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Collaborative Strategy Integrating School Environment and Self-Efficacy for Strengthening Metacognitive Competence and Learning Independence

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Abstract

This study examines the influence of the school environment on students' independent learning, with self-efficacy and metacognitive skills functioning as sequential mediators among senior high school students in Malaka Regency. Employing an explanatory survey design, data were collected from Grade XI students across six purposively selected schools representing twelve districts. The structured questionnaire comprised 41 items measured on a 5-point Likert scale and assessed four constructs: school environment, self-efficacy, metacognitive skills, and independent learning. Data analysis was conducted using the PROCESS Macro (Model 6) in SPSS 23. The results indicate that the school environment has a significant effect on self-efficacy ($\beta = 0.2137, p = 0.0017$) and independent learning ($\beta = 0.1794, p = 0.0066$), whereas its influence on metacognitive skills is not significant ($\beta = -0.0241, p = 0.7542$). Additionally, self-efficacy does not significantly affect metacognitive skills ($\beta = 0.1354, p = 0.0731$) or independent learning ($\beta = -0.0125, p = 0.8468$). In contrast, metacognitive skills exert a significant positive influence on independent learning ($\beta = 0.2365, p = 0.0001$). The total effect of the school environment on independent learning remains significant ($\beta = 0.1779, p = 0.0077$), although the indirect effects through the mediating variables are not statistically significant. These findings suggest that a supportive and well-structured school environment directly enhances students' independent learning more effectively than indirect psychological pathways. It is recommended that educational institutions further strengthen their learning environments and incorporate metacognitive skill development to promote students' self-regulation and autonomy.

Keywords: Metacognitive Skill, School Environment, Self-Efficacy, Students' Independent Learning.

1. Introduction

The rapid advancement of technology and information in the digital era has generated substantial transformations across multiple spheres of life, including the economic, educational, and sociocul-

tural sectors [1, 2, 3]. Advanced technologies such as Artificial Intelligence (AI) [4] and the Internet of Things (IoT) [5] have helped improve the quality of education. In the economic sector, technologies such as big data [6] and non-cash and cardless payment systems [7] play a crucial role in facilitating economic activity. In the social sector, the application of telemedicine in healthcare [8] and crowdsourcing for public welfare [9] have opened up broader access to healthcare services and social initiatives. These technological developments have facilitated access to information, accelerated work processes, and created new opportunities [10]. However, these advances also present significant challenges, particularly in the economic sector, which is characterized by the increasing need for a workforce with specialized skills and the ability to adapt quickly to technological change. Therefore, the presence of high-quality human resources (HR) who possess not only technical expertise but also well-developed critical thinking skills constitutes a crucial factor in responding to the evolving dynamics and demands of change [11].

In addition to technical competencies, human resources with strong character and integrity are essential to keep pace with the rapid advancement of technology [12]. These traits include self-awareness, self-confidence, independence, emotional intelligence, flexibility, adaptability, stress tolerance, creativity, initiative, willingness to learn, reflective nature, lifelong learning, and professional behavior [13]. Strong character not only helps individuals adapt to ever-evolving technology but also ensures that technology is used responsibly and in alignment with positive goals. In this context, qualified and characterful human resources are able to optimally utilize technology to achieve more effective and efficient work results.

Beyond mere optimization, high-quality human resources with strong character are essential for driving sustainable progress. Such individuals are capable not only of initiating and implementing innovations that yield short-term benefits, but also of generating positive long-term impacts [14]. The integration of technical competencies with robust character development constitutes the primary foundation for addressing global challenges while ensuring that technology is utilized to enhance societal welfare.

In the educational context, the affective domain plays a critical role, particularly within the implementation of the Outcome-Based Education (OBE) curriculum and the Merdeka Belajar–Kampus Merdeka (Independent Learning–Independent Campus) policy. These two initiatives emphasize not only cognitive and psychomotor competencies but also prioritize the cultivation of character and affective values. Consequently, the curriculum is designed to develop individuals who possess strong technical expertise while simultaneously upholding positive moral and ethical values, enabling them to confront future challenges effectively [15].

Character development is an integral component of efforts to prepare resilient and adaptive human resources amid dynamic global changes. Within the OBE framework, assessment does not solely measure academic learning outcomes but also evaluates students' attitudes, values, and moral reasoning. A similar orientation is evident in the Independent Learning–Independent Campus policy, which provides students with opportunities for holistic development, including affective competencies that contribute to character formation [16]. Education that prioritizes affective development is therefore expected to produce a generation better equipped to contribute positively to society. One of the character attributes currently receiving particular emphasis is independence, which is essential in fostering lifelong learning and facilitating effective online learning environments [17, 18].

Independent learning has proven to be an effective solution to various educational challenges across both formal and non-formal settings. Empirical studies demonstrate that independent learning significantly enhances academic achievement in face-to-face as well as online learning contexts [19, 20]. This improvement is attributable to the active role students assume in regulating their own

learning processes, which subsequently strengthens learning outcomes. Moreover, independence fosters metacognitive skills—namely, the ability to reflect upon and regulate one’s cognitive processes—which are crucial for improving learning effectiveness [21].

Independent learning also prepares students for higher levels of education and equips them to confront increasingly complex challenges [22]. In the professional domain, independence serves as a foundational skill, as evidenced in medical and health education, where self-directed learning contributes to improved clinical performance. Students who develop independence in learning tend to acquire more advanced competencies in clinical practice [23, 24]. In addition, independent learning positively influences mental health and personality development. [25] explain that independent learners tend to be more resilient, capable of overcoming challenges, and better at exercising self-regulation. Such independence supports the formation of positive habits—including reading, writing, and effective communication—that are vital in both academic and professional contexts [26, 27, 28]. Thus, fostering independent learning not only enhances academic performance but also contributes to character formation and the development of essential life skills.

