The Mediating Role of Micro- and Meso-Level Factors in the Relationship between University Students' Self-Regulated Learning and Problem-Solving Skills

Esti Zaduqisti[11], Ali Mashuri[2]
[1]Master of Social Science Program, Faculty of Social and Political Sciences, Universitas Brawijaya, Malang, Indonesia
[2]Department of Psychology, Faculty of Social and Political Sciences, Universitas Brawijaya, Malang, Indonesia

Abstract. This study aimed to elucidate problem-solving skills in relation to self-regulated learning (SRL) among university students. The roles of emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmates' support were examined as mediators of SRL contribution to explaining problem-solving skills. A correlational design, including 224 respondents as participants, was adopted through an online questionnaire. This study analyzed the data using PROCESS installed in SPSS version 29. The results showed that SRL, academic self-efficacy, teacher charismatic leadership, and classmate support played a significant role in improving problem-solving skills. Furthermore, SRL significantly and positively predicted emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmate support. All variables exhibited significant mediating effects on the relationship between SRL and the enhancement of problem-solving skills, with the exception of emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmate support. This study contributed to the development of educational psychology by examining the roles of academic self-efficacy, teacher charismatic leadership, and classmate support as important mechanisms that explained how SRL positively affected problem-solving skills, while emotional intelligence did not act as a mediator.

Keywords: Students' self-regulated learning, problem-solving skills, emotional intelligence, academic self-efficacy, teacher charismatic leadership, classmate support.

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*Corresponding author: Master of Social Science Program, Faculty of Social and Political Sciences, Universitas Brawijaya, Malang, Indonesia
E-mail: esti.zaduqisti@ub.ac.id

Introduction

Problem-solving skills represent the highest level of human learning, requiring cognitive abilities, emotional balance, personal beliefs, and social interactions (Csapó & Funke, 2017). These skills are developed through a complex process in which students interpret challenges, manage uncertainty, persist in the face of adversity, and construct meaning from experiences (Beghetto, 2018). Therefore, problem-solving skills are holistic abilities shaped by the interaction of internal motivation, emotional awareness, educational influences, and social connectedness (Csapó & Funke, 2017). Cognitive abilities are needed by individuals to face and overcome challenges in both daily and professional life (Jonassen, 2000). In education, problem-solving skills play a crucial role as a determinant of university students' academic achievement (Stadler et al., 2018). In this context, students can apply the most effective strategies and actions to address academic challenges. Conversely, a lack of problem-solving skills has negative cognitive, emotional, and social impacts. Struggling students often experience higher levels of stress and anxiety following the inability to manage academic challenges and daily life issues (Burke & Stewart, 2024; Lohman, 2002).

Studies in educational psychology indicate that problem-solving skills are affected by micro, meso, and macro factors (Jonassen, 2006; Zhao et al., 2021). According to Kahar et al. (2025) and Merrill (2018), micro factors report that problem-solving skills are determined by the individual, in the form of abilities or performance. Meso factors, as argued by Merrill (2013), hold that problem-solving skills are determined by interactions among students, peers, and teachers, promoting active engagement, critical thinking, and real-world problem-solving. In line with several studies (Ausubel, 1963; Jonassen, 2006), macro factors hold

that institutions and policies play a role in determining problem-solving skills. Given the important role in students' academic success, identifying and testing factors that improve problem-solving skills is a relevant and urgent step.

In recognition of the relevance and urgency, this study examines self-regulated learning (SRL) as a learning strategy with the potential to be implemented as an intervention to improve students' problem-solving skills. Studies in educational psychology have empirically reported the role of SRL in improving problem-solving skills (Hwang & Oh, 2021; Jasim Imran et al., 2024; Mohammadi et al., 2020; Nisa et al., 2024; Rahayuningsih et al., 2021). However, analyses in educational psychology have not adequately identified and tested mediating variables in the effect of SRL on problem-solving skills (Zimmerman & Campillo, 2003).

Mediator variables are crucial psychosocial mechanisms that explain why SRL effectively improves students' problem-solving skills (Heidari & Bazgirpour, 2025). Drawing on theories and prior analyses, emotional intelligence and academic self-efficacy serve as micro factors. In contrast, expectations of charismatic leadership and perceptions of the support received from classmates act as meso factors that mediate the positive effect of SRL on students' problem-solving skills.

