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Structural Equation Modelling of Factors Influencing Confidence in Mathematics

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ABSTRACT

Students' confidence in mathematics plays a crucial role in determining academic performance, persistence, and interest in STEM pathways. This study aimed to analyze how intrinsic and extrinsic factors influence confidence in mathematics, with self-efficacy as a mediating variable. A descriptive- correlational design was employed, and data were collected through a validated survey from 353 Grade 10 students enrolled in public high schools in Tacurong City during the third quarter of the 2024–2025 school year. Using Structural Equation Modeling (SEM), the study found that both intrinsic and extrinsic factors significantly influence confidence, directly and indirectly, through self-efficacy. Extrinsic factors such as teacher and peer support and intrinsic factors like motivation and prior achievement were positively associated with confidence. Because self-efficacy showed the strongest direct effect, interventions should prioritize building students' belief in their mathematical abilities. The findings provide evidence for designing policies and practices that support learners' psychological and contextual needs in mathematics education.

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1. INTRODUCTION

Students' confidence in mathematics significantly affects their academic performance, engagement, and future pursuits in STEM-related fields. Confidence reflects a learner's belief in their capability to succeed in mathematical tasks, and it is strongly associated with persistence, performance, and willingness to take on challenges. In international contexts, countries with high mathematics performance often demonstrate stronger levels of student confidence, indicating the importance of this psychological construct (Çiftçi & Yildiz, 2019). However, in the Philippine setting, persistent underperformance in mathematics has raised concerns regarding students' mathematical self-belief. The 2019 TIMSS report ranked the Philippines lowest among 58 countries, with Filipino Grade 4 students averaging only 297 points in mathematics (Suguitan & Natividad, 2022).

Mathematical self-confidence is influenced by various personal and environmental factors. Intrinsic factors such as motivation, academic self-concept, and prior success are critical in shaping students' self-belief (Bofah & Ntow, 2017; Zhou *et al*., 2015). Students who perceive themselves as capable are more likely to engage meaningfully with mathematical content, persevere in difficult tasks, and attain higher achievement (Lazarides & Rubach, 2017). Likewise, extrinsic factors (such as parental support, teacher quality, classroom environment, and peer interactions) serve as external reinforcements that influence student attitudes and behaviors toward mathematics (Sukkamart *et al*., 2023; Ryan & Deci, 2019). In **Table 1**, the distribution of respondents across four public high schools in Tacurong City provides the demographic context for the study sample.

Figure 1 presents the hypothesized Structural Equation Model (SEM), illustrating the direct and indirect effects of intrinsic and extrinsic factors on confidence, mediated by self-efficacy. SEM is a powerful analytical technique that allows the simultaneous examination of multiple relationships, offering a nuanced understanding of how these variables interact. The model assesses how intrinsic motivation and extrinsic support affect self-efficacy and, subsequently, students' confidence in mathematics (Schunk & DiBenedetto, 2020). It also highlights the relevance of theoretical frameworks such as Bandura's Social Cognitive Theory and Deci and Ryan's Self-Determination Theory in understanding academic behaviors.

Although existing research has explored self-efficacy, motivation, and math anxiety, fewer studies integrate these variables into a comprehensive structural model, particularly within the Philippine educational context. International studies, including those from TIMSS 2023, suggest that the relationship between self-efficacy and achievement may vary by cultural and systemic factors, calling for localized research to explore these differences (Chan *et al*., 2024; Wiberg *et al*., 2024).

This study aims to analyze the direct and indirect effects of intrinsic and extrinsic factors on students' confidence in mathematics, with self-efficacy as a mediating variable, using Structural Equation Modelling. The novelty of this paper lies in its context-specific SEM application, its integration of emotional and contextual dimensions of learning, and its contribution to improving educational interventions. The findings are expected to provide a deeper understanding of how internal beliefs and external supports shape students' confidence, thereby offering evidence-based strategies for teachers, curriculum planners, and policymakers.

2. METHODS

We presented the methodology used in investigating the structural relationship among intrinsic factors, extrinsic factors, self-efficacy, and students' confidence in mathematics. It

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includes the research design, participants, sampling technique, data gathering instruments, data collection procedures, and data analysis methods.

2.1. Research Design

This study employed a descriptive-correlational design utilizing SEM. The descriptive approach was used to systematically collect and summarize data concerning the influence of various intrinsic and extrinsic factors on students' confidence in mathematics. The correlational component analyzed the strength and direction of relationships between the identified variables without manipulating them (Levitt *et al.*, 2018). SEM allowed the testing of direct and indirect pathways to determine how intrinsic and extrinsic factors influence self-efficacy and, in turn, confidence in mathematics (Fraenkel *et* al., 2019).

2.2. Locale of The Study

The research was conducted in all medium public high schools in Tacurong City, Sultan Kudarat, namely Apolinario S. Bernardo High School, Upper Katungal National High School, Rajah Muda National High School, and San Pablo National High School.