Based on the above discussion, it is evident that character development—particularly learning independence—has a significant influence on educational outcomes and related dimensions. However, one of the key challenges facing education in Indonesia is the generally low level of learning independence among students. This issue has been documented through various data and empirical observations, including field evidence from students in Kupang City. The findings are as follows:

Table 1. Data on Indicators of Learning Independence Level

Learning Independence Indicators	Indicator Scale
Learning Motivation	47
Planning and Implementation	32
Self-Control	27
Interpersonal Communication	39
Source: Google Form, 2024	

As shown in Table 1, the overall level of students’ learning independence remains relatively low. This is evident from the scores obtained across all indicators, each of which falls within the low category. Further confirmation was obtained through interviews with several students. For example, TS and RG indicated that the primary challenges in developing learning independence are related to self-regulation and the implementation of planned learning activities. They reported frequent distractions caused by activities such as using mobile phones, playing online games, browsing social media, and socializing with friends, all of which impede their learning processes.

These findings align with previous research demonstrating that online gaming and excessive social media use can diminish students’ learning independence [29]. Studies also highlight additional contributing factors, including reduced motivation [29] and various indicators such as motivation [30], self-control [31], planning and implementation [32].

The substantial impact of independent learning should motivate various stakeholders to actively cultivate human resources with strong self-directed learning capacities. In light of this situation, the researchers deem it necessary to conduct a more in-depth investigation into the factors that influence learning independence and the strategies that can effectively enhance it. This study is intended not only to deepen understanding of the phenomenon of independent learning but also to provide a scientific foundation for the development of more effective educational policies, both by the government and other relevant stakeholders.

Accordingly, the primary focus of this research is to comprehensively examine the interactions and components that contribute to the development of students' independent learning skills. The concept of Self-Regulated Learning (SRL) was first introduced by Albert Bandura, who defined it as a process in which individuals actively direct and regulate their own learning through the use of cognitive and metacognitive strategies [33]. Bandura further explained that SRL emerges from the reciprocal interaction among personal factors, behavioral patterns, and environmental influences. A detailed explanation of these components is presented in Figure 1.

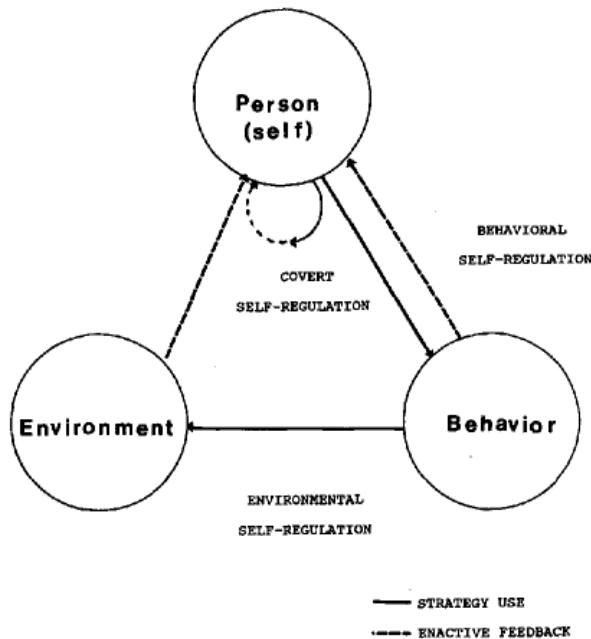


Figure 1. A triadic analysis of self-regulated functioning [34]

Based on Figure 1, a Triadic Analysis of Self-Regulated Functioning, there are three main aspects that shape self-regulation. First, personal factors (Person), which play a crucial role in shaping an individual's perspective, interpreting situations, and responding to challenges [35]. Second, environmental factors (Environment), which act as a medium that provides a variety of content and interactions that shape individual experiences and values [36]. controlling actions, emotions, and thoughts to achieve predetermined personal goals [37]. Through this analysis, it can be seen that the research focus is more on environmental and personal factors, both of which have a big influence on the formation of independent learning. Finally, the third aspect is behavior, where after personal factors and the environment, individuals behave as they are affected by the first and the second factors.

Regarding environmental factors [34] explains that, under certain conditions, the environment may serve as a dominant determinant in shaping independent learning. A supportive environment—whether within the family, school, university, or broader community—can encourage individuals to engage more actively in self-directed learning. This support becomes effective when interactions within the environment are characterized by intensity, mutual trust, effective communication, and consistent reciprocal reinforcement. For example, lecturers who provide continuous guidance or academic environments that facilitate student collaboration can create a motivating and supportive climate. Thus, a conducive environment not only promotes the formation of independent learning habits but

also strengthens students' self-confidence and autonomy in acquiring knowledge [38].

A similar dynamic applies to personal factors, in which an individual's inherent characteristics play a critical role in fostering independent learning. Key components of this dimension include self-efficacy, metacognitive abilities, and the capacity to uphold personal principles and values. Individuals with high self-efficacy possess a strong belief in their ability to accomplish tasks and achieve goals independently. Well-developed metacognitive skills enable learners to actively monitor and evaluate their learning processes, identify strengths and weaknesses in the strategies employed, and adjust their approaches to enhance learning effectiveness. Moreover, individuals with resilient personalities are better equipped to manage their emotions, establish clear personal objectives, and overcome challenges without excessive dependence on external support. In this regard, personal factors significantly contribute to an individual's capacity to effectively regulate and manage their own independent learning [39].

Based on the description above, it can be seen that the environment plays a vital role. As a dynamic academic space, the university provides various activities within the environment, such as learning, competency development, interventions (regulations), and assessments, encouraging independent learning in students [40]. In addition to providing various activities, the university also strengthens values and experiences through various interactions in the learning process [41]. Lastly, the university also provides real examples in the process and figures so that they can become role models and real learning for students [42]. Based on the above explanation, it can be understood that if interactions within the university environment are well established (based on mutual trust, effective communication, and mutual support), students will feel more motivated and helped to take the initiative in their learning process, thus encouraging the creation of independent learning [43].

Apart from environmental factors, personal factors also have an equally important role in forming independent learning, especially the aspect of self-efficacy. Self-efficacy is a major aspect of personal factors [44]. High self-efficacy enables students to more easily understand material and complete assignments and achieve academic goals independently [45]. In addition, with good self-efficacy, students can overcome existing challenges [46] they will be more motivated to take the initiative in learning [47]. Thus, self-efficacy contributes greatly to building independence in learning because it provides understanding and confidence so that students are able to manage the learning process according to their own abilities [48].