SRL refers to individual capability as a student to understand and control the learning environment. This capability reflects the extent to which students engage in self-regulation, including goal setting, self-monitoring, self-instruction, and self-reinforcement (Harris & Graham, 1999; Shunk, 1996). Formally, SRL is the degree to which students are active participants in the learning process, metacognitively, motivationally, and behaviorally (Zimmerman, 1989). Self-regulated students use processes that translate pre-existing abilities into behaviors relevant to various learning tasks. Panadero (2017) reviewed six major SRL models or theories, focusing on Zimmerman (2013) and Zimmerman and Schunk (2013) SRL model, specifically the triadic model. In this context, SRL is the ability to regulate behavior, environment, and self in the learning process.

Problem-solving skills are derived from the accumulated characteristics of a problem, problem representation, and individual characteristics. In the academic realm, these skills are the ability to solve challenges and problems that are abstract or concrete, complex or simple, familiar or unfamiliar within a particular culture (Jonassen, 2000). Psychological literature (Hardin, 2003) described several problem-solving theories, including metacognition theory. According to metacognition theory, problem-solving skills are derived from experience, self-awareness in problem-solving, and the ability to monitor and control mental processes (Bruer, 1993). Students can overcome various challenges and problems by regulating the behavior and the environment. Several studies (Baars et al., 2017; Fuchs et al., 2003; Hwang & Oh, 2021; Tzohar-Rozen & Kramarski, 2014) empirically supported the argument, reporting that SRL played a significant role in improving problem-solving skills in the academic field.

According to Jonassen (2000), problem-solving skills are affected by internal and external social factors. This study focuses on emotional intelligence as an internal affective factor and a predictor of problem-solving skills. In a review of various definitions of emotional intelligence, Ackley (2016) reported that the concept was the ability to understand and manage personal and societal emotions. Several studies (Hess & Bacigalupo, 2014; Shahbazi et al., 2018) reported that emotional intelligence played a significant role in improving problem-solving skills.

The second internal individual factor is academic self-efficacy. This refers to individual belief that motivates students to achieve a certain level of academic performance or specific academic goals (Schunk & Pajares, 2022). Several studies (Kim, 2022; Kim & Kim, 2016; Zhang et al., 2018) have shown that high academic self-efficacy contributes to strong problem-solving skills. Meanwhile, this study also examined meso factor of problem-solving skills. Teacher charismatic leadership is conceptualized as a meso-level phenomenon that operates in group and organizational contexts (Pillai & Meindl, 1998). In an educational context, this concept reflects skills of teachers in communicating and engaging students through emotional persuasion and positive feelings (Tsai, 2017). Hoveida and Davarpanah (2019) found that charismatic leadership played a significant role in improving creative thinking and problem-solving skills.

Classmate support refers to perceptions of the degree to which the classroom environment accommodates and supports learning needs. This is the academic, emotional, and social support students provide to one another in the classroom or study group (Hoferichterd et al., 2022). Even though studies directly examining the impact of perceived classmate support are limited, a supportive classroom environment can enhance problem-solving skills. For example, Hoferichterd et al. (2022) in Germany found that classmate support improved the ability to face challenges and achieve academically. Students in classes with adequate classmate support showed better coping strategies when facing academic challenges.

Simamora and Saragih (2019) reported that guided discovery learning in a supportive classroom context improved students' mathematical problem-solving

skills. This approach promotes active students' engagement and a sense of support, enhancing problem-solving skills. Mustafa et al. (2024) also emphasized that effective classroom management through problem-solving strategies contributed to a quality learning experience. In this context, students feel supported, which can improve problem-solving skills.

Previous studies have shown mixed results regarding the relationship between SRL and emotional intelligence. Winarso and Supriady (2017) found a positive correlation between the variables among tenth-grade students. Therefore, students who effectively manage the learning process also exhibit higher emotional intelligence. Lubis (2016) examined the interaction between social support, SRL, and emotional intelligence, where social support and emotional intelligence significantly contributed to the development of SRL. Dianah and Oktariza (2024) investigated the influence of emotional intelligence on SRL among Junior High School students. This result was reported by Mustofa et al. (2022) and Dewi (2019) among high school and university students, respectively. The studies suggested that higher levels of emotional intelligence were associated with stronger SRL abilities.

Other studies have shown that SRL significantly improves emotional intelligence. For example, Azhary et al. (2021) reported that emotional intelligence levels of participants in classes implementing SRL learning model were significantly higher, using students at Junior High School 15 in Sukabumi City as a sample. Suanda et al. (2025) experimented with a sample of students at Senior High School 8 Denpasar. The emotional intelligence levels of participants in the experimental group were significantly higher than those in the control group.

