

Growth Mindset and Confidence in Self-Directed Learning among Students in Four Southeast Asian Countries: The Mediating Role of Mathematics Self-Efficacy

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Abstract. Growth mindset has been widely studied in relation to students' motivation and academic achievement, yet less is known about how it relates to students' confidence in managing their own learning. This study examined whether mathematics self-efficacy helps explain the association between growth mindset and confidence in self-directed learning among Southeast Asian students. PISA 2022 data from 4,693 students in Malaysia, Singapore, Indonesia, and Thailand were analysed using Pearson correlations and structural equation modelling, with gender and socioeconomic status included as covariates. Growth mindset was positively associated with mathematics self-efficacy ($\beta = .086$), while mathematics self-efficacy showed a stronger positive association with confidence in self-directed learning ($\beta = .373$). The direct association between growth mindset and confidence in self-directed learning was not significant ($\beta = -.019$). However, a small but significant indirect association through mathematics self-efficacy was observed ($\beta = .032$, 95% CI [.017, .042]). These findings suggest that mathematics self-efficacy may represent one pathway linking broader beliefs about the development of ability with students' confidence in managing their learning. The results also indicate that growth-mindset approaches may be more meaningful when accompanied by opportunities to strengthen task-specific confidence.

Keywords: growth mindset, mathematics self-efficacy, confidence in self-directed learning, PISA 2022

1. Introduction

Self-directed learning (SDL) has become increasingly important as students are expected to take greater responsibility for planning, monitoring, and regulating their own learning. It involves setting learning goals, selecting appropriate strategies, maintaining motivation, and evaluating progress [1]. In PISA 2022, however, the relevant measure focuses more specifically on students' confidence in their capacity for SDL, rather than directly observed learning behaviour [2]. Understanding what may support this confidence is therefore important.

One factor that may contribute to students' SDL is growth mindset (GM), the belief that intellectual abilities can develop through effort, effective strategies, and learning experiences [3].

GM has been associated with motivation and academic achievement. Yet the relationship is not consistently strong. Meta-analytic evidence suggests that its effects are generally modest and often depend on individual or contextual factors [4, 5]. A growth-oriented belief alone may therefore be insufficient to explain how students manage their learning.

Mathematics self-efficacy (MSE) offers one possible mechanism. Self-efficacy (SE) refers to individuals' beliefs about their capability to perform particular tasks and can influence effort, persistence, and self-regulation [6, 7]. Because these beliefs are domain-specific, MSE may be more closely connected to students' responses to mathematical learning demands. Recent studies have also linked MSE with academic performance and learning-related behaviours [8, 9].

Despite these findings, several questions remain. Existing research on GM has focused largely on academic achievement, while less attention has been given to students' confidence in managing their own learning. More importantly, it remains unclear whether MSE functions as a psychological mechanism linking GM with confidence in SDL. Less is known about whether this pathway is observed among students in Southeast Asian educational contexts. Addressing these gaps, the present study uses PISA 2022 data from Malaysia, Singapore, Indonesia, and Thailand to examine the relationships among GM, MSE, and confidence in self-directed learning (CSDL). This study raises the following two research questions (RQ):

RQ1: Is growth mindset positively associated with mathematics self-efficacy?

RQ2: Is mathematics self-efficacy positively associated with confidence in self-directed learning, and does it mediate the association between growth mindset and confidence in self-directed learning?

Based on growth mindset theory and social cognitive theory, the following hypotheses were proposed:

H1: Growth mindset is positively associated with mathematics self-efficacy.

H2: Mathematics self-efficacy is positively associated with confidence in self-directed learning.

H3: Mathematics self-efficacy mediates the association between growth mindset and confidence in self-directed learning.

2. Method

2.1. Data source and participants

This study used PISA 2022 data collected by the OECD [10]. The analysis included students from Malaysia, Singapore, Indonesia, and Thailand. The main variables were growth mindset (GROSAGR), mathematics self-efficacy (MATHEFF), and confidence in self-directed learning (SDLEFF), with socioeconomic status (ESCS) and gender (ST004D01T) included as control variables. The initial dataset contained 4,700 students selected from the four countries. Seven cases with missing information on the study variables were excluded, leaving 4,693 students for analysis.

2.2. Measures

Growth mindset (GROSAGR) was derived from four PISA items assessing students' beliefs about whether intelligence and ability can change. Responses ranged from *strongly disagree* to *strongly agree*. Higher scores indicate a stronger GM [10].

Mathematics self-efficacy (MATHEFF) was based on nine items asking students how confident they felt about completing formal and applied mathematics tasks. Responses ranged from *not at all confident* to *very confident*, with higher scores representing stronger MSE [10].

Confidence in self-directed learning (SDLEFF) was measured using eight items. Students were asked how confident they would feel about managing their learning independently if their school building closed again. The items covered tasks such as finding learning resources, planning schoolwork, maintaining motivation, and evaluating learning progress. Higher scores indicate greater CSDL [10]. Accordingly, SDLEFF is treated as a measure of students' perceived capacity for SDL rather than their actual learning behaviour.