In addition to self-efficacy, metacognitive skills also play a crucial role in fostering independent learning. Metacognition refers to a person's ability to understand, monitor, and regulate their thinking processes and the strategies they use in learning. Students who have good metacognitive skills can plan and adjust various aspects needed in the learning process [49]. In addition, metacognition can also help students in the process of monitoring and evaluating learning, thereby helping the independent learning process [50, 51]. Finally, metacognition can help students learn more flexibly and can help students in the process of understanding new things so they can be more independent [52]. Based on this explanation, it can be seen that this ability enables them to more effectively overcome various difficulties that arise in the learning process, optimize their knowledge acquisition, and remain focused on their learning goals. Therefore, metacognition is a crucial aspect in facilitating independent learning, as it encourages students to think critically and reflectively about their learning [53].

The foregoing explanation is consistent with findings from numerous empirical studies that examine how learning independence is developed. Several studies indicate that the school environment and the interactions that occur within it have a positive and significant influence on the formation of independent learning [54, 55]. Similar evidence applies to self-efficacy and metacognition. Self-efficacy constitutes a critical personal factor that supports the development of independent learning

[56, 57, 58]. whereas metacognitive competence contributes to optimizing students' ability to manage and direct their learning processes autonomously [59, 60]. Despite the extensive body of research on learning autonomy, self-efficacy, and metacognitive competence, relatively few studies have explored the integrated interaction between self-efficacy and the school environment, particularly in relation to region-specific conditions. This gap is especially relevant in Malaka Regency, a border region characterized by challenging educational circumstances, including limited facilities, restricted access, and variations in the quality of learning.

This study underscores the importance of self-directed learning not merely as an attitudinal construct but also as a fundamental component in cultivating high-quality, critical, and globally competitive human resources. Understanding, promoting, and strengthening self-directed learning is essential for developing both educational dimensions and student character in a comprehensive manner. Furthermore, self-directed learning offers a holistic and collaborative approach that involves synergistic efforts among schools, families, and communities in fostering character development and academic competence among high school students in Malaka Regency.

Accordingly, this study posits that enhancing self-directed learning contributes not only to improved academic achievement but also to the development of adaptive, creative, and responsible character traits. Unlike previous research, which often focuses on isolated variables, the present study highlights the integration of multiple stakeholders to enhance educational effectiveness, particularly in border areas where access to education remains a significant challenge. The focus on Self-Regulated Learning (SRL) within the local context represents a novel contribution toward the development of more adaptive and contextually relevant learning strategies.

Furthermore, this study aims to analyze the influence of self-efficacy and the role of the school environment in strengthening learning autonomy and metacognitive competence among high school students in Malaka Regency, particularly in border areas, while also examining the interaction between the two in shaping effective self-regulated learning. In addition, the study seeks to formulate a collaborative strategy to enhance learning autonomy and metacognitive competence in a holistic and contextually relevant manner. The urgency of this study lies in its potential to produce a community-based education policy implementation strategy, which not only supports the achievement of the Golden Generation 2045 vision, but can also be replicated in other areas with similar conditions. By considering these various aspects, this study is formulated in the title: "A Collaborative Approach to the Development of Metacognitive Abilities and Independent Learning in High Schools in Malaka Regency: Synergy of Personal Factors, and the School Environment in Preparing the Golden Generation 2045".

2. Methods

This study used an explanatory survey design to examine the influence of the school environment (X) on learning independence (Y), with self-efficacy (M1) and metacognitive (M2) as sequential mediators. This design was chosen because it can reveal causal relationships while explaining the internal mechanisms that shape students' learning independence [61]. The study population was all eleventh-grade students in the Malaka region with diverse social, economic, and academic backgrounds. The sample was determined through random sampling in six schools selected purposively from a total of 12 sub-districts with a sample size of 223 students. The study involved 223 high school students aged 16–17 years, consisting of 90 males (40.4

The research instrument was a structured questionnaire containing 41 items, with 10 items each for school environment, self-efficacy, and learning independence, and 11 for metacognitive. All items used a 5-point Likert scale, developed through adaptation of validated instruments and the addition of new items appropriate to the local context. Details of the indicators for each variable are shown

in Table 1

Table 2. Research variable indicators

Variable	Variable Indicators
School Environment	Conditions; Learning Places; Teaching Quality; Student Relations; Facilities; Regulations [62]
Self-Efficacy	Optimistic in doing lessons and assignments; Making a plan to complete the task; Feeling confident; Commitment; Persistence; Self-motivation; Responding well; Using life experience; Handling situations effectively [63]
Metacognitive	Setting goals; Control attention; Reflect on sources of difficulties; Choice of activities; Reflect on learning strategies; Evaluate achievement [64]
Learning Independence	Task analysis; Confidence; Self-control; Sufficient observation; Self-consideration; Self-reaction [65]

Construct validity was tested using Confirmatory Factor Analysis (CFA) to ensure the suitability of the measurement model, while reliability was measured using Construct Reliability (CR) using a criterion of ≥ 0.70 as the minimum limit of acceptance (Figure 3. Overall Measurement Model of Independent Learning Study). Before the main data analysis was conducted, statistical assumption tests were first conducted including normality, linearity, and homoscedasticity to ensure the appropriateness of the data and avoid estimation bias. Data analysis was conducted with PROCESS macro version 3.5 on SPSS 23 using Model 6, which was designed to test the direct and indirect effects of the school environment on learning independence through the mediation of self-efficacy and metacognition sequentially. The details can be seen in Figure 2.

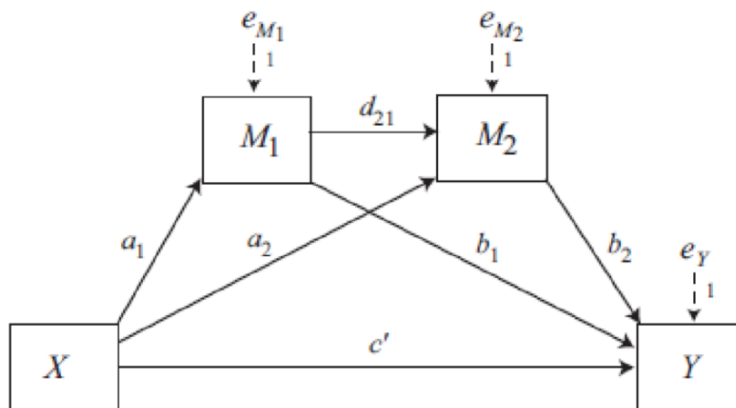


Figure 2. Model 2 sequential mediation (Hayes model 6)

3. Results and Discussion

3.1 Results

3.1.1 Overall Model Fit Test

A measurement model is said to fit if the model can estimate the population covariance matrix (Σ) which is not different from the sample data covariance matrix (S).

