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Exploring the Relationship between Self-Regulated Learning and Critical Thinking: The Role of Self-Reflection in Enhancing Higher-Order Thinking Skills

Abdelmomen Khalil✉[1]& Nadia Hellalet[2]

[1,2] Applied Language and Culture Studies Lab (ALCS), Faculty of Letters and Humanities, Chouaib Doukkali University, El Jadida, Morocco

✉ khalil.abdelmomen@ucd.ac.ma

Abstract. This quantitative study assessed Critical Thinking (CT) proficiency, explored Self-Regulated Learning (SRL) strategies, and examined the relationships between SRL and CT and their components. Additionally, it examined the effect and predictive roles of SRL strategies in shaping CT skills and addressed the extent to which self-reflection mediates the effect of performance control on CT skills. The sample consisted of 150 students from Moroccan preparatory classes. The Collegiate Academic Achievement Proficiency (CAAP) Critical Thinking Test (CTT) was administered to assess CT proficiency. The Academic Self-Regulated Learning Questionnaire (ASRLQ) was used to examine SRL strategies. The results demonstrated students' average level of CT and statistically significant correlations between the components of SRL and CT. Structural Equation Modeling (SEM) analysis indicated a statistically significant high path from SRL to CT ($\beta = 0.75$, SE = 0.07, $t = 10.71$, $p < .001$), confirming the effect of SRL on CT. Additionally, the findings of the mediation analysis with bootstrapping confirmed the indirect effect of self-reflection on the relationship between performance control and CT. This study highlights the importance of enhancing students' SRL strategies and the role of self-reflection in developing learners' higher-order thinking skills. These findings highlight the use of differentiated instructional approaches that consider planning, monitoring, and reflection strategies as central mechanism for developing CT, metacognitive awareness and promote learner autonomy.

Keywords: Critical Thinking; Learner Autonomy; Self-regulated Learning; Self-reflection

1. Introduction

Critical thinking (CT) is a vital ability that enables students to meet the challenges of the 21st-century job market (Le, 2024). Many researchers have examined the role of CT in preparing students for academic and workplace success (Xiang, 2024; Kerruish, 2025). This need is stimulated by a dynamic learning context characterized by technological advancements and global issues that force individuals to engage in higher-order thinking (Chen et al., 2024). A sound understanding of rational thinking and reasoning is required for students to creatively and critically respond to current issues and arrive at well-supported conclusions and judgments (Kerruish, 2025). Moreover, CT protects individuals from misinformation and social manipulation (ALI, 2022). Hence, developing students' CT skills necessitates enhancing their SRL and critical self-reflection skills, which are essential for achieving positive learning outcomes (Landrum, 2022).

1.1. Problem Statement

The role of SRL strategies has received increasing attention in facilitating CT development (Bagheri, 2015). These strategies are key factors in predicting academic achievement (Al-Rasheedi & El-Zraigat, 2025). They enable learners to control their learning processes by planning, monitoring, and reflecting on their performance (Arvatz, 2025). Thus, SRL refers to the process by which learners actively control their cognitive, motivational, and behavioral engagement in learning activities (Zimmerman, 2000). This process necessitates goal-setting, self-monitoring, performance control, and self-reflection (Zimmerman, 2000). Students with strong SRL strategies can analyze problems, assess evidence, and draw reasoned

conclusions (Teng, 2021). These strategies support greater engagement with content and challenge learners to question assumptions and consider alternative perspectives. Halpern (2014) emphasized the significance of cultivating CT skills, which, when paired with SRL strategies, can empower students to develop the analytical, interpretative, and problem-solving abilities necessary for academic success.

Although SRL and CT have been researched extensively as independent constructs (Zimmerman, 2000), their interrelationship has been underexamined, especially within Moroccan preparatory institutions, where educational reforms are focusing on autonomous learning, competence-based education, and 21st-century skills. Current research largely dwells on SRL's contribution to academic achievement and metacognitive awareness (Dent & Koenka, 2016), with minimal consideration of how SRL strategies directly impact the development of CT proficiency (Akcaoğlu et al., 2022). Additionally, CT has been accepted as an essential educational outcome, the processes by which SRL components, such as forethought, performance control, and self-reflection, promote CT sub-skills, such as analysis of arguments, evaluation of arguments, and extending arguments, are still theoretical and lack empirical validation. Given these gaps, the present study investigates the levels of CT skills among Moroccan preparatory school students, explores their use of SRL strategies, and examines the relationship between SRL and CT. Furthermore, this study examined the effect and predictive roles of SRL strategies in shaping CT skills and addressed the extent to which self-reflection mediates the effect of performance control on CT skills (Arvatz et al., 2025). Addressing these gaps is critical not only for enhancing theoretical understanding but also for informing culturally relevant pedagogical practices and designing pedagogical interventions that can foster independent learning, self-reflection, and CT. This study seeks to align Moroccan education with international standards. Therefore, the following research questions were formulated:

1. What levels of CT proficiency do Moroccan preparatory school students exhibit?
2. Are there any significant correlations between SRL, CT, and their components?
3. To what extent do SRL strategies predict students' CT Skills?
4. To what extent does self-reflection mediate the effect of performance control on CT performance?

The following hypotheses are proposed:

1. There are statistically significant positive correlations between SRL strategies and CT skills, including their subcomponents.
2. Students who report on higher SRL strategy use do demonstrate significantly higher CT skills.
3. Self-reflection significantly mediates the relationship between performance control and CT performance.

1.2. Research Objectives

This research centers on examining the CT abilities of Moroccan preparatory school students and exploring how these skills relate to their SRL strategies. The purpose of this study is to bridge this gap by establishing a clear baseline of students' analytical reasoning abilities while simultaneously investigating whether SRL processes, including forethought, performance control, and self-reflection, serve as meaningful pathways for developing these critical skills. By focusing specifically on this educational context, where students are expected to move beyond rote memorization toward independent judgment, the study aims to illuminate how cognitive self-regulation and CT intersect in a context where both constructs are increasingly emphasized. By addressing the above-mentioned research questions, this study aimed to inform theory and practice and target the development of instructional interventions that leverage self-regulatory processes to foster analytical reasoning, thereby supporting the practical implementation of Morocco's educational reform objectives while contributing to the broader literature on how metacognitive strategies facilitate CT development.

2. Theoretical Framework

This study is grounded in Zimmerman's (2000) SRL model, which considers learning an active cyclical process involving three interconnected phases: forethought, performance control, and self-reflection. These phases include the learner's ability to set goals, implement strategic approaches during learning activities, and evaluate outcomes to enhance future performance. Foremost in this model are learners' self-reflective practices, where students monitor their cognitive processes and make strategy modifications accordingly. The model provides a framework for exploring how learners self-regulate and reflect on their learning.

The relevance of SRL to CT is apparent in the common focus on metacognition and intention. According to Facione (1990), CT entails purposive, self-regulatory judgment and includes abilities such as analysis, inference, and evaluation. These abilities are highly consistent with self-regulated learners' strategic monitoring and reflective practices. As students plan thoughtfully, monitor their understanding while learning, and critically evaluate their outcomes, they are more inclined to engage in CT. Halpern's (2014) definition of CT as a teachable and transferable ability that facilitates individuals in addressing complex and real-world issues provides evidence for this relationship. By integrating these theoretical perspectives, this study examined the relationship between students' SRL strategies and CT skills. The framework also supports a mediational analysis of how self-reflective practices influence the relationship between performance control and CT.