The empirical results emphasize that SRL plays a causal role in enhancing emotional intelligence. This emphasis is consistent with the assumptions of Metacognitive and Affective Model (MASRL; Efklides, 2011; Efklides & Schwartz, 2024). MASRL model emphasizes that emotional intelligence reflects the ability to control and monitor emotions (Efklides et al., 2026).

Social Cognitive Theory (Schunk & DiBenedetto, 2022) emphasizes that SRL includes goal setting, strategic planning, self-monitoring, and self-reflection. These behaviors provide mastery experiences that enhance academic self-efficacy. Higher self-efficacy strengthens persistence, problem-solving strategies, and cognitive engagement. Therefore, academic self-efficacy mediates the role of SRL in enhancing problem-solving skills. A significant relationship between SRL and academic self-efficacy has been reported. Alegre (2014) found a positive correlation between academic self-efficacy, SRL, and academic performance among first-year college students. The study shows that students who manage the learning process effectively tend to have higher self-confidence in academic abilities, leading to improved performance. Guerra (2020) found that SRL mediated the relationship between academic self-efficacy and participation in class activities. These results imply that students with strong SRL engage in learning activities, enhancing self-efficacy and academic achievement. In Indonesia, a study conducted by Ruliyanti (2015) at Senior High School 2 Bangkalan showed a significant relationship between academic self-efficacy, SRL, and academic achievement in mathematics. In this context, students with higher self-efficacy and self-regulation skills tended to achieve better academic outcomes. Collectively, SRL plays a significant role in enhancing self-efficacy, which positively impacts academic achievement, including problem-solving skills. Even though direct studies on the combined effects of SRL and teacher charismatic leadership are still rare, the concept is theoretically plausible since students with high SRL tend to be more reflective and cognitively active. The implication is that more attention is paid to the aspects of the charismatic leadership style of teachers who emphasize the importance of intellectual stimulation or inspirational motivation. The argument is consistent with Winne and Azevedo's (2022) metacognitive theory, where students with high SRL actively evaluate lessons. Therefore, these individuals are more sensitive to pedagogical cues, such as intellectual stimulation or motivational behavior. Charismatic leadership can also improve problem-solving skills (Biswas & Rahman, 2019). The variable mediates the role of SRL in predicting problem-solving skills.

This study examined the role of SRL on peer support or perceptions of support in the classroom. Direct evidence on how SRL affects peer support is limited, and existing studies suggest a bidirectional relationship. SRL can increase students' awareness and appreciation of classroom support, positively affecting perceptions. Hastuti and Yoenanto (2019) reported the effect of SRL and external factors such as teacher and peer social support on mathematics achievement. Even though this study primarily focused on how the factors affect academic performance, the complex relationship between SRL and peer support was reported. Students who actively engage in SRL may develop increased awareness of support, leading to more positive perceptions.

Referring to the theory and previous results, this study tests four hypotheses. First, SRL plays a positive and significant role in predicting students' problem-

solving skills (H1). Second, emotional intelligence (H2a), academic self-efficacy (H2b), teacher charismatic leadership (H2c), and classmate support (H2d) play a positive and significant role in predicting problem-solving skills. Third, SRL plays a positive and significant role in predicting emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmate support (H3). Fourth, emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmate support significantly mediate the positive predictive role of SRL for problem-solving skills (H4).

This study is based on the assumption that SRL and problem-solving skills intersect with complex factors at micro- and meso-levels, originating internally and externally (Greiff et al., 2015) for three reasons. First, no previous analysis has integrated micro and meso factors as a mechanism to explain the significant role of SRL in explaining problem-solving skills. Second, this study examines the role of emotional intelligence and academic self-efficacy as micro factors, as well as teacher charismatic leadership and classmate support as meso factors, to answer the question of why SRL plays a positive role in predicting problem-solving skills. Third, the integration of micro and meso factors as mediators of the role of SRL on academic self-efficacy is the first study in Indonesia to be tested specifically among university students.

To fill the gap above, this study examines the role of emotional intelligence and academic self-efficacy as micro factors, as well as teacher charismatic leadership and perceived peer support as meso factors that mediate the role of SRL on students' problem-solving skills. The purpose is to answer four questions, namely (1) Does SRL significantly improve students' problem-solving skills? (2) Do micro variables of emotional intelligence and academic self-efficacy play a significant role in improving students' problem-solving skills? (3) Do meso variables of teacher charismatic leadership and peer support play a significant role in improving students' problem-solving skills? (4) Do micro and meso variables significantly mediate the role of SRL on students' problem-solving skills?