Based on the results of the measurement model fit test (CFA), the model can be said to be fit and suitable for use. This is indicated by the RMSEA value = 0.049, which is below 0.05, as well as the

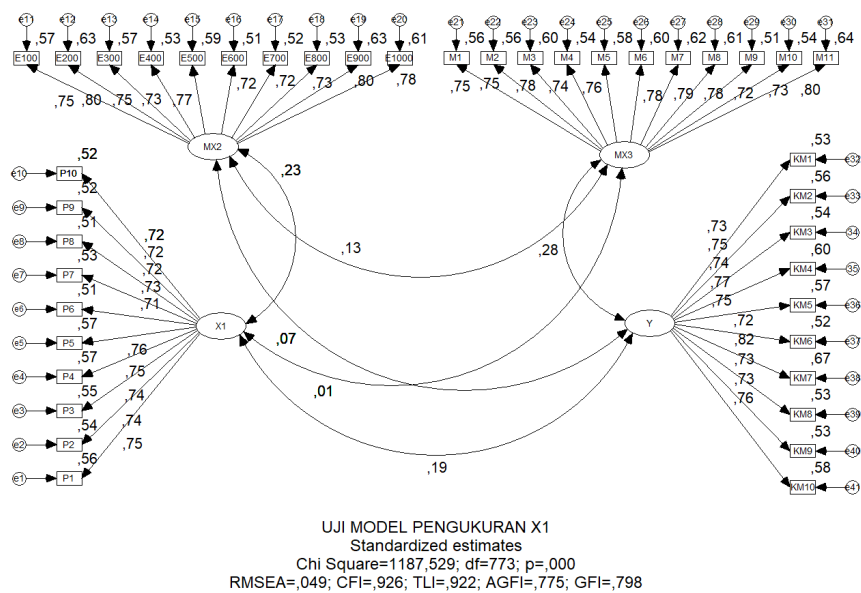


Figure 3. Overall Measurement Model of Independent Learning Study

CFI value = 0.926 and TLI = 0.922, which have exceeded the minimum limit of 0.90. Although the Chi-Square value is significant ($p = 0.000$) and the AGFI index = 0.775 and GFI = 0.798, it is still below the ideal criteria (≥ 0.90). This condition is understandable because the Chi-Square test is sensitive to large sample sizes, so other indicators become more important in decision making [61]. In terms of convergent validity, all indicators have a standardized loading factor (SLF) above 0.50 with a range of 0.51 to 0.82, indicating that each indicator is valid in reflecting the latent construct being measured. Thus, although there are several less than optimal fit indices, the combination of RMSEA, CFI, TLI, and SLF results provides a strong basis for stating that this measurement model is adequate and can be continued in reliability test analysis. The summary of construct reliability is shown in Table 3.

Table 3. The summary of construct reliability

Construct	CR	AVE	$\sqrt{\text{AVE}}$	Interpretation
X1	0.921	0.537	0.733	Reliable (CR > 0.70); convergent validity (AVE > 0.50); AVE > 0.70 → supports discriminant validity
Y	0.928	0.563	0.751	Reliable; convergent validity; AVE is high enough for discriminant validity
MX2	0.930	0.569	0.755	Reliable; convergent validity; supports discriminant validity
MX3	0.938	0.580	0.762	Reliable; convergent validity; supports discriminant validity

Referring the data in Table 3, it indicates that the Construct Reliability (CR) shows a coefficient above 0.7 which indicates that the construct reliability is in the good category [66].

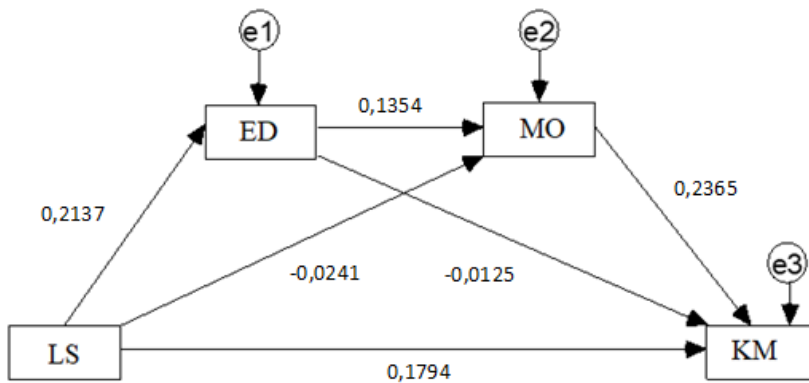


Figure 4. Model of Independent Learning Study

Description:

- **LS:** School Environment
- **ED:** Self-Efficacy
- **MO:** Metacognitive Skills
- **KM:** Learning Independence

Based on the results of the hypothesis test, it was found that

1. The School Environment (SEN) has a significant influence on Self-Efficacy (SE) with a coefficient of 0.2137 ($p = 0.0017$). This indicates that the more positive or supportive the school environment (physical, social, and academic), the more confident students will feel in their ability to learn and overcome challenges. High self-efficacy is an important foundation for developing independent and confident student character.
2. The School Environment (SEN) did not have a significant influence on Metacognition (ME) (coefficient = -0.0241, $p = 0.7542$). This means that a supportive school environment does not necessarily improve students' ability to regulate, monitor, and evaluate their own thinking and learning processes. This may be because metacognitive aspects are more influenced by internal learning strategies or direct interventions such as metacognitive training, rather than the general environment.
3. The direct effect of LS on KM was also significant (0.1794, $p = 0.0066$), indicating that the majority of LS's influence on KM is direct, rather than through mediating variables. This means that the school environment can directly encourage students to learn independently, without the need for intermediaries such as self-efficacy or metacognitive skills. In the context of implementation, this supports schools' efforts to create a climate that directly encourages active and reflective learning.
4. Furthermore, Self-Efficacy (ED) on Metacognition (MO) was also insignificant (coefficient = 0.1354, $p = 0.0731$), although it approached the critical value of 0.05. This indicates that although students feel capable and confident, this does not necessarily translate directly to their ability to organize higher-order thinking strategies. This suggests that increasing self-efficacy needs to be balanced with explicit training in metacognitive skills. For more detailed overall results, is in Table 4.

