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Correlation between Metacognitive Awareness and Students' Self-Efficacy in Chemistry Learning among Grade XII Students

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Abstract
This study aims to identify the relationship between metacognitive awareness and students' self-efficacy in chemistry learning among grade XII students at MAN Pontianak. This research employed a quantitative approach with a descriptive correlational design involving 36 students selected through purposive sampling. The instruments used were the Metacognitive Awareness Inventory (MAI) questionnaire and a self-efficacy questionnaire, both of which had been validated and tested for reliability. Data were analyzed using descriptive statistics and the Pearson Product-Moment correlation test. The results showed that students' metacognitive awareness was predominantly in the very well-developed category (66.7%), while self-efficacy was classified as very high (91.7%). The correlation analysis revealed a positive but weak and statistically insignificant relationship between metacognitive awareness and self-efficacy ($r = 0.249$; $p = 0.144 > 0.05$). These findings indicate that although both variables are at high levels, metacognitive awareness does not necessarily predict students' self-efficacy in chemistry learning. This study contributes to the understanding of the complex interaction between cognitive and affective factors in chemistry education. Practically, the results suggest that teachers should not only develop students' metacognitive skills but also implement instructional strategies that explicitly strengthen self-efficacy, such as providing mastery experiences, constructive feedback, and problem-based learning environments.

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INTRODUCTION

Chemistry studies matter and the changes that accompany it. Many concepts in chemistry are abstract and require higher-order thinking skills, which often causes students to experience learning difficulties (Ayustiani et al., 2021). These difficulties can impact students' ability to manage their learning process effectively. One internal factor related to learning management is metacognitive awareness, namely an individual's awareness of their own thinking processes (Ohtani & Hisasaka, 2018).

Metacognitive awareness is a crucial aspect of learning because it relates to students' ability to recognize, control, and evaluate their own thinking during the learning process. In chemistry, which contains many abstract concepts, many chemical concepts and processes cannot be directly observed, thus impacting low student learning outcomes at the high school level. This also occurs because students do not yet have the ability to optimally manage their thinking processes while learning, which is closely related to metacognitive aspects (Ohtani & Hisasaka, 2018). Therefore, this ability is highly needed by students.

Metacognition encompasses knowledge about cognition and cognitive regulation, which plays a role in enhancing the effectiveness of student learning (Schraw & Dennison, 1994a). Therefore, low metacognitive awareness can cause students to experience difficulties in managing their learning process, resulting in low learning outcomes (Ohtani & Hisasaka, 2018). Previous literature reviews have suggested that metacognition plays a role in enhancing learning and enabling students to focus more efficiently on what is needed in learning, thereby improving student academic achievement (Ohtani, 2018).

Students with good metacognitive awareness tend to be able to control their learning activities

and overcome learning difficulties more effectively (Schraw & Dennison, 1994a). In addition to metacognition, self-efficacy is also an important factor influencing learning success (Sari, 2023). Self-efficacy is defined as an individual's belief in their ability to perform tasks and achieve specific goals (Bandura, 1997). Self-efficacy refers to students' confidence in their ability to succeed (Yanti et al., 2025). Students with high self-efficacy tend to be more confident, persistent, and resilient when facing learning difficulties. On the other hand, students with low self-efficacy tend to avoid challenging tasks and give up easily when faced with academic difficulties (Sari, 2023). Therefore, self-efficacy is an important aspect in supporting student motivation and learning success, especially in chemistry.

Metacognitive awareness and self-efficacy in the context of chemistry education play complementary roles in supporting student learning processes and outcomes (Kadum & Karpudewan, 2025). Chemistry learning requires higher-order thinking skills, problem-solving skills, and a deep understanding of concepts. Metacognitive awareness helps students develop appropriate learning strategies. This is in line with previous literature reviews that metacognitive strategies significantly improve students' abilities to plan, monitor, and evaluate their learning processes, resulting in deeper understanding and improved learning achievement in complex science contexts such as chemistry (Dewi et al., 2025). Meanwhile, self-efficacy increases students' confidence in their ability to complete complex chemistry tasks.

Students with high self-efficacy in chemistry learning tend to demonstrate stronger intrinsic motivation, confidence in solving complex problems, and are able to overcome learning obstacles more effectively (Kadum & Karpudewan, 2025). The Ministry of Education and Culture states that chemistry learning requires the involvement of metacognitive aspects and self-confidence for optimal learning (Herlanti, 2015). Therefore, metacognitive aspects and self-efficacy contribute not only to cognitive skills but also to student motivation, academic engagement, and emotional resilience in facing the difficulties of learning abstract and conceptual chemistry. The integrated development of these two aspects in the high school chemistry curriculum requires special study so that learning strategies can support students to become more reflective, confident, and academically successful learners.

Several previous studies have shown a relationship between metacognitive awareness and self-efficacy in learning. Students with high self-efficacy tend to demonstrate better metacognitive skills in managing and controlling their learning process (M. Aurah, 2013). Other literature also states that an individual's belief in their abilities encourages the use of more effective and reflective learning strategies (Sen & Yulimaz, 2016). Other literature also states that there is a positive relationship between metacognition and self-efficacy in science learning (Hidayati, 2021, Riyadi, 2018). These findings indicate that these two variables are interrelated in supporting student learning success.