2.1. Critical Thinking

Dewey (1933) was among the first scholars who define CT based on the notion of "reflective thinking" (p. 9). Facione (1990) defines the term as " a purposeful and self-regulated cognitive process that includes interpretation, analysis, evaluation, and inference" (p. 3), which encompasses offering explanations grounded in evidence, criteria, contextual factors, and methodologies that substantiate the judgment being formed (p. 3). Therefore, CT is characterized as a reflective process applied to decision-making and problem solving. In this context, Paul and Elder (2006) define CT as "the art of thinking while thinking in order to make thinking better: more clear, more accurate, more defensible" (p. 1). This self-regulatory aspect of CT is subjected to continuous monitoring and refinement to attain more valid and reliable outcomes (Pereles et al., 2024).

Recent studies have stated that CT is essential for reducing decision-making errors and making better judgements in intricate situations (Vincent-Lancrin, 2024; Le, 2024). In this regard, CT serves as the basis for engaging in reflective thinking (Kuhn, 2019), a skill that is essential for active citizenship (Vincent-Lancrin, 2024). This is relevant to the needs of the 21st century, where organizations and companies recruit employees who can think critically, solve problems efficiently, and communicate effectively (National Research Council, 2012), and consider them as a basis for tackling complex issues (Al Aziz et al., 2023) and making effective decisions (Pereles et al., 2024).

CT skills arguably allow learners to engage in independent and reflective thinking (Ennis, 2011). Within an academic endeavor, CT skills allow students to engage in self-regulatory learning, thereby developing a deep understanding of their disciplines and enabling them to shift from traditional learning to analytical evaluation of information (Khalil et al., 2025). In this respect, Abrami et al. (2015) affirmed that learners who gain high levels of CT are better equipped to immerse themselves in evaluating content, assessing its validity, and articulating reasoned perspectives (Halpern, 2014). In this investigation, CT is defined as the effective application of cognitive abilities to accurately evaluate, analyze, and synthesize data, arguments, or claims to develop well-reasoned decisions and conclusions in a self-regulatory manner. This reflects the focus of higher education on developing critical, reflective and independent thinking.

2.2. Self-Regulated Learning

SRL is a key competence in modern education, allowing learners to take conscious control of their cognitive, emotional, and behavioral involvement in academic activities. It refers to the

learner's ability to actively manage and direct their cognitive, motivational, and behavioral processes toward the achievement of specific academic goals (Munahefi, 2022). According to Zimmerman (2000), self-regulation is defined as: It involves metacognitive awareness, intrinsic motivation, and strategic engagement, allowing learners to take ownership of their educational development. This includes planning, setting goals, self-monitoring, and self-reflection, which are not only fundamental to academic success but also vital for coping with complicated problem-solving contexts (Zimmerman, 2000).

Boekaerts (1999) extended this view by highlighting that SRL leverages knowledge, skills, and attitudes in various learning contexts. Schunk and Mullen (2013) argued that the use of self-regulation strategies enhances student performance in knowledge transfer activities and academic achievement (Al-Rasheedi et al., 2025). SRL is theorized as a process of independent learning, enabling students to take control of their learning experiences through the use of strategies that align with their understanding of tasks while strengthening their decision making and motivation (Abdullah, 2025). Sun et al. (2018) formally described SRL as an integration of motivational beliefs, behaviors, and metacognitive processes that are purposefully designed and adapted to achieve personal goals.

Sarwar et al. (2025) further highlighted SRL as an active and self-guided process that involves systematic planning, monitoring, regulation, and evaluation. Rita and Henrieta, (2025) also claims that students who engage in self-regulatory learning show high academic achievement because they can monitor, reflect and adjust their learning behaviors. Additionally, Zimmerman (2010) contended that SRL goes beyond academic contexts, allowing individuals to solve real-life problems. This self-directed learning ability is particularly important for developing CT. It also provides learners with reflective and evaluative abilities to solve problems and make decisions. Therefore, SRL not only facilitates academic success but also provides a basis for developing CT skills in students.

2.3. Self-Reflection

Dewey (1933) defines reflection as the "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it" (p. 9). Similarly, Schön (1983) views reflection as a process of making sense of "some puzzling or troubling or interesting phenomenon" while simultaneously analyzing and restructuring the implicit understandings that inform action (p. 50). Both scholars emphasize the role of deliberate thought and analysis as foundational to understanding and improving reflective practice. Hence, a reflective student critically examines their practices, identifies areas for improvement, and implements changes to enhance performance. Critical self-reflection, a deeper form of reflection, is instrumental in fostering transitions and growth, as it challenges established patterns of thinking and presuppositions, thereby cultivating higher-order thinking skills (Brockbank & McGill, 2006; Cleary, 2025; Arvatz, 2025).

Reflection is a transformative cognitive process that underpins the development of CT by enabling learners to examine the validity of their beliefs and evaluate the effectiveness of their problem-solving strategies (Arvatz, 2025). Through critical self-reflection, students develop meta-awareness that facilitates deeper learning and informed decision-making (Cleary, 2025). This process is both individual and social (Mewborn, 1999) and is supported by pedagogical tools such as reflective writing, which create conditions for critical reflective learning (Brockbank & McGill, 2006). Therefore, critical reflective learners are better equipped to connect new understandings with prior knowledge, critically evaluate their own perspectives, and broaden their thinking within larger socio-political or conceptual contexts. This progression enables students to engage in higher-order thinking, ultimately supporting their academic and personal growth (Moon, 2007).

2.4. Relationship between Self-Regulated Learning and Critical Thinking

Previous studies on the relationship between SRL and CT have tackled their underlying factors and variables that can shape their development. For instance, studies investigating students' use of SRL and CT engagement in relation to the guided discovery learning approach have revealed that this instructional approach has a positive influence on their application (Susanti

& Purbandari, 2024; Yazdani & Sadeghi, 2022). In this regard, Sukardi et al. (2025) acknowledged a significant correlation between students' CT skills and their level of SRL, highlighting the value of SRL in facilitating higher-order cognitive skills. In a related context, Setiyawan et al. (2024) claimed that SRL enables students to solve problems effectively, demonstrating that students with high levels of SRL performed better than their counterparts with low SRL in mathematical CT activities. Similarly, Miatun and Khusna (2020) found significant differences in CT abilities among students with different SRL levels.

The aspects of SRL and CT are interrelated in that they emphasize metacognition, evaluation, and decision-making processes. These processes allow learners to analyze information, monitor their understanding, and make reasoned judgments (Facione, 1990; Halpern, 2014). SRL engages learners in planning, monitoring, and evaluating their learning. These strategies are closely associated with CT skills that require deliberate reflective practice (Nanda et al., 2023). Previous studies have confirmed strong positive relationships between SRL strategies and CT abilities (Widana, 2022; Yani & Miatun, 2024). In other words, students who actively monitor and reflect on their learning strategies are more capable of critically analyzing information, assessing evidence, and transferring their understanding to new situations.

3. Method

3.1. Research Design

The present study relied on a quantitative, correlational research design to investigate the correlation between SRL strategies and CT skills among Moroccan preparatory school students. This research design was appropriate for measuring CT skills and SRL strategies and for investigating the predictive and mediating effects between variables using statistical analysis. Two validated tools were used to collect data: the Collegiate Assessment of Academic Proficiency – Critical Thinking Test (CAAP-CTT) to measure students' CT performance, and an ASLQ, developed and validated by Nambiar et al. (2022), to determine students' use of SRL strategies.

Based on post-positivist principles, the role of the researchers in this study was confined to collecting, analyzing, and interpreting data objectively, following the principle that reality is out there and can be observed in the same way by different unbiased observers (Shaw & Satalkar, 2018). Efforts were made to minimize personal bias and maintain objectivity throughout the research process. The researchers acted as impartial analysts, detached from influencing the participants or data (Scott, 2003; Shaw & Satalkar, 2018). This commitment to objectivity ensured that the study's findings were based solely on the data collected and were free from subjective interference.