Socioeconomic status (ESCS) reflects students' family educational, occupational, and material resources, while gender (ST004D01T) records students' gender information. Both were included as covariates [10].

2.3. Data analysis

Descriptive statistics and Pearson correlations were first used to examine relationships among the main variables. Observed-variable path analysis within a structural equation modelling (SEM) framework was then conducted to test the proposed mediation pathway:

Growth mindset → *Mathematics self-efficacy* → *Confidence in self-directed learning*

The model estimated the association between GM and MSE (path a), the association between MSE and CSDL (path b), and the direct association between GM and CSDL (path c'). ESCS and gender were included as covariates predicting both MSE and CSDL. The specified path model was just-identified ($df = 0$), consequently, global fit indices were not informative for evaluating overall model fit.

The indirect association was calculated as $a \times b$ and tested using bootstrap 95% confidence intervals. An indirect effect was considered significant when the confidence interval did not include zero. Models were estimated using maximum likelihood. All analyses were conducted in R using the lavaan package [11]. Given the cross-sectional nature of the data, statistical associations should not be interpreted as evidence of causation. The analyses were conducted without PISA student sampling weights or replicate weights.

3. Results

3.1. Descriptive statistics and correlations

Through descriptive statistics and Pearson correlation analysis, the relationships between GM, MSE and CSDL were studied (Table 1). The average score for GM was $M = -0.01$, $SD = 0.95$, consistent with the standardized distribution of the PISA index. GM was weakly but significantly positively correlated with MSE ($r = 0.10$, $p < 0.001$), indicating that students who are more inclined to believe that abilities can develop tend to report greater confidence in their own mathematical abilities. MSE was moderately positively correlated with CSDL ($r = 0.40$, $p < 0.001$), suggesting that the more confident students are in their mathematical abilities, the more strongly they believe they can regulate their learning. In contrast, the correlation between GM and CSDL was weak and not significant ($r = 0.02$, $p = 0.19$).

Table 1. Descriptive statistics and pearson correlations among GM, MSE, and CSDL

Variable	M	SD	1	2
1. GM	-0.01	0.95		
2. MSE	-0.70	0.99	.10**	

Table 1. (continued)

			[.07, .12]	
3. CSDL	-0.27	0.87	.02	.40**
			[-.01, .05]	[.38, .43]

Note. * indicates $p < .05$. ** indicates $p < .01$.

3.2. Structural equation model and mediation analysis

The SEM test was used to examine whether MSE acts as a mediator between GM and CSDL (Figure 1, Table 2). The results showed that GM is significantly associated with MSE ($\beta = 0.086$, $p < 0.001$), supporting the H1. This indicates that students with a stronger belief in the plasticity of abilities tend to evaluate their mathematical abilities more confidently. MSE is also significantly associated with CSDL ($\beta = 0.373$, $p < 0.001$), supporting the H2 hypothesis. This finding suggests that students' confidence in their mathematical abilities is closely related to their willingness and ability to manage SDL.

Table 2. Path analysis and mediation results for GM, MSE, and CSDL, controlling for ESCS and gender

Parameter	Estimate	SE	z	p	CI_lower	CI_upper	Std.Estimate
a:GM→MSE	0.090	0.019	4.882	0.000	0.053	0.128	0.086
ESCS→MSE	0.224	0.014	15.573	0.000	0.196	0.253	0.233
Gender→MSE	-0.053	0.028	-1.882	0.060	-0.110	0.000	-0.027
c':GM→CSDL	-0.018	0.015	-1.180	0.238	-0.047	0.012	-0.019
b:MSE→CSDL	0.328	0.015	21.362	0.000	0.297	0.357	0.373
ESCS→CSDL	0.110	0.012	9.260	0.000	0.086	0.132	0.129
Gender→CSDL	-0.128	0.023	-5.497	0.000	-0.175	-0.082	-0.073
Indirect effect	0.030	0.006	4.760	0.000	0.017	0.042	0.032
Total effect	0.012	0.017	0.692	0.489	-0.022	0.046	0.013

Note. Model fit indices were $CFI = 1.000$, $TLI = 1.000$, $RMSEA = 0.000$, and $SRMR = 0.000$. The model was just-identified ($df = 0$), so these indices are not informative for evaluating overall model fit. Indirect effects were tested using 5,000 bootstrap samples with 95% confidence intervals.

However, the direct association between GM and CSDL was not significant ($\beta = -.019$, $p = .238$). Meanwhile, the bootstrap analysis showed that GM had a weak but significant indirect effect on CSDL through MSE ($\beta = 0.032$, 95% CI [0.017, 0.042]). These findings collectively support Hypothesis 3 (H3), demonstrating that MSE serves as an important pathway underlying the association between GM and CSDL. The model explained 7.5% of the variance in MSE and 38.0% of the variance in CSDL.