Methods

Participants and study design

The participant criteria were students with an active status in undergraduate or postgraduate programs. Based on the criteria, the number of participants was 224. Male and female respondents numbered 93 and 131, at 41.52% and 58.48%, respectively. The age of participants ranged from 17 to 24 years, with an average of 18.74 years. A priori power analysis was conducted using the WebPower application (Zhang & Yuan, 2018). The required minimum statistical power of .80 was achieved with a sample size of 224 respondents based on structural equation modeling (SEM) framework with a chi-square test, degrees of freedom (df) = 0, an effect size of .10, and a significance level of .05. This method used a correlational design, measuring each variable with a scale distributed in an online questionnaire using Google Forms.

Procedures and measurements

The online questionnaire was administered in Indonesian, following a forward-only translation procedure (Maneesriwongul & Dixon, 2004). The first and second authors translated the original English version of each scale into Indonesian. The translations were assessed for linguistic accuracy and cultural appropriateness for each item.

The online questionnaire started with informed consent, which asked participants to confirm the willingness to participate. After confirming the willingness, participants were asked to answer several questions using a Likert-type model to measure each variable. Scores for each variable were calculated based on the average value. The variables included SRL, emotional intelligence, academic self-efficacy, teacher charismatic leadership, and peer support.

SRL was measured using 38 items (Cronbach's Alpha reliability [α = .92]), with response options ranging from 1 (Never) to 7 (Always). López-Angulo et al. (2024) stated that SRL consisted of components of learning disposition (5 questions; e.g., “Before I start studying, I prepare the necessary materials.”), learning performance (6 questions; e.g., “While studying, I check whether the planned time is sufficient, and I adjust it if necessary”), self-evaluation (5 questions; e.g., “After I finish studying, I evaluate myself whether I have made progress compared to my previous knowledge”), goal attainment (7 questions; e.g., “When I try to change something, I pay attention to how I do it”), awareness (7 questions; e.g., “I am easily distracted from my plans” [reverse item]), adaptability (3 questions; e.g., “I learn from my mistakes”), proactivity (3 questions; e.g., “I can stick to plans that are working well”), and goal setting (2 questions; e.g., “I have difficulty setting goals for myself” [reverse item]). The second variable is emotional intelligence, measured by adapting studies by Davies et al. (2010), consisting of 10 questions (α = .87) and five answer choices (1 = Strongly Disagree, 5 = Strongly Agree). The emotional intelligence scale comprised components of appraisal of emotions (e.g., “I know the reasons behind my emotional changes”), appraisal of others’ emotions (e.g., “I can tell how someone is feeling by listening to the tone of their voice”), regulation of personal emotions (e.g., “I look for activities that make me happy”), regulation of others’ emotions (e.g., “I organize activities that other people

Table 1.
Descriptive Statistics (Mean, Standard Deviation, Correlation) of Variables

Variabel	M	SD	(1)	(2)	(3)	(4)	(5)	(6)
(1) SRL	4.967	.686	—	.370**	.502**	.242**	.375**	.543**
(2) EI	3.772	.770		—	.238**	.535**	.384**	.453**
(3) ASE	3.394	.438			—	.221**	.397**	.483**
(4) CHAR	3.770	1.015				—	.355**	.454**
(5) CLASS	3.350	.593					—	.504**
(6) SOLVE	4.657	.739						—

*Note: M = average. SD = standard deviation. **p < .01. SRL = self-regulated learning. EI = emotional intelligence. ASE = academic self-efficacy. CHAR = teacher charismatic leadership. CLASS = classmate support. SOLVE = problem-solving skills.*

Table 2.
Assumptions test

Prediktor	Tolerance	VIF	Skewness	Kurtosis	Normal	Robust
(1) SRL	.669	1.496				
(2) EI	.633	1.579				
(3) ASE	.695	1.438	-.595 (.163)	2.653 (.324)	14.100*	6.174^{ns}
(4) CHAR	.685	1.459				
(5) CLASS	.719	1.390				

*Note: The outcome variable or dependent variable is problem-solving skills (SOLVE). SRL = self-regulated learning. EI = emotional intelligence. ASE = academic self-efficacy. CHAR = teacher charismatic leadership. CLASS = classmate support. VIF = Variance Inflation Factor. Numbers in parentheses are the standard errors (SE) of skewness and kurtosis. Numbers below the Normal and Robust values for the homoscedasticity test are the Chi-square (χ2) values. *p < .05. ns = not significant.*

like"), and utilization of emotions (e.g., "When I am in a positive mood, I can generate new ideas").