2.3. Participants of The Study

The participants were all Grade 10 students officially enrolled in the third quarter of School Year 2024–2025 from the four public high schools mentioned (**Table 1**). This group was selected due to the pivotal stage Grade 10 represents in mathematical development, where students transition from foundational concepts to more advanced mathematical applications (Schunk & DiBenedetto, 2020).

Table 1. Distribution of respondents.

School	Population
Rajah Muda National High School (RMNHS)	56
San Pablo National High School (SPNHS)	82
Apolinario S. Bernardo National High School (ASBNHS)	129
Upper Katungal National High School (UKNHS)	86
Total	**353**

2.4. Sampling Technique

A complete enumeration technique was applied, involving all Grade 10 students from the selected public high schools. Given the complexity of the SEM model and the number of latent and observed variables, the study targeted a minimum sample size of 400 for robust statistical analysis (Su *et al.*, 2019). Bootstrapping was also employed to address any issues of non-normality in data distribution, increasing the reliability of parameter estimates (Efron & Tibshirani, 1993; Byrne *et al.*,, 2016).

2.5. Data Gathering Instruments

The study used a validated and pilot-tested questionnaire to measure intrinsic factors, extrinsic factors, self-efficacy, and confidence in mathematics. Items were derived and modified from existing validated instruments and aligned with the study's objectives. The internal reliability of the instrument was confirmed with a Cronbach's alpha of 0.812, indicating good reliability.

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2.6. Data Collection Procedures

After securing approval from educational authorities and obtaining informed consent from the participants, the researcher distributed the questionnaires. Data were collected in the third quarter of the school year to ensure students had sufficient exposure to the mathematics curriculum. The completed surveys were coded and processed with the assistance of a statistician using SPSS and AMOS for SEM analysis.

2.7. Data Analysis

Descriptive statistics were employed to summarize participants' levels of self-efficacy, intrinsic motivation, extrinsic factors, and confidence. SEM was conducted using AMOS software to assess the direct and indirect relationships between the variables. Model fit indices such as CFI, TLI, RMSEA, and SRMR were used to validate the model's adequacy (Hair *et al*., 2019; Ghanbar & Rezvani, 2023). All tests were set at a significance level of 0.05.

3. RESULTS AND DISCUSSION

3.1. Level of Confidence in Mathematics

Table 2 shows the assessed students' confidence in mathematics across several indicators. It presents metrics such as the mean (M), standard deviation (SD), and corresponding description.

Table 2. Student's level of confidence in mathematics.

Indicator	Mean	SD	Description
C1. I am confident I can practice math problems by myself until I understand them.	3.65	0.94	High
C2. I am confident that I can get a passing grade in Math.	3.60	1.03	High
C3. Math seems easy for me, and I am confident I will get a good grade in mathematics class.	3.46	1.01	Moderate
C4. Even if I do not understand a math problem at first, I am confident I will get it eventually.	3.56	1.04	High
C5. If I miss a math class, I am confident that I can make up the work.	3.46	1.07	Moderate
C6. If I get a bad grade on a math test, I know I can do better next time with more practice.	3.51	1.20	High
C7. I can get good grades in Math even if I skip classes.	3.01	1.33	Moderate
Overall	**3.47**	**0.77**	**Moderate**

Note: 1.00–1.50 = Very Low, 1.51–2.50 = Low, 2.51–3.50 = Moderate, 3.51–4.50 = High, 4.51–5.00 = Very High.

The findings indicate that students generally have a moderate confidence level in mathematics, with an overall mean score of 3.47 (SD = 0.77). While students show confidence in their mathematical abilities, there remains room for growth. The highest-rated indicator, "I am confident I can practice math problems by myself until I understand them" (M = 3.65, SD = 0.94), reflects students' belief in their capacity for self-directed learning.

This aligns with the self-efficacy theory, which posits that individuals who believe in their ability to succeed in specific tasks are more likely to persist and achieve their goals (Bandura, 1999). Self-regulated learning plays a significant role in both students' confidence and academic performance in mathematics (Zimmerman & Schunk, 2001).

Students also reported high confidence in their ability to pass math (M = 3.60, SD = 1.03) and their persistence with difficult problems (M = 3.56, SD = 1.04). This finding supports the literature (Dweck, 2019) growth mindset theory, which suggests that students who believe intelligence is malleable are more likely to embrace challenges and improve over time.

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However, students expressed lower confidence in areas related to attendance and performance, especially in the statement, "I can get a good grade in Math even if I skip classes" (M = 3.01, SD = 1.33). This suggests that they recognize the importance of classroom instruction. Regular class attendance correlates strongly with improved confidence and performance in mathematics due to structured learning and consistent practice (Bikić *et al.*, 2024).

Overall, the results imply that while students exhibit moderate to high levels of confidence in mathematics, more support is needed in reinforcing classroom participation and academic resilience. Interventions such as peer tutoring, guided problem-solving, and mindset development may help elevate students' mathematical self-belief and achievement.