3.2. Participants

The sample for this investigation included 150 students enrolled in second-year preparatory classes, as shown in Table 1. They were selected using a random stratified sampling method. Of these, 45% were male and 55% were female. Most of them (94%) fell within the 19–20 age category. Regarding their years of learning English, 53% of the participants had been learning English for four to five years, 33% for six to seven years, and 14% for more than seven years. This demographic background provides a foundation for measuring students' CT skills and analyzing their SRL practices.

Table 1. Participants' Demographic Background

Gender			Age		Years of Learning English	
	Frequency	Percent	Category	Percent	Years	Percent
Male	68	45%	19-20	94%	4-5	53%
Female	82	55%	21-23	6%	6-7	33%
Total	150	100%	Total	100%	+7	14%

Prior to data collection, written informed consent was obtained from institutional representatives in accordance with ethical guidelines. In addition, all participants were provided with an informed consent form prior to the study, outlining its purpose and ensuring their voluntary participation, emphasizing that participation was entirely voluntary and included assurances regarding the confidentiality of their responses. They were also assured that their responses would be utilized exclusively for research intentions and could not be directed toward any other purpose. Additionally, the right to cancel participation in the study at any time without any concerns was explicitly communicated and emphasized. This guaranteed that the confidentiality and anonymity of the respondents were preserved throughout the research process.

3.3. Data Collection

This study adopted two main instruments to answer the research questions. The first is the CAAP CT test as a core research instrument to measure preparatory class students' CT proficiency in conjunction with the variables of the investigation. The CAAP CT test is a standardized test designed to evaluate the CT skills of collegiate students (ACT, 2008). It was developed using the ACT Program in 2008. It is composed of 32 items, with 40 min allotted (ACT, 2008). It was developed to assess HOTS and reasoning skills, including CT (analysis, evaluation, and extension of arguments). The test has four consecutive reading passages based on everyday problems, followed by multiple-choice questions with four options (ACT, 2008). The structure of the questions requires students to employ their CT skills to analyze, evaluate, and draw conclusions (ACT, 2008). The question type represents multiple aspects of CT education. Table 2 presents the test specifications in detail.

Table 2. CAAP Critical Thinking Test Item Specifications

Indicators	Test number (item)	Number of items
Analysis of elements of arguments	2/3/4/7/8/9/10/11/13/14/17/ 19/20/21/25/26/29/31	18
Evaluation of arguments	6/12/16/18/23/24/27/28/32	9
Extending arguments	1/5/15/22/30	5
Total		32

To measure students' SRL strategies, the current study adopted the ASLQ, developed and psychometrically tested by Nambiar et al. (2022) as the second adopted instrument. The ASLQ is a self-report questionnaire that quantifies the extent to which learners manage their academic behaviors using cognitive, metacognitive, motivational, and behavioral strategies. Aligned with Zimmerman's (2000) SRL theory, the questionnaire offers a composite perspective of students assuming control of and managing their learning. The ASLQ has 36 items evaluated on a 4-point Likert scale (1 = strongly disagree, 4 = strongly agree). They are categorized into three subscales: Forethought (planning and goal setting), Performance Control (implementation of strategy in learning tasks), and Self Reflection (evaluation and adjustment following task completion). According to Nambiar et al. (2022), this instrument demonstrated high psychometric properties in a validation study of 1,032 undergraduate students. The major validation parameters are listed in Table 3.

Table 3. Psychometric Properties of the ALSQ

Dimension/Property	Cronbach's Alpha (α)	No. of Items
Forethought	0.72	10
Performance Control	0.85	19
Self-Reflection	0.75	7
Overall Reliability	0.90	*
Test–Retest Reliability	0.96	*

3.4 Data Analysis

Several statistical analyses were performed to address the research questions. Descriptive statistics were initially calculated to examine students' CT skills and SRL strategies. In addition, Pearson product-moment correlation was used to examine the relationships between SRL and CT, and between their subcomponents. To examine the predictive effect of SRL on CT proficiency, Structural Equation Modeling (SEM) was applied with the fit indices of CFI, TLI, RMSEA, and SRMR. Because this study aimed to quantify the effect of SRL on CT proficiency, SEM was employed because of its ability to estimate direct effects while adjusting for measurement error. The analysis yielded a statistically significant high path from SRL to CT (β = 0.75, SE = 0.07, t = 10.71, $p < .001$), and the model fit was excellent ($\chi^2(8) = 12.36$, $p > .05$, CFI = 0.99, TLI = 0.97, RMSEA = 0.045, SRMR = 0.035), confirming the appropriateness of the model. Additionally, a mediation analysis with bootstrapping was performed to investigate the indirect effect of self-reflection on the relationship between performance control and CT. These analyses were selected because of their strength in testing direct and indirect effects and their appropriateness in revealing the structural relations at the heart of the study's hypotheses.

4. Findings

4.1. Students' Critical Thinking Proficiency

Table 4 summarizes the preparatory class students' overall CT performance as measured by the CAAP CTT. The findings indicated that the students demonstrated a moderate level of CT aptitude, with a mean score of 64.50 (SD = 5.20) and a median of 66.00. Students were placed at their appropriate CT level based on their scores. More specifically, 20% of the students fell into the category of having "High Critical Thinking," (68-80), 27 % as "Above Average" (65-67), 37% as "Average" (61-64) and 16% as "Low" (40-60). These findings suggest that most students (64%) exhibited average or above-average CT levels. In conjunction with the investigated variables of the study, as illustrated in Table 3, students performed best in Analysis of Arguments (M=65.5), while achieving equal scores in Evaluating Arguments and Analyzing Arguments (M=64.00), indicating students' average to above-average performance in the CT.

Table 4. Students' Level of Critical Thinking

No	Range of Scores	Category of Measurement	N	%
1	68 - 80	High Critical Thinking	30	20%
2	65 - 67	Above Average Critical Thinking	40	27%
3	61 - 64	Average Critical Thinking	55	37%
4	40 – 60	Low Critical Thinking	25	16%
N	Mean	Std. Deviation	Min	Max
150	64.50	5.20	48.00	72.50

4.2. Students' Use of SRL and its Correlation with Critical Thinking

Table 5 reports the descriptive statistics of the participants' SRL strategy use. The results show that the Performance Control component (ability to control and monitor learning strategies during tasks) had the highest mean score (*M* = 3.40, *SD* = 0.39). This was followed by Self-Reflection (*M* = 3.33, *SD* = 0.44), which refers to the evaluation and refinement of strategies after task completion, and Forethought (*M* = 3.25, *SD* = 0.42), which involves planning and goal setting prior to task engagement. The overall SRL (*M* = 3.33, *SD* = 0.38) indicates that students generally engage in high self-regulation practices during their learning processes. The relatively low standard deviations across subscales suggest limited variability, indicating a consistent application of self-regulation strategies across the sample. These findings highlight Performance Control as the most prominent aspect of students' SRL profiles.