Table 4. Overall Results

Track	Coefficient	t count	p-value	Information
LS → ED	0,2137	3,1738	0,0017	Significant

LS → MO	-0,0241	-0,3135	0,7542	Not Significant
LS → KM (direct effect)	0,1794	2,7429	0,0066	Significant
ED → MO	0,1354	1,8007	0,0731	Not Significant
ED → KM	-0,0125	-0,1935	0,8468	Not Significant
MO → KM	0,2365	4,1282	0,0001	Significant
LS → KM (total effect)	0,1779	2,6908	0,0077	Significant

5. Self-Efficacy (SE) on Learning Independence (LEA) has a coefficient of -0.0125 with a t-value of -0.1935 and a p-value of 0.8468, indicating it is not significant. This means that students' self-efficacy levels do not directly influence their learning independence. This means that although students may have confidence in their abilities, this factor does not automatically lead to independent learning. Therefore, support from other factors such as the learning environment or metacognitive skills is needed to foster this independence.
6. MO showed the highest influence on LEA (coefficient = 0.2365, $p = 0.0001$). This supports the theory that students' ability to plan, organize, and evaluate their own learning process is a key indicator in developing learning independence. Thus, improving students' metacognition is an important aspect of educational interventions aimed at developing independent learners.
7. The table of total, direct, and indirect effects shows that the total effect of the School Environment (LS) on Learning Independence (KM) is significant (total effect = 0.1779, $p = 0.0077$). This indicates that the school environment, through teacher support, facilities, and a conducive learning climate, overall contributes to increasing student independence. This also reflects the potential for school environment-based interventions to directly encourage students to become more independent in their learning.

In addition to the direct effect, this study also describes the indirect effect. The results are as follows:

Table 5. The Indirect Effect

Path / Effect	Effect	SE	t	p	BootLLCI	BootULCI
Total Effect (LS → KM)	,1779	,0661	2,6908	,0077	,0476	,3082
Immediate Effect (LS → KM)	,1794	,0654	2,7429	,0066	,0505	,3083
Total Indirect Effects	-,0015	,0254	-	-	-,0526	,0482
LS → ED → KM (Ind1)	-,0027	,0148	-	-	-,0331	,0279
LS → MO → KM (Ind2)	-,0057	,0188	-	-	-,0446	,0303
LS → ED → MO → KM (Ind3)	,0068	,0051	-	-	-,0004	,0192

The results in Table 5 show that the School Environment (LS) has a significant total influence on Learning Independence (KM) of 0.1779 ($p = 0.0077$), with a direct influence that is also significant of 0.1794 ($p = 0.0066$). The indirect effect of LS on KM as a whole is very small and not significant (-0.0015), either through the path LS → ED → KM (-0.0027), LS → MO → KM (-0.0057), or LS → ED → MO → KM (0.0068). This indicates that the main contribution of LS to KM comes from direct influence, not through intermediaries of Self-Efficacy (ED) or Metacognitive (MO). This interpretation implies that although variables such as self-efficacy and metacognitive are often considered important in learning models, in the context of this study, the main influence still comes from the school environment directly. To strengthen learning independence, strategies to improve the quality and comfort of the learning environment can be a top priority, accompanied by additional approaches (for example, learning skills training and strengthening reflection) to strengthen these indirect effects that are not yet significant.

3.2 Discussion

3.2.1 The Influence of School Environment (LS) on Students' Self-Efficacy (ED)

The statistical analysis results show that the school environment has a positive (0.2137) and significant (0.0017) influence on student self-efficacy. These results illustrate the reality that a supportive school atmosphere can become a space for students' self-confidence to grow. This can be seen in a learning environment that has friendly interactions, open communication, and harmonious social relationships, so that students not only simply attend class but also feel safe to dream, try, and even bounce back when they encounter failure. This transforms the school from simply an academic space into a community that nurtures students' courage to try, learn from failure, and rediscover their self-confidence.

The above explanation is strengthened [62] which suggests that active collaboration between peers in the classroom provides space for students to mutually strengthen their self-efficacy through discussion and collaborative problem-solving. [63] also emphasized that social engagement in the classroom is directly proportional to motivation and achievement, which ultimately strengthens self-efficacy. In line with that [64] shows that students who learn in a cooperative atmosphere, where they interact, work together, and support each other, tend to have much higher academic self-confidence than students who learn in a competitive atmosphere.

This research is further reinforced by findings from previous studies. [65] for instance, asserts that support from teachers and peers plays a direct role in enhancing adolescents' self-efficacy, noting that the perception of being supported serves as a fundamental basis for fostering confidence in one's own abilities. [67] report that a conducive school climate can strengthen self-efficacy not only among students but also among teachers, thereby creating a positive cycle that promotes learning commitment and improves the quality of classroom interactions.

Based on these studies, an important implication emerges: schools should not merely function as institutions for the transmission of knowledge. Rather, they should serve as warm, communicative, and collaborative environments. Within such environments, teachers are expected to act as responsive facilitators who provide continuous support and guidance to students

3.2.2 The Influence of School Environment on Metacognition

The results of the statistical analysis show that the School Environment (LS) variable has a negative influence (-0.0241) on metacognition. This finding also indicates that statistically, the influence between the quality of the school environment and students' metacognitive abilities is not significant (0.7542). This condition indicates that although the school environment can support other aspects such as self-confidence, its contribution to metacognitive abilities is not strong enough to have a real impact on the learning process. This occurs because the dynamics of cooperation in group discussions are less than optimal and students' weak compliance with school rules. Group discussions that are not directed, minimal coordination, or even colored by the phenomenon of social loafing (the reluctance of some members to participate actively) can prevent the process of reflective thinking from running smoothly. In this situation, students also tend not to understand each other's thinking strategies, so that metacognitive practices do not develop. Similarly, poor classroom discipline and irregular implementation of school rules can hinder the creation of a conducive learning environment. A structured environment is essential for students to systematically plan, monitor, and evaluate their thinking processes.