3.2. Influence of Self-Efficacy

Self-efficacy plays a pivotal role in shaping students' confidence in mathematics. As reflected in **Table 3**, learners demonstrated a high level of self-efficacy with an overall mean of 3.62 (SD = 0.75). The highest-rated indicator was "I believe I will be able to use mathematics in my future career when needed" (M = 3.90, SD = 0.96), which suggests students understand the practical application of math beyond academic settings. Confidence in classroom participation (M = 3.67, SD = 1.03) and completing assignments (M = 3.60, SD = 1.02) also reinforce their belief in their mathematical abilities.

However, the indicator "I believe I am the kind of person who is good at mathematics" had the lowest mean score (M = 3.31, SD = 1.18), implying that while students believe they can succeed in math tasks, some still struggle with their self-concept as mathematically inclined individuals. This is consistent with the literature (McGee & Martin, 2011) on assertion that self-efficacy is largely influenced by feedback and experience rather than innate ability.

According to literature (Bandura & Cherry, 2020) regarding social cognitive theory, students with strong self-efficacy are more likely to embrace challenging problems, persist through difficulties, and achieve better academic outcomes. Some reports (Zimmerman & Schunk, 2001) also support this idea, asserting that self-regulated learners who are confident in their abilities tend to set higher goals and perform better. These findings suggest that enhancing students' self-efficacy through classroom interventions, real-life applications, and growth mindset strategies may further improve their confidence in mathematics.

Table 3. Factors affecting learners' confidence in mathematics in terms of self-efficacy.

Indicators	Mean	SD	Description
1. I believe I can do well in my mathematics class.	3.67	1.03	High
2. I believe I can do well on a mathematics test.	3.54	1.04	High
3. I believe I can complete all of the assignments in a mathematics course.	3.60	1.02	High
4. I believe I am the kind of person who is good at mathematics.	3.31	1.18	High
5. I believe I will be able to use mathematics in my future career when needed.	3.90	0.96	High
6. I believe I can use mathematics outside of school.	3.67	1.03	High
7. I believe I can answer questions in my mathematics class.	3.60	1.00	High
MEAN	**3.62**	**0.75**	**High**

3.3. Influence of Extrinsic Factors

Table 4 presents the descriptive results on extrinsic factors influencing students' confidence in mathematics. All indicators were rated as "High," indicating that external

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sources of motivation such as teacher support, peer collaboration, and family involvement played a significant role in shaping students' confidence.

This aligns with Social Cognitive Theory, which emphasizes the importance of social and environmental influences in the development of academic self-beliefs (Bandura, 1999). Notably, teamwork and collaborative efforts with peers (M = 3.73, SD = 1.02) emerged as the most significant contributor, showing the essential role of cooperative learning.

Table 4. Level of extrinsic factors influencing students' confidence in mathematics.

Indicators	Mean	SD	Note
1. I reach out to my mathematics teacher when I don't understand the topic.	3.65	1.07	High
2. My family helps me to review my lessons in mathematics before an examination.	3.12	1.31	High
3. Our classroom has well well-arranged setting during mathematics instruction.	3.64	1.00	High
4. There is family interaction when I need help to understand lessons in mathematics.	3.35	1.17	High
5. I have a positive relationship with my peers to exchange ideas in learning mathematics.	3.59	1.12	High
6. My peers share helpful resources, such as notes, study guides, online tools, or apps to enhance learning opportunities.	3.62	1.03	High
7. I have teamwork and collaborative efforts with my peers in learning mathematics.	3.73	1.02	High
MEAN	**3.53**	**0.77**	**High**

3.4. Influence of Intrinsic Factors

Table 5 presents the descriptive analysis of intrinsic factors affecting students' confidence in mathematics. All items received a "High" descriptive rating, with an overall mean of 3.78 (SD = 0.66), indicating that students possessed strong internal motivation and positive attitudes toward math learning.

The highest-rated item, "I think about how the things I learn in math can be helpful to me" (M = 3.91, SD = 0.96), suggests that students see real-world value in mathematics. This reflects the Expectancy-Value Theory, which asserts that students' motivation increases when they recognize the utility of a subject in their lives (Schmidt *et al*., 2012). While students generally showed enthusiasm and perseverance, anxiety remained evident, particularly in test preparation and fear of not understanding the lessons.

Table 5. Level of intrinsic factors influencing students' confidence in mathematics.

Indicators	Mean	SD	Description
1. I get tense when I prepare for a mathematics test.	3.72	0.91	High
2. I enjoy learning mathematics.	3.86	0.98	High
3. I put enough effort into learning mathematics.	3.84	0.97	High
4. I think about how the things I learn in math can be helpful to me.	3.91	0.96	High
5. If I am having trouble learning mathematics, I try to figure out why.	3.71	0.98	High
6. I worry I will not be able to understand the mathematics.	3.67	1.04	High
7. I find learning math interesting.	3.77	1.01	High
MEAN	**3.78**	**0.66**	**High**

3.5. Measurement Model Assessment

The measurement model was evaluated to assess the reliability and validity of the latent constructs used in the structural equation model (**Table 6**). This includes examining factor loadings, Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE).