Table 5. Students' Use of Self-Regulated Learning Strategies

SRL Component	N	Min	Max	Mean	SD	Cronbach's a
Forethought	150	1.5	4.0	3.25	0.42	0.85
Performance Control	150	1.8	4.0	3.40	0.39	0.87
Self-Reflection	150	1.6	4.0	3.33	0.44	0.84
Overall SRL Score	150	1.7	4.0	3.33	0.38	0.85

A Pearson correlation was performed to explore the relationship between students' SRL strategies and their CT proficiency. The results revealed a strong positive correlation (r =.72, p <.01). According to Cohen's (1988) interpretation, this represents a large effect size, indicating that students who reported greater use of SRL strategies tended to demonstrate significantly higher CT. The same statistical analysis was applied to examine the relationships between the subcomponents of SRL and CT. As demonstrated in Table 6, the findings revealed statistically significant positive correlations across all subscales (p < .01). The Forethought aspect of SRL was moderately correlated with Analysis of Arguments (r = .49), Evaluation of Arguments (r = .44), and Extending Arguments (r = .42), representing medium effect sizes according to Cohen's (1988) interpretation. Performance Control showed strong correlations with Analysis (r = .61), Evaluation (r = .58), and Extension (r = .56), all of which were indicative of large effect sizes. Self-reflection exhibited the strongest associations, particularly with Evaluation of Arguments (r = .62) and Extending Arguments (r = .65), which also reflected large effects, while its correlation with Analysis of Arguments (r = .59) was similarly strong. These results imply that Self-Reflection and Performance Control are especially critical in facilitating CT sub-skills.

Table 6. Correlation Between Subskills of SRL and CT

SRL	CT		
	Analysis	Evaluation	Extension
Forethought	r = .49**	r = .45**	r = .41**
Performance Control	r = .61**	r = .58**	r = .53**
Self-Reflection	r = .58**	r = .63**	r = .65**

Table 7 presents the results of the SEM that was performed to test the effect of SRL on the CT performance of preparatory school students. The analysis indicated a significant and strong standardized path coefficient from SRL to CT (β = 0.75, SE = 0.07, t = 10.71, p < .001), suggesting that higher levels of self-regulation predicted higher CT performance. The model in Table 8 shows an excellent fit to the data, as supported by the fit indices: $\chi^2(8) = 12.36$, $p > .05$, Comparative Fit Index (CFI) = 0.99, Tucker-Lewis Index (TLI) = 0.97, Root Mean Square Error of Approximation (RMSEA) = 0.045, and Standardized Root Mean Square Residual (SRMR) = 0.035. These fit measurements meet and exceed the commonly accepted thresholds, supporting the appropriateness of the model in representing the data structure. Overall, the SEM results provide robust support for the positive effect of SRL strategies on students' CT proficiency.

Table 7. Structural Equation Modeling Results

Path	Standardized Estimate (β)	SE	t-value	p-value
SRL → CT	0.75	0.07	10.71	< .001

Table 8. Model Fit Indices for SEM

Model Fit Index	Value	Recommended Cutoff
χ^2 (df = 8)	12.36	Non-significant (p > .05)
CFI	0.99	≥ .95
TLI	0.97	≥ .95
RMSEA	0.045	≤ .06
SRMR	0.035	≤ .08

4.3. Mediation Analysis of the Effect of Performance Control on CT via Self-Reflection

A bootstrapped mediation analysis was performed to examine whether self-reflection mediated the relationship between Performance Control and CT. The results in Table 9 indicate that Performance Control significantly predicted self-reflection (β = 0.52, p < .001), and self-reflection significantly predicted CT (β = 0.60, p < .001). The direct effect of Performance Control on CT remained significant (β = 0.30, p = .001), but the indirect effect through self-reflection was also significant (β = 0.31, p = .001), with a 95% bootstrap confidence interval [0.21, 0.42] that did not include zero. These results suggest partial mediation, indicating that self-reflection is a key mechanism through which Performance Control enhances students' CT performance.

Table 9. Mediation Analysis

Path	Unstandardized β	SE	t	p
Performance → Self-Reflection	0.52	0.06	8.67	< .001
Self-Reflection → CT	0.60	0.07	8.57	< .001
Performance → CT (direct)	0.30	0.09	3.33	.001
Indirect effect (a × b)	0.31	0.05	—	.001

Note. Bootstrapped 95% confidence interval for the indirect effect = [0.21, 0.41].

The findings of this study showed that Moroccan preparatory school students had a moderate level of CT, with average performance on its subcomponents: Analyzing Arguments, Evaluating Arguments, and Extending Arguments. Regarding SRL strategies, students reported high engagement, most notably in Performance Control, followed by Self-Reflection and Forethought. To explore the relationship between SRLS and CT, Pearson's correlation analysis showed a strong and statistically significant positive correlation between SRL strategies and CT performance (r = .72, p < .001), with moderate to large effect sizes found across the components of SRL and CT, leading to the rejection of the null hypothesis. Based on this correlation, SEM was employed to examine the effect of SRL strategies on CT proficiency. The SEM results confirmed a significant positive path from SRLS to CT (β = 0.75, p < .001), supported by excellent model fit indices (CFI = 0.99, RMSEA = 0.045). To further examine the mechanism underlying this relationship, a bootstrapped mediation analysis was performed, showing that self-reflection significantly mediated the link between Performance Control and CT (indirect effect = 0.31, p = .001), warranting the rejection of the null hypothesis.

5. Discussion

5.1. Critical Thinking Skills

The findings of this study indicate that preparatory class students demonstrated a general average to above-average level of CT (64%). The study proved that the highest aptitude was in the Analysis of Arguments and revealed parallel aptitudes in the Evaluation and Extension of Arguments. These findings suggest that the students exhibited the ability to think critically, similar to previous studies, such as Intan et al. (2024), Abidin and Sulaiman (2024), As'ari and

Suaidi (2023), Hardianti et al. (2023). In the Indonesian context, Hardianti et al. (2023) reported that students had a moderate level of CT skills, as assessed according to the attributes described by Facione and Facione (2013). Consistent findings were reported in an investigation conducted by Intan et al. (2024). Their findings highlighted a moderate level of CT ability through interpretation, analysis, evaluation, inference, explanation, and self-regulation. In another study, Abidin and Sulaiman (2024) argued that students exhibited the ability to think critically by identifying, analyzing, and solving problems, thinking logically, making appropriate decisions, and drawing careful conclusions. These findings are also in harmony with As'ari and Suaidi's (2023) examination of students' CT skills. However, the findings of this study contradict those of previous studies that assessed students' CT skills (Asrowi et al., 2025; Jumariati et al., 2024; Dina et al., 2024). These studies found that most students demonstrated low CT aptitude.

The high ability in the Analysis of Arguments can be explained by the strong Performance Control and Self-Reflection skills demonstrated by the students. Furthermore, the students' level of proficiency in Evaluating and Extending arguments, goes hand in hand with the existing body of literature that emphasizes the significance of argument analysis and evaluation as essential elements of CT (Kerruish, 2025; Halpern, 2014; Jamil et al., 2024; Butt, 2010). This indicates that students possess the ability to use logical reasoning and objective judgment (Ali, 2022; Saputro et al., 2020). In contrast, students' ability to extend arguments reflects their ability to think critically and creatively in complicated scenarios (Le, 2024).

5.2. Relationship Between Self-Regulated Learning and Critical Thinking

This study demonstrated a strong positive correlation between SRL and CT skills among Moroccan preparatory class students ($r = .72$, $p < .01$), representing a large effect size and rejecting the null hypothesis. This finding aligns with existing studies suggesting that SRL learners tend to exhibit autonomy, intrinsic motivation, and active engagement in learning (Jin & Ji, 2021; Knowles, 1975; Lin, 2023). Ghanizadeh and Mirzaee (2012) found self-regulation to be an important positive predictor of CT. This is also supported by Facione and Facione (2013), who stressed that self-reflection is an essential cognitive skill of critical thinkers. Without the ability to control their own learning and cognitive processes, people may find it difficult to develop their CT skills.