Academic self-efficacy was measured with 10 questions (α = .89; e.g., "I believe in my ability to learn, even when I am having a bad day"), adapted from Rowbotham and Schmitz (2013). Response options for the academic self-efficacy scale ranged from 1 (Not at All True) to 4 (Very True). Teacher charismatic leadership was measured with 14 questions (α = .97; e.g., "My professor often encourages us to think about the future and prepare for it"), adapted from Tsai (2017), with response options ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Classmate support was measured with three questions (α = .82; e.g., "Most of the students in my class are kind and helpful"), adapted from Danielsen et al. (2010), with response options ranging from 1 (Never) to 4 (Almost Always). The final variable, problem-solving skills, was measured with 17 questions (α = .96) adapted from Sahin et al. (1993), with response options ranging from 1 (Extremely Strongly Disagree) to 6 (Extremely Strongly Agree). The scale consisted of several components including reflective style (5 questions; e.g., "When making decisions, I consider the consequences of each alternative and compare them with each other"), problem-solving confidence (5 questions; e.g., "Given enough time and effort, I am confident I can solve most problems I face"), monitoring (3 questions; e.g., "When I have a problem, I think of as many ways as possible to solve it until I run out of ideas"), and planfulness (4 questions; e.g., "I make decisions and am happy with them later"). Finally, participants were asked to provide demographic information, including age and gender.

Each hypothesis was analyzed using PROCESS Macro Model 4 (Hayes, 2018). In comparison to conventional regression, PROCESS Macro Model 4 offers a more efficient approach to testing mediation, automates the calculation of direct and indirect effects, and uses bootstrapping to generate confidence intervals. This model also saves time and reduces measurement error that can bias the analysis results.

Results and Discussion

Results

Descriptive statistics

Table 1 reports descriptive statistics for each variable. The highest and lowest mean scores were for SRL and peer support, respectively. Each variable was positively and significantly correlated. The strongest correlation was between SRL and problem-solving skills, while the weakest was between academic self-efficacy and teacher charismatic leadership.

Assumption test

Assumption test was conducted before testing each hypothesis. According to Hayes (2018), the assumption test includes multicollinearity, residual normality, and homoscedasticity, as reported in Table 2 below. Multicollinearity assumption test was carried out with the result that VIF (Variance Inflation Factor) for all predictors was less than 10, with a tolerance value greater than .20 (Shrestha, 2020). These results showed that the data were free from multicollinearity. For the residual normality assumption test, the t-residual value for skewness and kurtosis, using the Bonferroni correction, was -5.521 ($p < .001$). The results showed that the residuals were not normally distributed (Tofighi & Kelley, 2020). According to the Breusch-Pagan test, the Chi-square ($\chi 2$) value for the normal estimate was significant ($p = .015$), but the homoscedasticity assumption was not met. The Chi-square ($\chi 2$) value for the robust estimate was not significant ($p = .290$), and the assumption was met (Akewugberu et al., 2024). Considering the assumption test results, the bootstrap method was applied with 5000 replications. The method had proven reliable for handling data with residuals that are not normally distributed.

Hypothesis test

Each hypothesis was tested using PROCESS Macro Model 4 (Hayes, 2018), installed in SPSS version 29. Problem-solving skills, emotional intelligence, academic self-efficacy, teacher charismatic leadership, classmate support, and SRL were input as the dependent (Y), the first mediator (M1), the second mediator (M2), the third mediator (M3), the fourth mediator (M4), and the independent variable (X), respectively. Age ($r = -.011$, $p = .432$) and gender ($r = .080$, $p = .116$) were not significantly correlated with problem-solving skills. Therefore, these demographic variables were not controlled as covariates in PROCESS Macro Model 4.

The total effect regarding the role of SRL as an independent variable or predictor of problem-solving skills without controlling for the role of the four mediators was significant (unstandardized regression coefficient [B] = .5849, standard error [SE] = .0608, $t = 9.6245$, $p = .001$, 95% lower limit confidence interval [LLCI] = .4652, 95% upper limit confidence interval [ULCI] = .7047, $R2 = .2944$, $F = 92.6317$, $p < .001$).

Figure 1 reports PROCESS Macro Model 4 analysis results. As shown in Figure 1, SRL role in explaining emotional intelligence is 13.68% ($R2 = .1368$, $F = 35.183$, $p < .001$), academic self-efficacy is 25.17% ($R2 = .2517$, $F = 74.676$, $p < .001$), teacher charismatic leadership is 5.87% ($R2 = .0587$, $F = 13.853$, $p < .001$), and classmate support is 14.05% ($R2 = .1405$, $F = .36.298$, $p < .001$).