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Factor loadings for most items exceeded the threshold of 0.70, indicating strong indicator reliability (Hair *et al*., 2019). Items falling slightly below 0.70 were retained due to theoretical relevance and acceptable model fit. **Table 6** shows that Cronbach's alpha values for all constructs ranged from 0.799 to 0.846, exceeding the acceptable threshold of 0.70. Similarly, all CR values were above 0.85, suggesting strong internal consistency among indicators.

AVE values revealed adequate convergent validity for Confidence (0.502) and Self-Efficacy (0.525), but slightly lower values for Extrinsic Factors (0.483) and Intrinsic Factors (0.455), which may require refinement in future studies.

Table 6. Cronbach's alpha, composite reliability, and average variance extracted from the initial SEM.

Latent Factors	Cronbach's Alpha	Composite Reliability (ρ_a)	Composite Reliability (ρc)	AVE
Confidence	0.833	0.838	0.875	0.502
Extrinsic Factors	0.822	0.826	0.867	0.483
Intrinsic Factors	0.799	0.807	0.853	0.455
Self-Efficacy	0.846	0.853	0.884	0.525

3.6. Discriminant Validity and Cross Loadings

Discriminant validity was assessed using the cross-loading approach to ensure that indicators correlated more strongly with their respective constructs than with others (**Table 7**). The loadings of each item on its intended construct were higher than its loadings on other constructs, supporting discriminant validity (Hair *et al*., 2019). According to the guideline, the loading on the associated latent variable should be at least 0.20 higher than on other constructs.

Table 7. Cross loadings.

Indicator	Confidence	Extrinsic Factors	Intrinsic Factors	Self-Efficacy
C1	0.708	0.494	0.509	0.571
C2	0.776	0.450	0.526	0.624
C3	0.766	0.472	0.428	0.615
C4	0.746	0.505	0.494	0.607
C5	0.683	0.385	0.382	0.566
C6	0.595	0.390	0.452	0.453
C7	0.670	0.468	0.356	0.577
EF1	0.392	0.660	0.371	0.401
EF2	0.501	0.712	0.394	0.501
EF3	0.409	0.666	0.375	0.423
EF4	0.508	0.746	0.356	0.529
EF5	0.471	0.721	0.476	0.532
EF6	0.405	0.687	0.392	0.432
EF7	0.405	0.666	0.415	0.443
IF1	0.381	0.434	0.587	0.455
IF2	0.513	0.396	0.726	0.549
IF3	0.411	0.360	0.746	0.459
IF4	0.408	0.434	0.713	0.496
IF5	0.478	0.386	0.681	0.477
IF6	0.314	0.321	0.566	0.274
IF7	0.461	0.359	0.682	0.459

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Table 7 (continue). Cross loadings.

Indicator	Confidence	Extrinsic Factors	Intrinsic Factors	Self-Efficacy
SE1	0.575	0.475	0.481	0.728
SE2	0.695	0.538	0.543	0.803
SE3	0.561	0.480	0.459	0.718
SE4	0.629	0.536	0.430	0.773
SE5	0.452	0.409	0.508	0.587
SE6	0.526	0.432	0.533	0.662
SE7	0.646	0.537	0.519	0.776

The results confirm that discriminant validity was established, as all indicators demonstrated the highest loading on their respective constructs.

3.7. Outer Loadings – Indicator Reliability

The outer loadings of each item on its respective latent construct were assessed to determine item reliability (**Table 8**). An indicator loading of 0.70 or higher is generally considered acceptable, as it indicates that the construct explains more than 50% of the variance in the item (Hair *et al*., 2019). Items with loadings below 0.70 may be retained if their removal does not significantly improve composite reliability or AVE.

Table 8. Outer loadings - matrix.

Indicators	Confidence	Extrinsic Factors	Intrinsic Factors	Self-Efficacy
C1	0.708			
C2	0.776			
C3	0.766			
C4	0.746			
C5	0.683			
C6	0.595			
C7	0.670			
EF1		0.660		
EF2		0.712		
EF3		0.666		
EF4		0.746		
EF5		0.721		
EF6		0.687		
EF7		0.666		
IF1			0.587	
IF2			0.726	
IF3			0.746	
IF4			0.713	
IF5			0.681	
IF6			0.566	
IF7			0.682	
SE1				0.728
SE2				0.803
SE3				0.718
SE4				0.773
SE5				0.587
SE6				0.662
SE7				0.776

The majority of outer loadings exceed the recommended 0.70 threshold, demonstrating adequate item reliability. However, some indicators such as C6 (0.595), SE5 (0.587), and IF6

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(0.566) fall below the threshold but may be retained due to theoretical relevance and their contribution to construct validity (Henseler & Schuberth, 2020).

3.8. Measurement Model Refinement

Measurement model refinement is essential for ensuring the accuracy, reliability, and validity of the constructs in the SEM. This process involves reviewing and adjusting the measurement indicators to meet accepted statistical criteria, such as reliability, convergent validity, and discriminant validity (Hair *et al*., 2019).