These findings are consistent with evidence reported in various prior studies. For example [68] emphasizes that low-quality collaboration may impede the development of metacognitive skills, as misconceptions and communication conflicts can weaken individuals' metacognitive abilities. Similarly, [69] found that interactions occurring in unstructured learning environments are associated with

reduced accuracy in students' metacognitive monitoring. In addition, [70] highlight that limited metacognitive awareness within collaborative groups can diminish the effectiveness of problem-solving due to the use of suboptimal thinking strategies. Collectively, these studies reinforce the hypothesis that environmental dynamics—such as weak collaboration and inadequate school discipline—can constitute significant barriers to metacognitive development.

Furthermore, these results are strengthened by research [71] which shows that the application of metacognitive strategies and self-regulated learning is not always effective if not supported by good classroom structure. Students tend to be resistant to reflective methods without clear rules and guidance. A similar finding is shown by [72] An unsupportive learning environment, reflected in group interactions with minimal self-control, has the potential to hinder the development of metacognitive abilities. These findings provide practical implications for teachers and schools, emphasizing the importance of creating clear group discussion structures, establishing individual responsibilities, and ensuring monitoring of the learning process. Furthermore, consistently enforcing classroom rules can create a disciplined and directed learning environment, which ultimately serves as an important foundation for the development of students' metacognitive awareness and skills.

3.2.3 The Influence of School Environment on Learning Independence

The results of the statistical analysis indicate that the School Environment variable exerts a positive (0.1794) and significant ($p = 0.0066$) influence on students' learning independence. This finding conveys an important implication: the more conducive the school environment—particularly through healthy social relationships and responsive teacher behavior—the greater the likelihood that students will be able to regulate and manage their own learning processes. Thus, learning independence is shaped not only by internal student factors but also by strong external support originating from the school community.

In relation to self-efficacy, these results suggest that a positive school environment not only enhances students' confidence but also provides a safe and supportive space for them to experiment, make mistakes, and recover throughout the learning process. The positive and significant effect can be attributed to the quality of social interactions within the school. Such quality is reflected in harmonious peer relationships and teachers' openness in assisting students when they encounter difficulties, thereby creating an environment conducive to sustained learning engagement.

This is consistent with findings from [73] who emphasize that consistent social support from both teachers and peers significantly contributes to the development of self-regulation and learning independence. Similarly, [74] highlight that responsive teachers and a collaborative classroom climate can foster self-regulated learning while simultaneously strengthening student autonomy. [75] further report that the school environment — particularly peer interactions within structured discussion groups—can improve students' self-monitoring and self-evaluation skills related to their learning processes. Collectively, these studies confirm that positive school-based interactions play a decisive role in determining the quality of independent learning cultivated within educational settings.

Additional support for this conclusion is found in the work of [76], who demonstrate that a classroom environment characterized by task orientation, teacher support, fairness, and cooperation not only has a positive effect on students' task performance and learning independence but also acts as a mediating mechanism that strengthens the relationships among these factors. Based on these findings, it is imperative for schools and teachers to foster open communication, promote constructive student interactions, and design supportive programs such as peer tutoring, structured discussion sessions, and peer mentoring systems. These initiatives can enhance the overall school climate and, in turn, contribute to the development of stronger learning independence among students.

3.2.4 The Influence of Self-Efficacy on Metacognition

The statistical analysis showed that self-efficacy had a positive (0.1354) but insignificant (0.0731) effect on metacognition. This finding indicates a tendency that increased self-efficacy can support metacognitive development, but the statistical evidence obtained is not yet strong enough to conclude its effectiveness conclusively. In other words, although students with high self-efficacy tend to be more confident in their academic abilities, this has not yet fully translated into systematic reflective practices in organizing and evaluating their thinking processes. One explanation for this phenomenon is the gap between students' beliefs and reflective practices. Many students are confident in completing tasks, even when faced with distractions or environmental pressures. However, they often make decisions without thoroughly considering alternatives. Self-efficacy gives them the courage to take steps, but does not always encourage them to engage in metacognitive processes such as planning strategies, monitoring progress, and evaluating results. As a result, self-confidence serves only as an initial impetus, not a real instrument for developing higher-order thinking skills.

This explanation is in line with the findings of a number of international studies. [77] shows that in the context of open learning, self-efficacy does not have a significant impact on the use of metacognitive strategies if students do not have adequate task value and prior knowledge. Furthermore, the research results [78] shows that although increased self-efficacy can encourage metacognitive abilities, its role is more as a mediator that bridges the relationship between metacognition and academic achievement, rather than as the main predictor. Different things are explained [79] where there is a positive and significant influence between self-efficacy and metacognitive skills in elementary school students, but he also emphasized the existence of other factors that contribute significantly to metacognitive variance. These findings emphasize that efforts to improve students' self-efficacy need to be accompanied by explicit teaching of reflective strategies. Furthermore, teachers can facilitate this by providing space to explore alternative solutions, incorporating reflective questions into assignments, and fostering metacognitive-based group discussions. In this way, self-efficacy becomes not just a personal belief but a truly internalized habit of reflective thinking that supports students' academic success.

3.2.5 The Influence of Self-Efficacy on Learning Independence

The statistical analysis results show that self-efficacy has a negative (-0.0125) and insignificant (0.8468) effect on learning independence. This finding suggests that students' belief in their abilities does not always align with increased learning independence. In fact, the slightly negative direction of the effect indicates that self-confidence alone is not sufficient to encourage students to become independent; furthermore, this effect has not been empirically proven to be significant. In other words, self-efficacy without the support of appropriate reflective skills and learning management strategies has the potential to become merely a subjective belief with no real impact on learning independence.

The above phenomenon can be explained by students' difficulty in utilizing failure experiences as a learning tool, as well as their low persistence in facing academic challenges. Many students are confident, but when faced with obstacles or failure, they tend to give up trying instead of evaluating and improving their learning strategies. Self-efficacy that is not accompanied by the ability to persist and learn from failure can lead to a false sense of complacency, leaving students feeling satisfied with their beliefs without the motivation to take further initiatives. Without a process of reflection and consistent efforts to face difficulties, the character of learning independence is difficult to develop.