Supporting H1, SRL was a significant positive predictor of problem-solving skills ($B = .30$, $SE = .064$, $t = 4.711$, $p < .001$, 95% LLCI = .174, 95% ULCI = .425). Except for emotional intelligence, which did not significantly predict problem-solving skills ($B = .109$, $SE = .058$, $t = 1.871$, $p = .063$, 95% CI [−.006, .224]), all proposed mediators reported significant positive effects. Academic self-efficacy was positively associated with problem-solving skills ($B = .317$, $SE = .098$, $t = 3.243$, $p = .001$, 95% CI [.124, .509]), followed by teacher charismatic leadership ($B = .154$, $SE = .043$, $t = 3.632$, $p < .001$, 95% CI [.071, .238]) and classmate support ($B = .258$, $SE = .071$, $t = 3.630$, $p < .001$, 95% CI [.118, .398]). The hypotheses were supported and accepted except for H2d, H2a, H2b, and H2c.

Figure 1 shows that SRL positively and significantly predicts emotional intelligence ($B = .415$, $SE = .070$, $t = 5.932$, $p < .001$, 95% LLCI = .277, 95% ULCI = .553), academic self-efficacy ($B = .321$, $SE = .037$, $t = 8.642$, $p < .001$, 95% LLCI = .247, 95% ULCI = .34), teacher charismatic leadership ($B = .359$, $SE = .096$, $t = 3.722$, $p < .001$, 95% LLCI = .169, 95% ULCI = .548), and classmate support ($B = .324$, $SE = .054$, $t = 6.025$, $p < .001$, 95% LLCI = .218, 95% ULCI = .430), supporting H3. Emotional intelligence does not play a significant mediating role in the relationship between SRL and problem-solving skills (Indirect effect: $B = .045$, BootSE = .028, 95% BootLLCI = -.009, 95% BootULCI = .101). Meanwhile, Academic self-efficacy, teacher charismatic leadership, and classmate support served as significant mediators of the positive relationship between SRL and problem-solving skills. The indirect effect through academic self-efficacy was significant ($B = .102$, BootSE = .042, 95% BootCI [.030, .192]). Similarly, significant indirect effects were observed through teacher charismatic leadership ($B = .055$, BootSE = .023, 95% BootCI [.017, .106]) and perceived classmate support ($B = .083$, BootSE = .030, 95% BootCI [.030, .149]). In this context, H4 can be partially accepted.

In line with the recommendations of Hayes et al. (2025), EIV (errors-in-variables) regression was applied to test the consistency of the analysis. This regression is crucial for addressing measurement error in ordinary least squares (OLS) by estimating the reliability of the independent variable X and the mediator M, as well as applying HC3 (heteroskedasticity-robust inference number 3) following the default standard error determinant (Hayes & Cai, 2007). The results are presented in Table S1 in the Appendix. In accordance with H1, SRL is a significant positive predictor of problem-solving skills. Supporting H2a, H2b, and H2c, academic self-efficacy, teacher charismatic leadership, and classmate support exhibited significant effects on problem-solving skills.

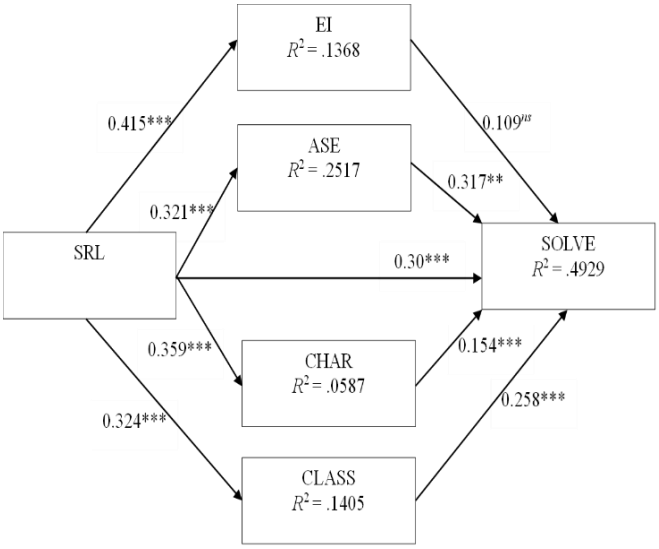

Figure 1. Path diagram

*Note: Figures in the figure are unstandardized regression coefficients. **p < .01. ***p < .001. ns = not significant. SRL = self-regulated learning. EI = emotional intelligence. ASE = academic self-efficacy. CHAR = teacher charismatic leadership. CLASS = classmate support. SOLVE = problem-solving skills.*

In contrast, emotional intelligence did not report a significant effect, leading to the rejection of H2d. SRL also plays a significant role in predicting academic self-efficacy, teacher charismatic leadership, classmate support, and emotional intelligence. Academic self-efficacy, teacher charismatic leadership, and classmate support significantly mediated the relationship between SRL and problem-solving skills, while emotional intelligence did not exhibit a significant mediating effect.