Low-loading indicators (below 0.70) were carefully evaluated. While some were retained for theoretical justification, others were considered for removal to improve model fit. This step ensures that the constructs meaningfully represent their latent variables and that the model achieves acceptable psychometric properties.

Figure 1 illustrates the initial SEM with labelled outer loadings and AVE values, demonstrating the need for refinement due to suboptimal item loadings in constructs such as Intrinsic and Extrinsic Factors.

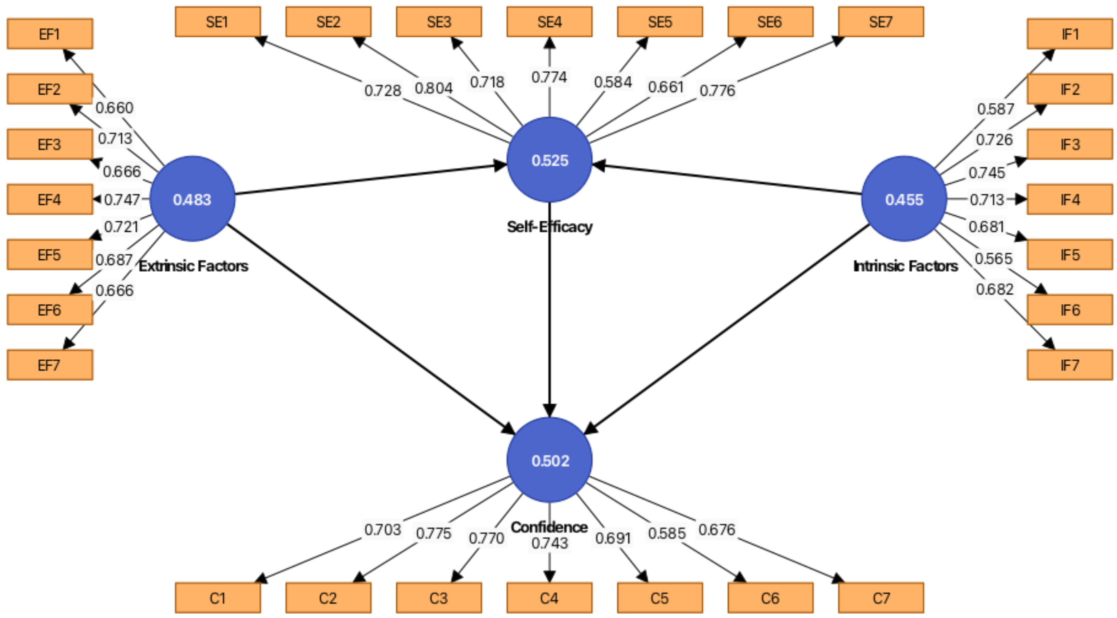

Figure 1. Initial SEM with outer loadings and AVE values.

Following this, indicators below the 0.70 threshold were removed, and the model was re-estimated (**Figure 2**). As a result, the revised SEM showed improved reliability and validity. All retained indicators met or exceeded the required thresholds, with AVE values surpassing 0.50, indicating strong convergent validity.

3.9. Reliability and Validity of Refined SEM

To ensure the robustness of the measurement model, reliability and validity assessments were conducted using the refined SEM (**Table 9**). The primary indicators for evaluating internal consistency and construct validity were Cronbach's Alpha, CR, and AVE.

The results indicate that all constructs exhibit high internal consistency, with Cronbach's Alpha values exceeding the recommended threshold of 0.70 (Hair *et al*., 2019). Self-Efficacy recorded the highest alpha value (0.843), reflecting strong item coherence.

Similarly, both ρa and ρc values surpassed the 0.70 criterion, confirming the reliability of all latent variables. The AVE values for all constructs were above the 0.50 threshold,

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establishing sufficient convergent validity (Fornell & Larcker, 1981). Self-Efficacy yielded the highest AVE (0.614), while Intrinsic Factors recorded the lowest acceptable AVE (0.533).

These results support the refined model's reliability and validity, providing a strong foundation for further structural analysis.