The above results are supported [34] emphasizes that students who do not learn from failure will have difficulty improving their strategies, thus hindering the development of their self-regulation skills. [80] also found that high self-efficacy does not automatically increase learning independence if reflection on failure experiences does not occur. Furthermore, building persistence through structured support is also crucial, as without the ability to persist in the face of obstacles, self-efficacy alone is insufficient to foster independent learning habits [81, 82, 83]. These three findings emphasize that learning independence only develops when self-efficacy goes hand in hand with reflective ability and persistence in facing challenges.

Furthermore, research is different from research [66] Self-efficacy influences learning independence by forming the basis of an individual's belief in their ability to regulate and control their learning process independently through a series of cognitive and metacognitive processes such as goal setting, monitoring, reflection, and self-evaluation. These findings provide clear direction for schools and teachers: building self-efficacy must be accompanied by challenging learning experiences, space for post-task reflection, and support in developing perseverance. Thus, self-efficacy no longer stands alone but becomes an effective catalyst in developing independent, resilient students who are able to optimally manage their learning process.

3.2.6 The Influence of Metacognition on Learning Independence

The results of the statistical analysis indicate that the Metacognitive variable has a positive (0.2365) and significant (0.0001) influence on learning independence. This finding confirms that the better students' ability to plan, monitor, and evaluate their thinking processes, the higher the level of learning independence achieved. This significant influence can be understood through students' reflective behavior in facing assignments. Furthermore, equally important is the habit of students assessing the effectiveness of their learning methods and identifying the causes of incomplete assignments. This encourages them to be more proactive in redesigning learning strategies, reassessing the methods used, and adapting new approaches when encountering obstacles. This reflective process gives rise to strong learning independence, as students no longer simply follow directions but take personal responsibility for their academic success.

This finding is in line with various international studies. [84], for example, emphasizes that metacognitive skills increase students' awareness and control of their thinking, which directly impacts their ability to learn independently. [85] also reported that providing autonomy support in learning strengthens self-regulation strategies, especially monitoring and evaluation, which are important foundations for learning independence. Beside, [72] also confirmed that groups with strong metacognitive interactions demonstrated better learning performance, as the shared reflective awareness enriched self-regulatory strategies.

These three studies demonstrate consistency: well-managed metacognition is key to the development of effective learning independence. Furthermore, [86] explained that metacognitive support in the flipped classroom model not only makes group cooperation closer, but also fosters motivation from within students which helps them learn independently. Based on these findings, the practical implication for schools and teachers is the importance of integrating explicit training on metacognitive strategies, from planning, monitoring, to evaluation, into the learning structure. Teachers can facilitate reflective discussions, provide self-evaluation rubrics, and design structured peer feedback sessions. In this way, students not only gain self-efficacy but also the concrete skills to independently develop effective and sustainable learning strategies.

3.2.7 The Influence of School Environment on Learning Independence Mediated by Self-Efficacy

The results of the study indicate that the influence of the school environment on learning independence—when mediated by self-efficacy—is negative and statistically insignificant. This finding sug-

gests that although the school environment theoretically has the potential to enhance students' independent learning through the development of self-efficacy, the actual conditions within the school context do not yet support this mechanism effectively. In practice, students' interactions and levels of self-confidence appear to be insufficiently strong to yield a meaningful or statistically significant effect, despite the negative direction observed.

The weakness of the school environment in fostering constructive interactions is reflected in students' limited ability to collaborate productively during group discussions and their low adherence to school rules. Ineffective group discussions reduce students' opportunities to practice essential competencies such as communication, collaborative problem-solving, and critical reflection. Consequently, the school environment has not functioned optimally as a setting through which self-efficacy can be strengthened to support greater learning independence. . According to [87] Less collaboratively organized learning environments and limited teacher support have been shown to reduce students' opportunities to practice themselves. Besides that, [88] An emotionally uncomfortable classroom atmosphere, combined with a lack of effective learning support, makes it difficult for students to manage their thoughts and control themselves. These two perspectives reinforce the idea that poor interactions in schools hinder the development of independent learning characteristics.

Low self-efficacy exacerbates this situation within students. Data shows that students rarely learn from failure and don't consider alternatives when faced with difficult situations. [89] explains that low self-efficacy causes students to be reluctant to take risks and give up easily when facing academic challenges. As well as, [90] highlighted that self-efficacy not accompanied by adequate goal setting, such as self-set grade goals, negatively impacts learning motivation and academic outcomes. Both support that without mature self-efficacy, students do not develop independent learning initiatives. Problematic independent learning characteristics are also evident in students' attempts to avoid delaying learning, low confidence in understanding the material on their own, inability to reward themselves, and lack of awareness of the importance of correcting mistakes. This is consistent with the research results [85], who found that student autonomy support directly enhances self-regulation strategies such as planning and process evaluation; without such support, students are vulnerable to failing to internalize independent strategies. In addition, [91] He also explained that students will more easily develop and achieve when they are in a supportive environment, believe in their own abilities, and are free to determine their own learning methods. Without these, independent learning will struggle to develop properly.

In line with that, research [92] explains something different where in his research it was discovered that in the digital era like now, the school environment can be a space that encourages students to believe in their own abilities and find their learning motivation, so that they grow into independent individuals in learning. [51] also explained the same thing, where high self-efficacy encourages students to be more confident in their ability to organize, monitor, and complete assignments independently, so that independent learning in online learning can develop optimally. These findings have important implications, namely the need for schools and teachers to strengthen reflection-based learning, improve discipline and compliance with school rules, and provide a healthy discussion space so that students can build academic confidence and independent learning strategies. Thus, although the effects observed in this study were not significant, improving the school environment and strengthening self-efficacy have the potential to significantly increase independent learning in the future.