Discussion

The purpose of this study was to analyze the role of SRL in improving students' problem-solving skills and to explore the psychological mechanisms of micro and meso variables as mediators of the relationship. SRL significantly improved problem-solving skills, but the direct effect was mediated by academic self-efficacy, teacher charismatic leadership, and classmate support. These results suggest a potential new contribution to the educational psychology literature by integrating micro- and meso-level variables as determinants of SRL's effectiveness in improving problem-solving skills.

In this study, SRL plays a significant role in explaining students' problem-solving skills. These results have theoretical implications for extending SRL model and classical social-cognitive theory (Chou et al., 2024). Traditionally, SRL improves academic performance through mediation by factors such as self-efficacy and motivation (Pintrich & Garcia, 2012). This type of learning can play a direct and independent role in problem-solving skills beyond the mediators. Therefore, the cognitive, metacognitive, and motivational components of SRL directly enhance higher-order cognitive abilities such as problem-solving skills. This can expand SRL theory since learning is a facilitator but also a direct driver of cognitive performance.

The second theoretical implication relates to transformational and charismatic leadership models in educational psychology. Even though previous studies largely focused on the effect of teachers' leadership on learning outcomes of students (Allen et al., 2022; Wang et al., 2020), the direct role of SRL in problem-solving skills remained significant after controlling for charismatic leadership. This suggests that internal self-regulatory capacities can complement external environmental cues, leading to a bidirectional model. Theoretically, this idea refines leadership models in education by integrating students' agency as an independent determinant of cognitive outcomes, building on classical models.

The third theoretical implication is that the role of SRL remains significant even when controlling for classmate support. These results confirm that SRL serves as a powerful, independent cognitive and motivational system in shaping problem-solving skills. Classic social-cognitive and collaborative learning theories (Glassman et al., 2023) emphasize social interaction, peer support, and observational learning as central to problem-solving learning. The results extend the traditional theories by showing that self-regulation processes drive problem-solving outcomes independently of social support. This reinforces the idea that SRL equips students with internal strategies applied in less supportive environments.

Emotional intelligence does not play a significant role in explaining problem-solving skills. This variable has long been associated with emotion regulation and social functioning (Mayer et al., 2025). According to a literature review, emotional intelligence is a positive predictor of problem-solving skills (Altaras et al., 2025). The results indicate that emotional intelligence does not directly affect problem-solving skills but may enhance emotional resilience and interpersonal dynamics, facilitating problem-solving skills.

Empirical results regarding the suboptimal role of emotional intelligence indicate that problem-solving skills are more strongly affected by factors directly related to learning and academic performance. According to Bandura et al.'s (1996) Self-Efficacy Theory, academic self-efficacy is related to persistence, strategic thinking, and confidence in handling complex tasks. Teachers' charismatic leadership and classmates' support provide motivational and cognitive resources that facilitate effective problem-solving. Even though emotional intelligence supports students' adjustment, problem-solving skills are more dependent on academic self-confidence and the quality of learning environment.

This study reported significant roles for academic self-efficacy, teacher charismatic leadership, and classmate support in mediating the effect of SRL on problem-solving skills, extending several key psychological theories. The first is an extension of SRL theory by Zimmerman and Schunk (2013), where SRL does not operate in isolation but interacts with external social and motivational factors to improve cognitive outcomes. The theory emphasizes internal processes such as goal setting and self-monitoring. The processes are reinforced by the social environment, making SRL dynamic and context-dependent. The results extend Bandura et al.'s (1996) self-efficacy theory by showing that SRL increases self-efficacy and creates a feedback loop to improve problem-solving skills.

Despite the positive aspects mentioned above, this study has several limitations. First, the convenience sampling limited the generalizability of the results. Further studies should adopt stratified or cluster-based random sampling (Furman, 2023). The results on the relationship between SRL, emotional intelligence, academic self-efficacy, teacher charismatic leadership, classmate support, and problem-solving skills represent a broader population of students from various universities in Indonesia. Second, this study examined each variable using self-report measures and investigated the relationships through cross-sectional correlational analyses. The design is susceptible to common method bias (Podsakoff et al., 2024), which occurs when data for multiple variables are collected using the same method, source, or time point, artificially inflating or degrading the observed relationships. Further studies must adopt directly measured latent variable (DMLV) to address the shortcoming (Williams et al., 1996). This method is an application of confirmatory factor analysis (CFA) incorporating a social desirability responding measure. Common method bias will not be significant when CFA results indicate that each construct has an adequate goodness-of-fit after controlling for social desirability responding.