This is also reinforced by the Pearson correlation coefficient analysis, which designated statistically significant positive relationships between all SRL and CT subscales ($p < .01$). The analysis indicated that forethought, performance control, and self-reflection were significantly correlated with the evaluation, analysis, and extension of arguments. Notably, Self-Reflection and Performance Control had a strong indirect impact on CT sub-skills, highlighting the importance of monitoring, controlling, and reflecting on learning processes to enhance CT performance. Therefore, developing EFL learners' self-reflection strategies can indirectly enhance their CT ability. Teng (2021) claimed that explicit instruction of SRL strategies, reinforced by social scaffolding, can enhance students' high-order thinking skills. The findings of this study are consistent with social cognitive theory, which suggests that individuals with stronger SRL strategies tend to set learning goals and use cognitive and metacognitive strategies more often, eventually resulting in higher academic achievement (Teng, 2021; Trautner & Schwinger, 2020). Moreover, these findings are in line with previous research showing that self-reflection and performance control strategies influence CT proficiency, with their influence on metacognitive processes (Mohammadi et al., 2020; Mohammadi et al., 2022; Vollinger et al., 2018).

Notably, engaging in metacognitive strategies had a significant and direct effect on CT skills. Therefore, it is necessary for EFL learners to apply SRL strategies to attain a deep understanding and to involve themselves in CT practices throughout the learning process (Morshedian et al., 2016). These findings align with previous studies proving that cognitive and metacognitive strategy deployment is a strong predictor of CT (Bagheri, 2015; Nikoopour et al., 2011). In educational psychology, SRL plays a key role in promoting reflective and active learning, especially in foreign-language learning (Teng & Zhang, 2022). Through self-regulation, reflection, cognition, and metacognition, EFL learners can take an active role in

their learning processes, ultimately achieving learner autonomy, which is widely regarded as the ultimate goal of education (Teng & Zhang, 2022; Zhang & Zhang, 2019). Consequently, fostering these strategic learning processes is vital for enhancing learners' higher-order thinking and reflective practices in language learning and teaching.

Taking into consideration our local context, Moroccan preparatory institutions operate as high-stakes filtering mechanisms where SRL functions less as intellectual autonomy (Sholeh, 2019). Students navigate a linguistic double-bind, processing technical content in French while reasoning internally in Darija or Arabic, which creates cognitive load that complicates the SRL and CT relationship (Chana, 2022). Moreover, self-reflection serves as a "backstage" arena where students privately evaluate ideas while maintaining surface compliance (Preston, 2025). Thus, the strong SRL and CT correlation we observed likely reflects trained alignment with examination criteria rather than genuine inquiry. Consequently, reform efforts must work with, rather than against, these instrumental regulatory strategies.

5.3. Factors Affecting Critical Thinking Skills

SEM analysis revealed the predictive effect of SRL on the CT performance of Moroccan preparatory school students. The analysis indicated a significant and strong standardized path coefficient from SRL to CT ($\beta = 0.75$, SE = 0.07, $t = 10.71$, $p < .001$), suggesting that effective use of self-regulation predicts higher CT performance. The findings suggest that individuals who employ self-regulatory strategies are likely to perform better in CT skills. These findings are in line with previous research that acknowledged the effect of these strategies on the enhancement of CT abilities (Çakici, 2018; Magno, 2010). Magno (2010). In support of this, Ku and Ho (2010) noted that advanced critical thinkers employ various metacognitive strategies. In addition, as students master these strategies, they become more autonomous and self-directed in their learning activities (Djudin, 2017; Zhang, 2016). This effect was also noted by Shamir et al. (2009), who identified that students' CT ability could be enhanced through explicit instruction of SRL strategies. Thus, these complementary skills have sophisticated dynamic processes that require further examination.

In addition, based on the analysis of path coefficients, of the three key constituents of SRL, Self-reflection is the most influential factor when both its direct and indirect impacts are considered. These results highlight the inherent roles of planning, controlling, and reflection as key facets of SRL that require explicit and structured teaching (Zimmerman, 2000). Notably, the components of SRL do not function separately but interactively and sequentially (Teng & Zhang, 2017). In accordance with Bandura's (1986) social cognitive theory, self-regulated learners actively control and guide their learning effectively, and hence, develop their higher-order thinking skills (Schraw et al., 2006; Usher & Schunk, 2018; Zimmerman, 2000). In this respect, Mohammadi et al. (2020) claimed that targeted SRL instruction led to notable improvements in students' problem-solving and CT skills. Drawing on Vygotsky's (1978) concept of the zone of proximal development, it can be inferred that engaging learners in reflective practice activities can enhance their metacognitive and strategic abilities and facilitate the development of learner autonomy (Zhang & Zhang, 2019), which is essential for continuous academic growth.

5.4. Metacognitive Self-Reflection

The findings of the mediation analysis offer strong evidence that self-reflection is an important mediating mechanism in the relationship between performance control and CT, leading to the rejection of the null hypothesis. Performance control significantly predicted self-reflection ($\beta = 0.52$, $p < .001$), which, in turn, significantly predicted CT ($\beta = 0.60$, $p < .001$). Notably, although the direct effect of performance control on CT was still significant ($\beta = 0.30$, $p = .001$), the indirect effect through self-reflection was also significant ($\beta = 0.31$, $p = .001$). These findings highlight the role of self-reflective processes in developing CT skills. Theoretically, this is consistent with the models of Zimmerman (2000) and Greene (2021), who posit that self-reflection is essential for guiding and monitoring cognitive processes related to learning and reasoning.

Additionally, the evidence indicates that students who actively use self-monitoring and evaluative thinking (performance control) are likely to understand and rehearse reflective tendencies, which in turn accounts for more advanced and independent thinking. This view is supported by Phan (2010) and Winne and Hadwin (2010), who claim that performance control as an SRL strategy affects cognitive performance in an academic setting. In this regard, self-reflection does not operate simply as an outcome of self-regulation but as a key factor in the cognitive processes. In addition, the findings of this study extend those of past studies (Phan, 2010; Winne & Hadwin, 2010) by presenting empirical validation of the mechanistic processes whereby performance control affects cognitive performance in academic contexts. Rather than acting as a simple direct predictor, performance control appears to enable CT development by enhancing learners' SRL strategies. In line with Mohammadi et al. 's(2022) findings, self-reflection acts not only as a product of self-regulation but also as a basis for cognitive transformation, as proven in this study.

6. Conclusion

The findings of this study concluded that Moroccan preparatory school students had a moderate level of CT. Regarding SRL strategies, students reported high engagement, most notably in Performance Control, followed by Self-Reflection and Forethought. To explore the relationship between SRLS and CT, Pearson's correlation analysis showed a strong and statistically significant positive correlation between SRL strategies and CT performance ($r = .72$, $p < .001$), with moderate to large effect sizes found across the components of SRL and CT subcomponents. Building on this association, SEM was employed to examine the effects of SRL strategies on CT proficiency. The SEM results confirmed a significant positive path from SRLS to CT ($\beta = 0.75$, $p < .001$), supported by excellent model fit indices (CFI = 0.99, RMSEA = 0.045). To further examine the mechanism underlying this relationship, a bootstrapped mediation analysis was performed, showing that self-reflection significantly mediated the link between Performance Control and CT (indirect effect = 0.31, $p = .001$).

Limitations

This study had some limitations that need to be acknowledged. It relied on quantitative measurement, which might have been triangulated with qualitative measurement to examine students SRL strategies in detail. The integration of focus-group discussions and interviews may have provided deeper insights. Moreover, the study focused on three basic components of SRL (forethought, performance control, and self-reflection) but did not consider other aspects, such as emotional, social, cultural, and environmental factors. Recommendations drawn from the findings of this study suggest the need to study other variables that are relevant to students' CT skills and SRL strategies to analyze internal and external factors together.