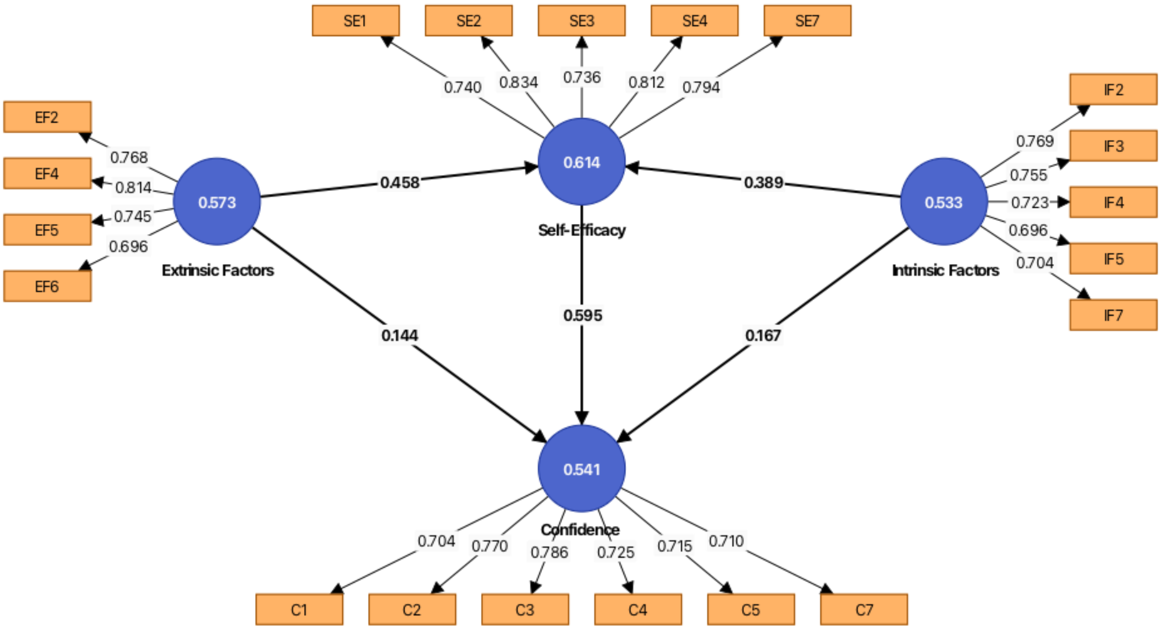

Figure 2. Refined structural equation model.

Table 9. Cronbach's alpha, composite reliability, and average variance extracted from the refined SEM.

Latent Factors	Cronbach's Alpha	Composite Reliability (ρa)	Composite Reliability (ρc)	AVE
Confidence	0.830	0.831	0.876	0.541
Extrinsic Factors	0.751	0.757	0.842	0.573
Intrinsic Factors	0.781	0.784	0.851	0.533
Self-Efficacy	0.843	0.848	0.888	0.614

3.10. Path Analysis

Path analysis was conducted using the refined SEM to examine the direct relationships among intrinsic factors, extrinsic factors, self-efficacy, and students' confidence in mathematics (**Table 10**). The standardized path coefficients, significance values, and remarks are presented below.

The path coefficients reveal that:

(i) Self-efficacy → Confidence has the strongest direct effect (β = 0.595), indicating that self-belief plays a critical role in students' mathematical confidence.

(ii) Both extrinsic and intrinsic factors significantly contribute to self-efficacy and confidence, with extrinsic factors having a greater impact on self-efficacy (β = 0.458) than intrinsic factors (β = 0.389).

(iii) Direct effects from both intrinsic and extrinsic factors on confidence are present but smaller in magnitude.

These findings support the central role of self-efficacy as a mediating variable in the development of confidence, highlighting its importance in instructional and motivational interventions.

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Table 10. Path coefficients (direct effects).

Latent Factors	Standardized path coefficient (β)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Remarks
Extrinsic Factors -> Confidence	0.144	0.145	0.042	3.463	0.001	Significant
Extrinsic Factors -> Self-Efficacy	0.458	0.459	0.045	10.084	0.000	Significant
Intrinsic Factors -> Confidence	0.167	0.167	0.043	3.907	0.000	Significant
Intrinsic Factors -> Self-Efficacy	0.389	0.391	0.049	7.991	0.000	Significant
Self-Efficacy -> Confidence	0.595	0.595	0.047	12.722	0.000	Significant

3.11. Indirect Effect

This section explores the mediating role of self-efficacy in the relationship between extrinsic and intrinsic factors and students' confidence in mathematics (**Table 11**). The indirect effects were assessed through the Structural Equation Model using bootstrapping methods.

Table 11. Specific indirect effects.

Latent Factors	Standardized path coefficient (β)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Remarks
Extrinsic Factors -> Self-Efficacy -> Confidence	0.273	0.272	0.033	8.271	0.000	Significant
Intrinsic Factors -> Self-Efficacy -> Confidence	0.232	0.232	0.035	6.550	0.000	Significant

The results indicate that:

(i) Self-efficacy significantly mediates the influence of both extrinsic and intrinsic factors on students' confidence in mathematics.

(ii) The indirect effect of extrinsic factors ($\beta = 0.273$) through self-efficacy is slightly stronger than the indirect effect of intrinsic factors ($\beta = 0.232$).

(iii) All indirect paths are statistically significant ($p < 0.001$), confirming that self-efficacy serves as a critical mechanism through which motivation and external support influence students' mathematical confidence.

These findings emphasize the central role of self-efficacy in enhancing students' confidence and suggest that any intervention aimed at improving mathematical confidence must include components that strengthen self-efficacy.

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3.12. Total Effects

This section presents the total influence of extrinsic and intrinsic factors, and self-efficacy, on students' confidence in mathematics (**Table 12**). Total effects are the sum of direct and indirect effects, offering a comprehensive view of the relationships among variables. These findings show that:

(i) Self-efficacy has the strongest total effect on confidence (β = 0.595), confirming its pivotal role in students' belief in their mathematical abilities.

