement in Mathematics	-2.89	1.34	-2.15	0.031	Reject H_0	Significant
c’	Video-Based Instruction → Academic Achievement in Mathematics (Direct Effect)	-1.71	1.13	-1.51	0.130	Fail to Reject H_0	Not Significant
a × b	Indirect Effect (Mediation)	-0.32	0.22	-1.46	0.144	Fail to Reject H_0	Not Significant
(a × b) -c	Video-Based Instruction → Academic Achievement in Mathematics (Total Effect)	0.25	1.28	0.20	0.12	Fail to Reject H_0	Not Significant

Level of Significance: 0.05
Decision Rule: Reject H_0 if $p < 0.05$

The table specifically shows that the direct effect of video-based instruction on academic achievement, controlling for self-efficacy, yielded an estimated Beta of -1.71, with a corresponding p-value of 0.130, which is greater than the 0.05 level of significance. Hence, the study fails to reject the null hypothesis. This indicates that the direct effect of video-based instruction on academic achievement, controlling for self-efficacy, is not significant. In contrast, the indirect effect of video-based instruction on academic achievement through self-efficacy obtained an estimated Beta of -0.32, with a p-value of 0.144, which is greater than the 0.05 level of significance. Thus, the study failed to reject the null hypothesis. This indicates that the indirect effect of video-based instruction on the criterion through the mediator is not significant. Lastly, the total effect of video-based instruction on academic achievement resulted in an estimated Beta of 0.25. The corresponding p-value is 0.12, which is above the 0.05 level of significance; therefore, the study failed to reject the null hypothesis. This indicates that the total effect of video-based instruction on the criterion is not significant.

The table likewise specifies the mediated proportion that is -1.28. While a proportional value above 1 or negative is mathematically possible in certain contexts, it typically points to a suppression effect or an unstable model in statistical interpretations of mediation. In practical terms, this indicates that the model is complex and does not show standard mediation. These results confirm no evidence of a significant mediating effect: while video-based instruction significantly impacts self-efficacy and self-efficacy significantly impacts achievement, there is no overall mediated pathway to achievement.

Summary of Findings

Based on statistical results, it was specifically found that:

1. Mathematics self-efficacy has low but significant correlation with academic achievement in mathematics; while Video-Based Instruction has no significant correlation with academic achievement in mathematics.
2. The direct effect of video-based instruction on academic achievement in mathematics, controlling for mathematics self-efficacy, is not significant.
3. The indirect effect of video-based instruction on academic achievement in mathematics through mathematics self-efficacy is not significant.
4. The total effect of video-based instruction on academic achievement in mathematics is not significant.

3.4 Mathematics Self-Efficacy and Mathematics Achievement Correlation

The finding that mathematics self-efficacy has a low significant correlation with academic achievement affirms Nuraini et al. (2024), who found that mathematics self-efficacy showed only a weak but statistically significant relationship with students' mathematics achievement. Likewise, this finding aligns with Schunk and DiBenedetto (2020), who emphasized that self-efficacy is a critical motivational construct affecting choices, effort, and persistence. Moreover, this current finding affirms Dogan et al. (2023), who underscored that lower-performing students significantly overestimated their grade point averages by approximately 13.5% and demonstrated larger discrepancies between estimated and actual performance compared to higher-performing students, despite reporting similar levels of confidence. This pattern reflects the Dunning–Kruger effect, where inaccurate self-assessment among lower achievers contributes to misaligned academic judgments and potentially hinders academic progress. On the contrary, this current finding contradicts Asoy and Picaza (2025), who found that self-efficacy showed a strong positive correlation with achievement in mathematics and influenced achievement in mathematics. While of Asoy and Picaza had 227 samples, but this current finding was established using 197 samples.

3.5 Video-Based Instruction and Mathematics Achievement Correlation

The finding that video-based instruction does not significantly correlate with academic achievement in mathematics supports Guro and Basmayor (2024), who affirmed that posttest scores following video lessons showed no significant difference compared to traditional approaches. Moreover, the current finding corroborates with Maputi et al. (2024), who noted that while multimedia instruction is perceived as moderately effective for the learning experience, it does not statistically translate to enhanced academic performance. Similarly, this finding also supports Badru et al. (2025), who highlighted that the effectiveness of candid video instruction does not differ between students of high and low numerical ability, suggesting a uniform lack of impact on achievement across diverse student groups. On the other hand, this finding contrasts Dipon and Dio (2024), who asserted that video-based instruction significantly improves academic performance across various grade levels and modalities.

3.6 Video-Based Instructions and Mathematics Achievement as Mediated by Mathematics Self-Efficacy

The finding of this study asserting that mathematics self-efficacy does not mediate the correlation between video-based instructions and mathematics achievement affirms Marin and Bolen-Amparo (2025) and Tan et al. (2025), who indicated that self-efficacy shows no significant mediated effect on blended or video-based learning approaches and mathematics achievement across various learning levels. Moreover, the current finding supports the idea that digital literacy and engagement may not directly translate to performance gains as stated by Widowati et al. (2023), who revealed that while engagement moderated self-efficacy, it did not create a significant mediation path to academic outcomes. However, the current finding questions Zakir et al. (2025) and Hong et al. (2025), who found that digital self-efficacy and classroom interaction serve as robust mediators that significantly enhance learning outcomes. This discrepancy suggests that the mediating role of self-efficacy may be highly dependent on the specific digital tools used and the level of student-teacher interaction provided within the instructional design.

4. Conclusion

Based on the findings, mathematics self-efficacy does not mediate the relationship between video-based instruction and academic achievement in mathematics. Although the mediator was significantly low correlated with the outcome, the direct and total effects of the instructional method remained non-significant. Hence, Albert Bandura's Social Cognitive Theory, positing that behavior is shaped through the reciprocal determinism of environmental, personal, and behavioral factors, was denied.

5. Recommendation

Based on the conclusion, the following are recommended:

1. Future studies may utilize other variables as mediators of the correlation between video-based instruction and mathematics achievement. Qualitative research or mixed-methods approaches may be explored to generate themes that identify why specific environmental inputs, such as digital tools, fail to trigger the expected dynamic interaction within the reciprocal determinism framework.

2. School leaders and educators may exert optimum efforts and allocate resources toward strengthening students' mathematics self-efficacy to improve academic achievement. Efforts and resources intended for video-based instruction may be directed toward pedagogical strategies that cultivate students' confidence, engagement, and problem-solving skills, rather than relying solely on the instructional medium.

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