Implications and Recommendations

This study has significant implications for educators and students in the EFL context. This emphasizes the need to enhance teachers' awareness of the necessity to develop students' SRL strategies within EFL classes. To be more specific, it is highly advisable that EFL instructors incorporate explicit instruction on the effective application of SRL strategies in their classes. By enabling students to assume responsibility for planning, monitoring, and reflecting on their learning processes, instructors can develop self-regulated learners who are more likely to become independent critical thinkers. Additionally, instructional interventions aimed at developing CT should not be solely based on outcome-driven assessments. Instead, educators should deliberately incorporate structured self-reflective activities, such as reflective journals, think-aloud protocols, reflective discussions, and reflective writing, to develop metacognitive awareness and promote learner autonomy. Consequently, developing active, strategic, and self-regulated skills helps students succeed academically and professionally.

Future research should adopt longitudinal designs to trace how SRL and CT co-develop over the preparatory cycle. Additionally, experimental studies could test targeted interventions to determine whether explicit SRL scaffolding can shift students from instrumental exam preparation toward genuine analytical independence. For educators and policymakers, our findings suggest integrating metacognitive strategy instruction into existing subject teaching rather than treating CT as an add-on course, with particular attention to leveraging self-reflection as a culturally viable entry point for analysis within Morocco's high-pressure examination context. Teacher training programs should equip instructors with tools to recognize and nurture regulatory strategies in real-time, while curriculum designers might reconsider the cognitive burden of French-medium instruction, potentially developing reflective protocols in students' primary languages to reduce linguistic load and deepen evaluative thinking.

Conflict of Interest Statement

The authors declare that there is no conflict of interest.

Declaration of Generative AI and AI-assisted Technologies

This manuscript was prepared with the assistance of Generative AI (Grammarly and Paperpal). The AI was used to assist in language refinement. All intellectual contributions, critical analyses, and final revisions were conducted by the authors. The authors take full responsibility for the accuracy, originality, and integrity of the content presented in this work.

References

Abdullah, F. N., Kirom, A., & Ali, M. (2025). Islamic neurofeedback: Measurement of brain activity in Dhikr meditation for the development of the concept of self-regulated learning. *Al-Dirasah: Jurnal Pendidikan Islam*, *1*(2), 38-49. https://doi.org/10.47731/aldirasah.v1n2.2025.5

Abidin, Z., & Sulaiman, F. (2024). The effectiveness of problem based learning on students' ability to think critically. *Zabags International Journal of Education*, *2*(1), 1–6. https://doi.org/10.61233/zijed.v2i1.13

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for teaching students to think critically: A metaanalysis. *Review of educational research, 85(2), 275–314. https://doi.org/10.3102/0034654314551063*

ACT. (2015). ACT CAAP guide to successful general education outcomes assessment. Retrieved from www.act.org/content/dam/act/unsecured/documents/4914ACT_CAAP_Guide-Web.pdf.

Akcaoğlu, M. Ö., Mor, E., & Külekçi, E. (2023). The mediating role of metacognitive awareness in the relationship between critical thinking and self-regulation. *Thinking skills and creativity*, 47, 101187. https://doi.org/10.1016/j.tsc.2022.101187

Al Aziz, S., Fauzan, A., & Helma, H. (2023). Computational thinking analysis of 21st century professional teacher candidates in solving math problems viewed from the four foundations of CT. *Jurnal Eksakta Pendidikan (JEP)*, *7*(2), 211-224. https://doi.org/10.24036/jep/vol7-iss2/779

Ali, I. I. (2022). Logical inferences according to the cognitive development model among preparatory school students. *International Journal of Health Sciences (IJHS)*, *59–72*. https://doi.org/10.53730/ijhs.v6nS9.12170

Al-Rasheedi, S. R., & El-Zraigat, I. A. (2025). the impact of using the flipped classroom model in developing gifted students' self-regulated learning skills and motivation toward their academic achievement in the State of Kuwait. *Jordanian Educational Journal*, *10*(3), 68-92. https://doi.org/10.46515/jaes.v10i3.1563

Arvatz, A., Peretz, R., & Dori, Y. J. (2025). Self-regulated learning and reflection: A tool for teachers and students. Metacognition *and Learning*, *20*(1), 1-24. https://doi.org/10.1007/s11409-025-09415-3

Arvatz, A., Peretz, R., & Dori, Y. J. (2025). Self-regulated learning and reflection: A tool for teachers and students. Metacognition and Learning, 20(1), 15. https://doi.org/10.1007/s11409-025-09415-3

As'ari, A., & Suaidi, A. (2023). Students' critical thinking skills perform in debate activities. *Journal of English Language Teaching and Cultural Studies*, 6(1), 55–64. https://doi.org/10.48181/jelts.v6i1.17491

Asrowi, A., Maulana, I., Budiarto, M. K., & Qodr, T. S. (2025). Assessing critical thinking skills in vocational school students during hybrid learning. *Journal of Education and Learning*, *19*(1), 232–240. https://doi.org/10.11591/edulearn.v19i1.21754

Ba, Y., Ming, W., & Zhang, H. (2025). Unlocking academic success: How growth mindset interventions enhance student performance through self-belief and effort regulation. *Acta Psychologica*, 256, 104977. https://doi.org/10.1016/j.actpsy.2025.104977

Bagheri, F. (2015). The relationship between critical thinking and language learning strategies of EFL learners. *Journal of Language Teaching and Research,* 6(5), 969–975. https://doi.org/10.17507/jltr.0605.08

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall. https://doi.org/10.5465/amr.1987.4306538

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International journal of educational research*, *31*(6), 445-457. https://doi.org/10.1016/s0883-0355(99)00014-2

Brockbank, A., & McGill, I. (2006). *Facilitating reflective learning through mentoring & coaching*. Kogan Page Publishers.

Butt, N. (2010). *Argument construction, argument evaluation, and decision-making: A content analysis of argumentation and debate textbooks.* Wayne State University.

Çakici, D. (2018). Metacognitive awareness and critical thinking abilities of pre-service EFL teachers. *Journal of Education and Learning, 7*(5), 116–129. https://doi.org/10.5539/jel.v7n5p116

Chana, S. M. (2022). Moroccan CPGE students' critical thinking skills and learning approaches: The case of Moulay Ismail CPGE Classes. *International Journal of Linguistics Studies*, 2(2), 73–81. https://doi.org/10.32996/ijls.2022.2.2.1

Chen, X., Zhao, H., Jin, H., & Li, Y. (2024). Exploring college students' depth and processing patterns of critical thinking skills and their perception in argument map (AM)-supported online group debate activities. *Thinking Skills and Creativity*, *51*, 101467. https://doi.org/10.1016/j.tsc.2024.101467

Cleary, T., Zhang, R., Russo, M. R., & Slemp, J. (2025). A systematic review of the self-regulation strategy inventory (SRSI): Uses, applications and psychometric characteristics. *School psychology review*, *54*(3), 343-362. https://doi.org/10.1080/2372966x.2024.2344107

Cohen, J. (1988). Set correlation and contingency tables. *Applied psychological measurement*, *12*(4), 425-434.

Dent, A. L., & Koenka, A. C. (2016). The relation between self-regulated learning and academic achievement across childhood and adolescence: A meta-analysis. *Educational psychology review*, 28(3), 425-474. https://doi.org/10.1007/s10648-015-9320-8

Dewey, J. (1933). Why have progressive schools? *Current History,* 38(4), 441–448. https://doi.org/10.1525/curh.1933.38.4.441

Dina, T. F., Prahani, B. K., Marianus, M., Wibowo, F. C., & Sanjaya, L. A. (2024). Critical thinking skills student profile and PBL needs assisted by android physics module. *Momentum: Physics Education Journal*, *8*(1), 11-22. https://doi.org/10.21067/mpej.v8i1.9059

Djudin, T. (2017). Using metacognitive strategies to improve reading comprehension and solve a word problem. Journal of Education, *Teaching and Learning*, 2(1), 124–129. https://doi.org/10.26737/jetl.v2i1.151

Ennis, R. (2011). Critical thinking: Reflection and perspective Part II. Inquiry: Critical thinking across the Disciplines, 26(2), 5–19. https://doi.org/10.5840/inquiryctnews201126215

Facione, P. A. (1990). Critical *thinking: A statement of expert consensus for purposes of educational assessment and instruction. research findings and 247 recommendations*. Newark, DE: American Philosophical Association.