(ii) Extrinsic and intrinsic factors both have significant total effects on confidence and self-efficacy, with extrinsic factors (β = 0.417) having a slightly stronger effect on confidence than intrinsic factors (β = 0.398).

(iii) All paths are statistically significant ($p < 0.001$), which underscores the combined and reinforcing nature of both internal and external influences on learners' confidence in mathematics.

Table 12. Total effects.

Latent Factors	Standardized path coefficient ($\boldsymbol{\beta}$)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Extrinsic Factors -> Confidence	0.417	0.418	0.047	8.874	0.000
Extrinsic Factors -> Self-Efficacy	0.458	0.459	0.045	10.084	0.000
Intrinsic Factors -> Confidence	0.398	0.400	0.047	8.391	0.000
Intrinsic Factors -> Self-Efficacy	0.389	0.391	0.049	7.991	0.000
Self-Efficacy -> Confidence	0.595	0.595	0.047	12.722	0.000

3.13. Explained Variance (R-Square Values)

This section reports the R-square (R^2) values, which represent the proportion of variance in the dependent variables (self-efficacy and confidence in mathematics) explained by the independent variables (**Table 13**). The results indicate that:

(i) 66.1% of the variance in students' confidence is explained by extrinsic factors, intrinsic factors, and self-efficacy, showing a strong explanatory power of the model for confidence.

(ii) 53.8% of the variance in self-efficacy is accounted for by extrinsic and intrinsic factors, which is considered a moderate-to-strong effect size.

(iii) Both R^2 values are statistically significant ($p < 0.001$), affirming that the model effectively explains the relationships among the variables.

Table 13. R-square values.

Latent Factors	Effect Size (R^2)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Confidence	0.661	0.665	0.032	20.440	0.000
Self-Efficacy	0.538	0.544	0.039	13.848	0.000

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3.14. Structural Model Assessment

To determine how well the proposed SEM fits the observed data, several model fit indices were assessed (**Table 14**). These indices evaluate the alignment between the theoretical model and the empirical data. These results indicate that the structural model demonstrates excellent fit, meeting or exceeding all widely accepted cutoff criteria (Hu & Bentler, 1999; Schermelleh-Engel *et al*., 2003). The SRMR and RMSEA are within optimal ranges, while the CFI, TLI, NFI, and IFI suggest a well-specified model. The PNFI value (0.89) also reflects a strong balance between model simplicity and goodness of fit.

Table 14. Model fit indices.

Fit Index	Value	Acceptable Threshold
Standardized Root Mean Square Residual (SRMR)	0.06	≤ 0.08
Root Mean Square Error of Approximation (RMSEA)	0.05	≤ 0.06
Comparative Fit Index (CFI)	0.99	≥ 0.95
Tucker-Lewis Index (TLI)	0.99	≥ 0.95
Bentler-Bonett Non-normed Fit Index (NNFI)	0.99	≥ 0.95
Relative Noncentrality Index (RNI)	0.99	≥ 0.95
Bentler-Bonett Normed Fit Index (NFI)	0.98	≥ 0.90
Bollen's Relative Fit Index (RFI)	0.98	≥ 0.90
Bollen's Incremental Fit Index (IFI)	0.99	≥ 0.95
Parsimony Normed Fit Index (PNFI)	0.89	≥ 0.50

3.15. Final Structural Model Summary and Interpretation

The final SEM reveals robust relationships among intrinsic factors, extrinsic factors, self-efficacy, and confidence in mathematics. After model refinement (wherein low-loading indicators were removed), the constructs demonstrated improved reliability and validity. The standardized path coefficients confirm the following:

(i) Self-efficacy → Confidence
$\beta = 0.595$, $p < 0.001$
This path shows the strongest influence, confirming that self-efficacy is a key determinant of students' confidence in mathematics.

(ii) Extrinsic Factors → Self-efficacy
$\beta = 0.458$, $p < 0.001$
External influences like peer collaboration, teacher support, and family involvement significantly enhance students' belief in their capabilities.

(iii) Intrinsic Factors → Self-efficacy
$\beta = 0.389$, $p < 0.001$
Internal motivators, including students' interest, effort, and value of mathematics, also contribute strongly to the development of self-efficacy.

(iv) Extrinsic Factors → Confidence (Direct)
$\beta = 0.144$, $p = .001$
While the direct path from extrinsic factors to confidence is significant, its effect size is weaker than that of the indirect path through self-efficacy.

(v) Intrinsic Factors → Confidence (Direct)
$\beta = 0.167$, $p < 0.001$
Similarly, intrinsic factors directly influence confidence but with a smaller effect size than their mediated impact.

(vi) Indirect Effects:

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Extrinsic → Self-efficacy → Confidence = 0.273
Intrinsic → Self-efficacy → Confidence = 0.232
These mediated effects highlight the central role of self-efficacy as a bridge between predictors and confidence.

(vii) R^2 Values: Confidence of 0.661 and Self-Efficacy of 0.538. These values suggest that the model explains 66.1% of the variance in confidence and 53.8% of the variance in self-efficacy—demonstrating strong predictive capacity.