3.2.8 The Influence of School Environment on Learning Independence through Metacognition

The research results show that although the school environment has a negative and insignificant influence on learning independence through metacognitive abilities, this influence occurs due to several factors. One of these is a less than conducive school environment, characterized by low lev-

els of cooperation in group discussions and students' lack of compliance with applicable rules. [93] emphasized that a supportive learning environment, reflected in the consistent presence of teachers and good collaborative structures, is an important factor for students to develop self-regulation strategies in building learning independence. [88] also suggested that negative classroom emotional conditions and a lack of quality instruction make it difficult for students to develop self-control and reflect on their learning. This view reinforces the idea that weak environmental interactions directly hinder the growth of students' learning independence.

The second problem is related to students' problematic metacognitive abilities, namely difficulty avoiding concentration disturbances and rarely reviewing the achievement of learning goals. [94] states that metacognition plays a key role in self-regulated learning. Without good skills in monitoring and controlling the learning process, students tend to have difficulty keeping their learning directed and structured. [95] found that teachers often only encourage monitoring without making the reflection process a focus of learning, so students are not trained to evaluate and revise their learning strategies. As a result, students do not develop the reflective thinking habits that are the foundation of independent learning. Third, the combination of an unsupportive learning environment and low metacognitive abilities often leads to low learning independence in students. This is evident in their tendency to delay learning, lack confidence in understanding material independently, rarely give themselves credit, and lack of awareness of the importance of correcting mistakes.

This research differs from the findings of [96], whose study demonstrated that a conducive learning environment and strong metacognitive skills play a crucial role in fostering independent learning. According to their results, a supportive classroom atmosphere, opportunities for exploration, and constructive teacher feedback—combined with students' abilities to plan, monitor, and evaluate their own learning—lead to robust and sustainable learning autonomy. The implications of their research highlight the importance of schools cultivating a collaborative and supportive learning climate while also providing systematic metacognitive training. Teachers can promote regular habits of reflection, self-evaluation, and disciplined learning through project-based learning activities and structured group discussions. Therefore, although the present study reveals a negative and statistically insignificant effect, efforts to improve the school environment and strengthen students' metacognitive skills still hold substantial potential for enhancing independent learning outcomes in the future.

3.2.9 The Influence of School Environment on Learning Independence is Mediated by Self-Efficacy and Metacognitive Ability

The results of the study indicate a positive yet statistically insignificant influence of the school environment on learning independence when mediated by self-efficacy and metacognitive abilities. Theoretically, a conducive school environment, strong self-efficacy, and well-developed metacognitive skills should encourage students to become more independent learners. However, the empirical findings suggest that these factors do not exert a sufficiently strong effect to reach statistical significance. This outcome points to underlying issues in the quality of school interactions, the level of students' self-efficacy, and the consistency of their metacognitive practices, all of which contribute to weak learning independence.

Weak interactions within the school environment are reflected in students' limited ability to collaborate effectively during group discussions and their minimal compliance with school regulations. Poorly structured group discussions tend to make students passive, reluctant to assume roles, and deprived of opportunities to develop reflective thinking skills. Similarly, low adherence to school rules contributes to a non-conducive learning atmosphere in which sustained focus is difficult to achieve and a culture of discipline fails to develop.

According to [97], if students are not accustomed to practicing independent learning through a

focused and in-depth thinking process, they will have difficulty adapting to academic demands, so that their independent learning will be limited. [98] emphasized that the rare application of self-regulated learning in students is a strong indication that their learning environment does not fully support the development of independent learning abilities and skills in reflecting on the learning process.

Low self-efficacy is also a significant factor explaining the insignificant mediation effect. Indications of weak self-efficacy are evident in students' inability to learn from failure and their habit of not considering alternatives before making decisions in difficult situations. [34] emphasized that students who do not make failure a source of reflective learning tend to fail to form strong self-regulation and learning independence. This is reinforced by [80] emphasizes that high self-confidence does not automatically make someone independent in learning if he is not able to learn from failure and turn it into a better learning strategy.

Metacognitive problems are also clearly visible from the difficulty in avoiding concentration disorders and the infrequent review students' achievement of learning goals. [99] stated that without consistent monitoring, control, and regulation, students' metacognitive development is not optimal and has a negative impact on learning independence. [100] emphasizes that without appropriate regulatory encouragement or triggers, students often struggle to monitor their own learning. As a result, learning independence declines: they tend to procrastinate, doubt their understanding, rarely give themselves credit, and are less aware of the importance of learning from mistakes.

Relevant research supporting these findings includes the study by [101] Students who believe in their abilities tend to learn in a planned way, so they are able to manage their own learning process. Correspondingly, [102] also proved that the application of self-regulated learning with a goal-setting and progress-monitoring approach can help design students become more independent in their learning process. The practical implication of this research is that schools and teachers need to create a more supportive learning environment by emphasizing discipline, healthy collaboration, and in-depth reflection on the learning process. Teachers can provide explicit guidance on metacognitive strategies, provide a forum for post-assignment reflection, and appreciate students' efforts, not just the final results, so that students' learning independence can develop significantly.

4. Conclusion

This study concludes that the quality of the school environment is a key factor that directly enhances students' learning independence, whereas self-efficacy does not exhibit a significant direct influence in this context. In contrast, metacognition demonstrates a significant positive effect on learning independence, indicating that strengthening students' metacognitive skills is an essential strategy for promoting autonomous learning. The analysis also reveals that the dual mediation pathway through self-efficacy and metacognition does not produce a significant effect, suggesting that the mediating roles of these variables are not yet functioning optimally. These findings imply that the influence of the school environment on learning independence occurs more effectively through direct rather than indirect pathways.

Based on these results, it is recommended that schools continuously enhance the quality of the learning environment by providing adequate facilities, fostering positive social interactions, and implementing policies that support student autonomy. Teachers are encouraged to integrate metacognition-based instructional strategies—such as guided lesson planning, reflection on learning strategies, and evaluation of learning outcomes—to help students manage their learning processes more effectively. Although self-efficacy did not exhibit a significant direct effect, adopting learning approaches aimed at improving students' self-confidence remains valuable, for example by offering realistic learning challenges and providing constructive feedback.

Future research is advised to incorporate additional mediating or moderating variables, such as intrinsic motivation or parental support, to deepen the understanding of the mechanisms shaping learning independence. Furthermore, similar studies should be conducted across different educational levels or regional contexts to test the generalizability of these findings and to identify contextual factors that may influence the observed relationships.

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