Facione, P. A., & Facione, N. C. (2013). Critical thinking for life: Valuing, measuring, and training critical thinking in all its forms. *Inquiry: Critical thinking across the disciplines*, *28*(1), 5-25. https://doi.org/10.5840/inquiryct20132812

Ghanizadeh, A., & Mirzaee, S. (2012). EFL learners' self-regulation, critical thinking and language achievement. *International Journal of Linguistics, 4*(3), 451–468. https://doi.org/10.5296/ijl.v4i3.1979

Greene, J. A. (2021). Teacher support for metacognition and self-regulated learning: A compelling story and a prototypical model. *Metacognition and Learning*, *16*(3), 651-666. https://doi.org/10.1007/s11409-021-09283-7

Halpern, D. F. (2014). *Thought and* knowledge: *An introduction to critical thinking (5th ed)*. Psychology Press.

Hardianti, H., Jabu, B., & Salija, K. (2023). Students' critical thinking skills in writing analytical exposition text. *ELT Worldwide: Journal of English Language Teaching*, *10*(2), 250. https://doi.org/10.26858/eltww.v10i2.52992

Intan, N., Ismail, I., & Susanah, S. (2024). Critical thinking skills of junior high school students in solving congruence problems based on mathematical abilities. *MATHEdunesa*, *13*(2), 350–366. https://doi.org/10.26740/mathedunesa.v12n2.p450-468

Jamil, M., Bokhari, T. B., & Ahmad, D. (2024). Evaluation of critical thinking elements: A qualitative content analysis of physics textbook grade IX. *Qlantic Journal of Social Sciences*, *5*(1), 344-350. https://doi.org/10.55737/qjss.337110358

Jin, M., & Ji, C. (2021). The correlation of metacognitive ability, self-directed learning ability and critical thinking in nursing students: A cross-sectional study. *Nursing open*, *8*(2), 936-945. https://doi.org/10.1002/nop2.702

Jumariati, J., Nasrullah, N., Sutiono, C., & Utomo, M. K. (2024). A study on EFL students' levels of critical thinking skills. *Celtic: A Journal of Culture, English Language Teaching, Literature and Linguistics*, *11*(2), 215-231. https://doi.org/10.22219/celtic.v11i2.33113

Kerruish, E. (2025). Critical thinking in higher education: Taking Stiegler's counsel on the digital milieu. *Pedagogy, culture & society*, *33*(1), 1-17. https://doi.org/10.1080/14681366.2023.2183983

Khalil, A., Hellalet, N., & Outamgharte, B. (2025). Investigating Moroccan EFL teachers' critical thinking attitudes: The impact of teaching experience and gender. *Thinking Skills and Creativity*, *56*, 101746. https://doi.org/10.1016/j.tsc.2024.101746

Knowles, M. S. (1975). *Self-directed learning* (Vol. 291). New York: Association press.

Ku, K. Y., & Ho, I. T. (2010). Metacognitive strategies that enhance critical thinking. *Metacognition and learning, 5*(3), 251–267. https://doi.org/10.1007/s11409-010-9060-6

Kuhn, D. (2019). Critical thinking as discourse. *Human Development,* 62(3), 146–164. https://doi.org/10.1159/000500171

Landrum, T. J. (2022). A strong foundation: A scientific frame of mind for evidence-based practices. In *Revitalizing Special Education* (pp. 79-92). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80117-494-720221004

Le, T. L. (2024). The role of critical thinking in secondary education. *Vinh University Journal of Science*, *53*(Special Issue 2), 165–173. https://doi.org/10.56824/vujs.2024.htkhgd208

Lin, Z. (2023). Why and how to embrace AI such as ChatGPT in your academic life. *Royal Society Open Science*, *10*(8), 230658. https://doi.org/10.1098/rsos.230658

Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and learning, 5*(2), 137–156. https://doi.org/10.1007/s11409-010-9054-4

Mewborn, D. S. (1999). Reflective thinking among preservice elementary mathematics teachers. *Journal for research in mathematics education*, *30*(3), 316-341. https://doi.org/10.2307/749838

Miatun, A., & Khusna, H. (2020). Pengaruh geogebra online berbasis scaffolding dan tingkat self-regulated learning terhadap kemampuan berpikir kritis. *PYTHAGORAS: Jurnal Matematika dan Pendidikan Matematika*, *15*(2), 124-136. https://doi.org/10.21831/pg.v15i2.34499

Mohammadi, R. R., Saeidi, M., & Ahangari, S. (2020). Self-regulated learning instruction and the relationships among self-regulation, reading comprehension and reading problem solving: PLS-SEM approach. *Cogent Education, 7*(1), 1–22. https://doi.org/10.1080/2331186x.2020.1746105

Mohammadi, R., Saeidi, M., & Ahangari, S. (2022). The effect of self-regulated learning instruction on reading comprehension and critical thinking: PLS-SEM approach. *Journal of School Psychology, 11*(2), 51–61. https://doi.org/10.1080/2331186x.2020.1746105

Moon, J. (2007). *Critical thinking: An exploration of theory and* practice. Routledge.

Morshedian, M., Hemmati, F., & Sotoudehnama, E. (2016). Training EFL learners in self-regulation of reading: Implementing an SRL model. *Reading & Writing Quarterly, 33*(3), 290–303. https://doi.org/10.1080/10573569.2016.1213147

Munahefi, D. N., Kartono, Waluya, B., & Dwijanto. (2022). Analysis of self-regulated learning at each level of mathematical creative thinking skill. *Bolema: Boletim de Educação Matemática*, *36*(72), 580-601. https://doi.org/10.1590/1980-4415v36n72a26

NACE. (2017). *Educational leadership* job *outlook 2018*. NACE. https://www.lander.edu/sites/lander/files/Documents/student_life/2018-nace-job-outlook.pdf.

Nambiar, D., Alex, J., & Pothiyil, D. I. (2022). Development and validation of academic self-regulated learning questionnaire (ASLQ). *International Journal of Behavioral Sciences*, *16*(2), 89-95. https://doi.org/10.30491/IJBS.2022.321176.1730

Nanda, A. D., Hasan, R., Sukri, A., Lukitasari, M., & Rivera, A. T. (2023). Reinforcement analyze and evaluate higher-order thinking skills using problem-based learning in ecosystem material. *Journal of Biological Education Indonesia*, *9*(3), 492-499. https://doi.org/10.22219/jpbi.v9i3.28604

National Research Council, Division of Behavioral, Social Sciences, Board on Science Education, & Committee on a Conceptual Framework for New K-12 Science Education Standards. (2012). A framework for K-12 science education: Practices, crosscutting concepts, and core ideas. *National Academies Press. https://doi.org/10.17226/13165*

Nikoopour, J., Farsani, M. A., & Nasiri, M. (2011). On the relationship between critical thinking and language learning strategies among Iranian EFL learners. *Journal of Technology Education, 5*, 3.

Paul, R., & Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of developmental education,* 30(2), 34.

Pereles, A., Ortega-Ruipérez, B., & Alcalde, M. L. (2024). The power of metacognitive strategies to enhance critical thinking in online learning. *Journal of Technology and Science Education*, *14*(3), 831. https://doi.org/10.3926/jotse.2721

Phan, H. P. (2010). Critical thinking as a self-regulatory process component in teaching and learning. *Psicothema, 22*(2), 284–292.