Overall, the final model underscores the critical mediating role of self-efficacy and the significant contributions of both intrinsic and extrinsic factors in shaping students' confidence in mathematics.

3.16. Discussion

The results of this study emphasize the significant role of both intrinsic and extrinsic factors in shaping students' confidence in mathematics, with self-efficacy emerging as a key mediator. The structural model demonstrated that self-efficacy has the strongest direct effect on confidence, suggesting that students who believe in their capability to succeed in mathematics are more likely to exhibit higher confidence levels. This finding supports Bandura's Social Cognitive Theory, which posits that belief in one's abilities is critical to successful performance (Bandura, 2001).

The analysis revealed that intrinsic factors such as enjoyment, effort, and recognition of mathematics' real-life value significantly contribute to both self-efficacy and confidence. These findings are consistent with the assertions of some papers (Schunk & DiBenedetto, 2020), which emphasize the motivational power of intrinsic factors in enhancing students' academic outcomes. However, the presence of math-related anxiety, indicated by the high scores for tension and worry, shows that while students are motivated, emotional barriers persist, which could hinder their confidence if not addressed effectively (Ramirez *et al*., 2018).

Extrinsic factors—including teacher support, family involvement, and peer collaboration—were also found to significantly influence self-efficacy and confidence. The highest-rated extrinsic item was teamwork with peers, highlighting the essential role of collaborative learning in building mathematical resilience. This aligns with studies that suggest peer influence and social learning environments play a crucial role in shaping students' attitudes and self-perception in mathematics (Tran & Phan, 2024; Kirkham & Chapman, 2020).

Moreover, teacher encouragement and the learning environment also emerged as critical, echoing the findings (Ryan & Deci, 2020), who stress the importance of structured external support in building competence and motivation. Family engagement, although slightly less influential, still contributed to higher confidence levels, reinforcing the literature suggesting that supportive home environments enhance students' academic self-concept (Fan & Williams, 2010).

The measurement model indicated acceptable reliability and validity across constructs, although the AVE for intrinsic and extrinsic factors fell slightly below the ideal threshold, suggesting some room for refinement. Despite this, the refined SEM showed strong model fit indices and explained a large portion of variance in both self-efficacy (R^2 = 0.538) and confidence (R^2 = 0.661), indicating robust explanatory power (Hair *et al*., 2019).

Importantly, the mediation analysis highlighted that the effects of both intrinsic and extrinsic factors on confidence were largely channeled through self-efficacy. This confirms that strengthening students' belief in their mathematical abilities may be more impactful than targeting confidence directly. This finding underscores the value of educational interventions

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focused on mastery experiences, goal-setting, and constructive feedback as strategies for cultivating self-efficacy (Chung *et al*., 2021).

In conclusion, this study reinforces that boosting students' self-efficacy through both internal motivation and external support systems is crucial for improving their confidence in mathematics. These insights provide a foundation for schools and educators to develop comprehensive programs that nurture self-belief and, in turn, elevate students' performance and engagement in mathematics.

4. CONCLUSION

This study explored the structural relationship among intrinsic factors, extrinsic factors, self-efficacy, and confidence in mathematics among Grade 10 students in public high schools in Tacurong City. The findings revealed that students generally exhibit moderate confidence in mathematics, supported by high levels of self-efficacy, intrinsic motivation, and positive extrinsic influences from peers, teachers, and families. Self-efficacy emerged as the most influential factor in shaping students' confidence, both directly and as a mediator between the other variables.

Intrinsic factors such as enjoyment, effort, and the perceived value of mathematics contributed positively to students' belief in their mathematical competence. However, symptoms of math anxiety were also present, indicating a need for emotional support strategies. Extrinsic factors—including teacher guidance, collaborative learning with peers, and family involvement—were also significant in influencing both confidence and self-efficacy. The refined SEM demonstrated a strong model fit and explained substantial variance in both self-efficacy and confidence, validating the theoretical framework.

Overall, the study confirms the centrality of self-efficacy in fostering students' mathematical confidence and highlights the interconnected roles of both internal and external motivators in building learners' belief in their abilities.

Based on the findings, the following recommendations are proposed:

(i) The Department of Education (DepEd) should integrate socio-emotional learning and self-efficacy-enhancing strategies in the mathematics curriculum to address both motivational and emotional barriers to learning.
(ii) School administrators and curriculum planners should promote peer-based instructional strategies such as collaborative group work and peer tutoring to enhance students' confidence through shared learning experiences.
(iii) Mathematics teachers should provide mastery-based learning opportunities, frequent feedback, and practical applications of mathematical concepts to reinforce students' belief in their competence.
(iv) Parents and guardians should be encouraged to participate in their children's mathematical learning by providing home support and maintaining a positive attitude toward mathematics.
(v) Future researchers may extend this study to include longitudinal analyses and explore interventions that strengthen self-efficacy across various grade levels and educational settings to ensure lasting improvements in students' confidence and performance in mathematics.

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5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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