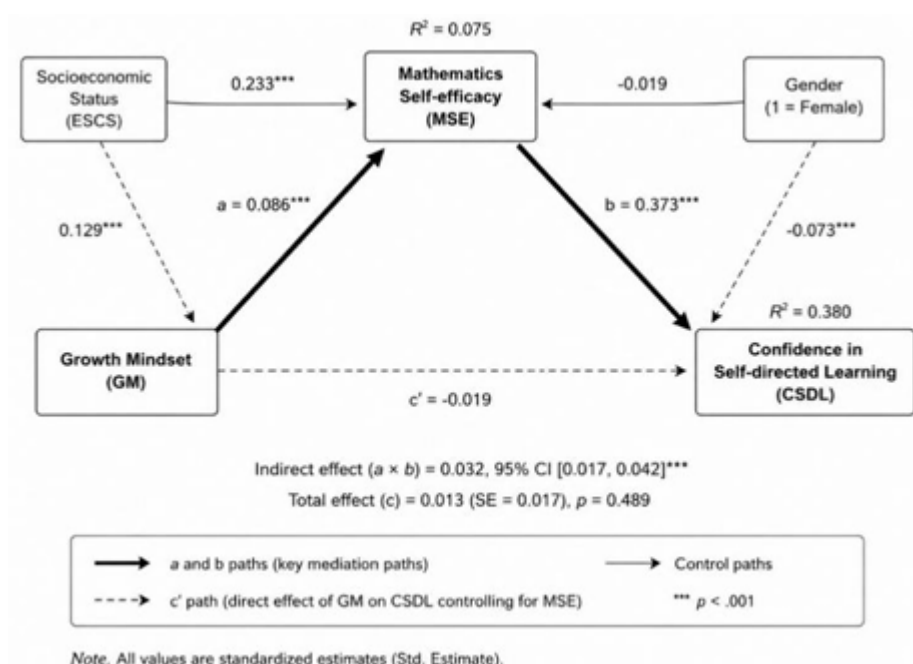


Figure 1. Standardized path coefficients of the mediation model

4. Discussion

This study examined whether MSE helps explain the association between GM and CSDL. The pattern was mixed. GM was positively related to MSE, MSE was more strongly related to CSDL, and the indirect pathway was significant. The direct association between GM and CSDL was not significant. This pattern speaks to the gap identified earlier: GM may be linked to CSDL through a more specific belief about personal capability.

One explanation for the non-significant direct association is that the two constructs operate at different levels. GM is a broad belief about whether ability can develop, while CSDL concerns whether students feel able to plan, sustain, and evaluate their own learning. Meta-analyses have shown that growth-mindset effects are generally small and vary across contexts [4, 5]. Dong et al. also found that GM was linked to mathematics outcomes through factors such as SE, motivation, failure attribution, and anxiety rather than through a simple direct pathway [8].

The first part of the indirect pathway was also weak. In this study, the GM–MSE coefficient was $\beta = .086$. Su et al. found a similarly modest positive relationship between GM and MSE [12]. This is reasonable because MSE is shaped by many experiences besides mindset. Street et al. showed that MSE can change across lessons and with perceived task difficulty [13]. Prior performance, recent success or failure, feedback, and anxiety may therefore contribute to MSE alongside broader beliefs about ability. Since the indirect association depends on both paths, a weak GM→MSE relationship naturally limits its overall size.

By contrast, MSE was more strongly associated with CSDL. The two constructs are conceptually closer because both involve judgments of perceived capability. SE is also closely related to persistence and self-regulation [7, 9]. Their shared focus on what students believe they can do partly explain the stronger association. This finding extends earlier work that has focused mainly on achievement by showing a small but meaningful indirect association with CSDL in a pooled Southeast Asian sample. In practice, growth-mindset messages alone may not be enough. They may

be more useful when paired with learning experiences that build task-specific confidence through manageable challenge, visible progress, and constructive feedback.

5. Conclusion

This study examined how GM, MSE, and CSDL are related among students from Malaysia, Singapore, Indonesia, and Thailand. GM was positively associated with MSE, and MSE was positively associated with CSDL. These results supported H1 and H2. The indirect association between GM and CSDL through MSE was also significant, supporting H3, while the direct association was not.

MSE may therefore represent one pathway linking GM with students' confidence in managing their own learning. However, the pathway was small and should not be treated as a complete explanation. GM research has often centred on academic achievement, whereas the present study considers how such beliefs may relate to students' confidence in organising and sustaining learning. It also adds evidence from a pooled Southeast Asian sample, an area that has received less attention in this line of research.

For practice, encouraging students to believe that ability can improve may not be sufficient on its own. Growth-mindset approaches may be more useful when students also have opportunities to build confidence in specific academic tasks through successful learning experiences and appropriate support.

The results should be interpreted with several limitations in mind. The data were cross-sectional and self-reported, so the direction of the relationships cannot be established. Students from four countries were analysed together, which may hide differences between national contexts. In addition, PISA sampling and replicate weights were not used. The estimates therefore describe relationships within the analytical sample rather than fully population-representative patterns. Further work could incorporate the full PISA survey design, compare countries separately, and examine these relationships over time using longitudinal data.

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