Preston, D. (2025). Explicating the inexplicable: Post-rationalization as a sensemaking strategy for self-regulated learning in design. *Art, Design and Communication in Higher Education,* 2(2), 73–81. https://doi.org/10.1386/adch_00115_1

Rita, N. N., & Henrieta, N. O. (2025). Student's self-regulatory skills as correlate of their academic achievement in biology in public secondary schools in Anambra state. *UNIZIK Journal of STM Education*, *8*(2), 180-191. https://journals.unizik.edu.ng/jstme/article/view/6582

Saputro, S. D., Tukiran, Z. A. I. S., Rohmah, N., Setyawati, N., & Faozi, R. (2020). Critical thinking activities through reasoning tasks towards cognitive achievements. *Universal Journal of Educational Research*, *8*(12B), 8149-8158. https://doi.org/10.13189/ujer.2020.082618

Sarwar, S., Tara, A. N., Abid, M. N., & Dukhaykh, S. (2025). Teachers' academic motivation and student procrastination behaviour: mediating effects of emotion regulation and study habits. *BMC psychology*, *13*(1), 52. https://doi.org/10.1186/s40359-025-02352-5

Schön, D. (1983). *The reflective practitioner: How professionals think in action*. New York: Basic Books. https://doi.org/10.2307/j.ctvpbnpjg.24

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36*(1–2), 111–139. https://doi.org/10.1007/s11165-005-3917-8

Schunk, D. H., & Mullen, C. A. (2013). Toward a conceptual model of mentoring research: Integration with self-regulated learning. *Educational Psychology Review*, *25*(3), 361-389. https://doi.org/10.1007/s10648-013-9233-3

Scott, W. (2003). Participant observation research: A deconstruction of researcher-participant relationship. *Education research and perspectives*, *30*(1), 94-104. https://search.informit.org/doi/10.3316/informit.044766213568062

Setiyawan, A. A., Agoestanto, A., & Isnarto, I. (2024). Enhancing self-regulated learning and critical thinking in STEM through flipped classroom models. *Jurnal Elemen*, *10*(2), 341-362. https://doi.org/10.29408/jel.v10i2.25322

Shamir, A., Mevarech, Z. R., & Gida, C. (2009). The assessment of meta-cognition in different contexts: individualized vs. peer assisted learning. *Metacognition and Learning*, *4*(1), 47-61. https://doi.org/10.1007/s11409-008-9032-2

Shaw, D., & Satalkar, P. P. (2018). Researchers' interpretations of research integrity: A qualitative study. *Accountability in Research*, *25*(2), 79–93. https://doi.org/10.1080/08989621.2017.1413940

Sholeh, A. (2019). Self-Regulated Learners in Voluntary Reading: The effects and Implications on EFL Reading Classes. *Journal for the Education of Gifted Young Scientists*, *7*(4), 867–883. https://doi.org/10.17478/JEGYS.621021

Sukardi, M. A., Tahbaria, R. N., & Maelani, U. (2025). Analysis of critical thinking skills and learning independence of elementary school students. *MIREJ: Multidisciplinary Innovation Research Journal*, *1*(1). https://doi.org/10.70152/mirej.v1i1.17

Sun, D., Xu, P., Zhang, J., Liu, R., & Zhang, J. (2025). How self-regulated learning Is affected by feedback based on large language models: Data-driven sustainable development in computer programming learning. *Electronics*, *14*(1), 194. https://doi.org/10.3390/electronics14010194

Susanti, E., & Purbandari, R. D. (2024). The influence of guided discovery learning assisted by fractional wheels and learning motivation on improving the critical thinking skills of grade V students at SD Negeri 1 Dagan Purbalingga. *In Proceedings of the 1st International Conference on Social Science (ICSS)* (Vol. 3, No. 1, pp. 206-218). https://doi.org/10.59188/icss.v3i1.183

Teng, L. S. (2021). Individual differences in self-regulated learning: Exploring the nexus of motivational beliefs, self-efficacy, and SRL strategies in EFL writing. *Language Teaching Research, 1–23. https://doi.org/10.1177/13621688211006881*

Teng, L. S., & Zhang, L. J. (2017). Effects of motivational regulation strategies on writing performance: A mediation model of self-regulated learning of writing in English as a second/foreign language. *Metacognition and Learning*, 13(2), 213–240. https://doi.org/10.1007/s11409-017-9171-4

Trautner, M., & Schwinger, M. (2020). Integrating the concepts self-efficacy and motivation regulation: How do self-efficacy beliefs for motivation regulation influence self-regulatory success? *Learning and Individual Differences, 80*, Article 101890. https://doi.org/10.1016/j.lindif.2020.101890

Usher, E. L., & Schunk, D. H. (2018). Social cognitive theoretical perspective of self-regulation. In D. H. Schunk, & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 19–35). New York: Routledge/Taylor & Francis. https://doi.org/10.4324/9781315697048-2

Vincent-Lancrin, S. (2024). Critical thinking. In *Elgar* Encyclopedia *of Interdisciplinarity and Transdisciplinarity* (pp. 124-128). Edward Elgar Publishing. https://doi.org/10.4337/9781035317967.ch27

Vollinger, ¨ V. A., Sporer, ¨ N., Lubbe, D., & Brunstein, J. C. (2018). A path analytic test of the reading strategies mediation model: Relating cognitive competences and motivational influences to individual differences in fifth-grade students' reading comprehension. *The Journal of Educational Research, 111*(6), 733–745. https://doi.org/10.1080/00220671.2017.1412930

Widana, I. W. (2022). Meta-analysis: The relationship between self-regulated learning and mathematical critical reasoning. Education. *Innovation. Diversity*, 1(4), 64–75. https://doi.org/10.17770/eid2022.1.6739

Winne, P. H., & Hadwin, A. F. (2010). Self-regulated learning and socio-cognitive theory. In P. Penelope, B. Eva, & B. McGaw (Eds.), *International encyclopedia of education* (pp. 503–508). Oxford, England: Elsevier. https://doi.org/10.1016/b978-0-08-044894-7.00470-x

Xiang, Y. (2024). The cultivation of critical thinking skills of college students in English classroom. *Region - Educational Research and Reviews*, 6(5), 81. https://doi.org/10.32629/rerr.v6i5.2143

Yani, F., & Miatun, A. (2024). Self-regulated learning and mathematical anxiety in relation to critical thinking ability. *Lectura: Jurnal Pendidikan,* 15(2), 470–483. https://doi.org/10.31849/lectura.v15i2.20571

Yazdani, H., & Sadeghi, M. (2022). A comparative study on the effects of digitally self-regulated and guided discovery learning instructions on EFL learners' vocabulary acquisition. *Applied Research on English Language*, 11(4), 25-46.

Zhang, D., & Zhang, L. J. (2019). Metacognition and self-regulated learning (SRL). In X. A. Gao (Ed.), *Second handbook of English language teaching* (pp. 883–898). Cham: Springer. https://doi.org/10.1007/978-3-030-02899-2_47

Zhang, L. J. (2016). A dynamic metacognitive systems perspective on language learner autonomy. In R. Barnard, & J. Li (Eds.), *Language learner autonomy: Teachers' beliefs and practices in east Asian contexts* (pp. 150–166). Phnom Penh: IDP Education. https://doi.org/10.5746/leia/la_asia

Zimmerman, B. J. (2000). Attainment of self-regulated learning: A social cognitive perspective. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of selfregulation: Research and applications* (pp. 13–39). Orlando, FL: Academic Press.