Conclusion

In conclusion, the important role of SRL is reported in improving problem-solving skills, with emotional intelligence, academic self-efficacy, teacher charismatic leadership, and classmate support as key mediators. This study contributes to educational psychology by integrating micro-level (individual) and meso-level variables as mediators. The results show the importance of SRL as a comprehensive process for directly explaining or predicting problem-solving skills. This is supported by motivational and social factors, offering a more nuanced understanding of how students are guided toward academic success. Useful insights are also provided for developing targeted interventions to enhance SRL and leverage the role of social support and leadership in improving problem-solving skills among students.

The results have the potential to provide valuable insights for policymakers in higher education, emphasizing the importance of developing students' SRL to enhance problem-solving skills. Policymakers should consider implementing programs that promote SRL strategies, such as goal setting, self-monitoring, and reflection, into the curriculum. Furthermore, a supportive environment that enhances academic self-efficacy, teacher charismatic leadership, and classmate support can improve the effectiveness of SRL interventions. Institutions facilitate students' development of problem-solving skills essential for academic success and future career readiness by integrating these elements into an educational framework.

Declaration

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Author Contributions

Conceptualization: E.Z; Methodology: E.Z., A.M; Data collection and investigation: E.Z.; Data analysis: A.M.; Writing—Original Draft Preparation: E.Z.,

A.M.; Writing—Review & Editing: E.Z., A.M.; Supervision: E.Z.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Use of Artificial Intelligence

Except for the Method and Result sections, the authors have used ChatGPT to brainstorm ideas in the Introduction, Theoretical Rationales, and Discussion. The authors then carefully and responsibly checked the accuracy and reliability of the ideas and their related references.

Ethical Clearance

Ethical review and approval were waived for this study, given that there is no psychologically significant risk to participants. Before filling out the online questionnaire, informed consent is obtained from all participants.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Appendix

Table S1.

Application of EIV (Errors-in-Variables) Regression in PROCESS Model 4 to Control Measurement Error for The Role of Emotional Intelligence, Academic Self-Efficacy, Teacher Charismatic Leadership, and Classmate Support as Mediators of Self-Regulated Learning on Problem-Solving Skills

Outcome(s)	Predictor	*B*	*se*(HC3)	*t*	*p*	95% CI	
						LLCI	*ULCI*
EI	SRL	.4515	.0716	6.3047	< .001	.3104	.5927
ASE		.3483	.0733	4.7549	< .001	.2040	.4927
CHAR		.3897	.0997	3.9090	< .001	.1932	.5862
CLASS		.3519	.0557	6.3146	< .001	.2421	.4618
SOLVE	SRL	.3078	.0913	3.3734	< .001	.1280	.4877
	EI	.1097	.0907	1.2101	.2276	-.0690	.2884
	ASE	.3185	.1384	2.3013	.0223	.0457	.5913
	CHAR	.1446	.0571	2.5345	.0120	.0322	.2570
	CLASS	.3158	.1225	2.5787	.0106	.0744	.5571

Effect				95% CI	
	B	*se*(HC3)	*t*	*p*	*LLCI*	*LLCI*
Total						
SRL→ SOLVE	.6358	.0674	9.4291	< .001	.5029	.7687
Direct						
SRL→ SOLVE	.3078	.0913	3.3734	< .001	.1280	.4877
Indirect						
	B	Boot*se*			Boot*LLCI*	Boot*LLCI*
SRL→ EI → SOLVE	.0495	.0410	—	—	-.0331	.1308
SRL→ ASE → SOLVE	.1109	.0576	—	—	.0130	.2397
SRL→ CHAR → SOLVE	.0563	.0262	—	—	.0115	.1138
SRL→ CLASS→ SOLVE	.1111	.0449	—	—	.0335	.2064

Note: SRL = self-regulated learning; EI = emotional intelligence; ASE = academic self-efficacy; CHAR = teacher charismatic leadership; CLASS = classmate support; SOLVE = problem-solving skills; B = unstandardized coefficient; se = standard error; t = t-value; p = coefficient significance; CI = internal confidence interval; LLCI = lower level of the confidence interval; ULCI = upper level of the confidence interval. HC3 = heteroskedasticity-consistent standard error number 3. Boot = bootstrapping sample 5000 times.