Although previous studies have examined the relationship between metacognitive awareness and self-efficacy, most of them were conducted in general science contexts or at different educational levels. Research specifically focusing on chemistry learning at the senior high school level, particularly in the Indonesian context, remains limited. Moreover, grade XII students face unique academic challenges, including preparation for final examinations and complex abstract chemistry content, which may influence both their metacognitive processes and self-efficacy. Therefore, this study provides a more contextualized and specific investigation, contributing to the limited body of research on the relationship between metacognitive awareness and self-efficacy in chemistry learning at the upper secondary level.

Information regarding students' metacognitive awareness and self-efficacy is also crucial for teachers in designing appropriate learning strategies (Karlen et al., 2023). Therefore, this study aims to provide an empirical overview of the relationship between metacognitive awareness and students' self-efficacy in chemistry learning. The purpose of this study is to identify the relationship between metacognitive awareness and self-efficacy in chemistry learning for 12th-grade students. The results of this study are expected to provide theoretical contributions to chemistry education and practical benefits for teachers, students, and educational institutions in improving the quality of learning.

METHOD

This research was conducted at MAN Pontianak, West Kalimantan. It used a quantitative approach with a descriptive correlational research design. The population was all 12th-grade students, while the sample size was 36 students, determined using purposive sampling. The purposive sampling technique was chosen for specific reasons: the sample was drawn from students taught by the same chemistry teacher. This aimed to control for external variables, particularly differences in teaching methods, material delivery styles, and learning interactions that could influence students' metacognitive awareness and self-efficacy. This resulted in more homogeneous data and a more accurate reflection of the relationships between variables, without bias caused by differences in learning treatments.

The sample size of 36 students represents one intact class, which is considered appropriate for correlational analysis and ensures homogeneity in learning experience. The use of purposive sampling was intended to control instructional variability, as all participants were taught by the same teacher using similar instructional approaches.

Regarding instrument validity and reliability, both instruments had undergone prior validation. The MAI instrument showed a reliability coefficient of 0.879, while the self-efficacy questionnaire had a reliability coefficient of 0.775, indicating acceptable internal consistency.

The instruments used in this study were the Metacognitive Awareness Inventory (MAI) questionnaire adopted from the MAI by Herlanti, (2015) which is an adaptation of the MAI by Schraw & Dennison (1994), and the Self-Efficacy questionnaire adopted from Sari (2023). This MAI instrument has been adapted to suit the Indonesian context (Sperber, 2011). This instrument has been tested for validity and reliability of 0.879, which means the questionnaire items are reliable or trustworthy as a data collection tool by Herlanti (2015), and the self-efficacy questionnaire instrument in this study was adopted from Sari' (2023) research, and has been tested for validity and reliability of 0,775. The selection of these two instruments was based on the consideration that both have a strong theoretical basis, have been widely used in educational research, and have been proven to be valid and reliable.

Table 1. MAI and Self-Efficacy Instrument Grid

	Metacognitive Awareness Inventory (MAI) Questionnaire 45 Questions		*Self-Efficacy Questionnaire 30-Questions*		
No	**Metacognitive Awareness Indicators**	**Number of Questions**	**Self-Efficacy Indicators**	**Number of Questions**	
				(+)	**(-)**
1.	Metacognitive Knowledge	16	Level Dimension	6	8
2.	Metacognitive Regulation	29	Dimension Strenght	8	4
3.			Dimension Generality	4	

The MAI and self-efficacy instruments in this study used a Likert measurement scale (Sugiyono, 2018). The scale used consists of four response categories, namely strongly agree, agree, disagree, and strongly disagree, with a score range of 1 to 4. The scoring technique is carried out by giving a score according to the response category for positive statements, while for negative statements scored reversed. The total score for each respondent is obtained by adding up all the item scores on each instrument, where a higher score indicates a higher level of metacognitive awareness or self-efficacy in chemistry learning.

Data collection techniques were carried out through indirect communication using questionnaires and direct face-to-face communication through interviews. The scores obtained from filling out the metacognitive awareness and self-efficacy questionnaires were then described based on the criteria set out in Tables 2 and 3. The level of students' metacognitive awareness was described referring to the classification according to (Green, 2002), which divides metacognitive awareness into four levels, namely not yet developed, starting to develop, already developed, and very well developed. This interpretation is based on a score

range of 0–100 that has been modified according to the assessment criteria (Herlanti, 2015), thus facilitating the systematic grouping of students' levels of metacognitive awareness.

Table 2. Metacognitive Awareness Criteria

Interval (%)	Categorization
0-25	Not Yet Developed
26-50	Starting to Develop
51-75	Already Developed
75-100	Very Well Developed

Meanwhile, the level of self-efficacy of students is interpreted using percentage criteria according to (Riduwan, 2010) which groups self-efficacy into five categories, namely very high, high, quite high, low, and very low.

Table 3. Self-Efficacy Awareness Criteria

Interval (%)	Categorization
76-100	Very High
51-75	High
26-50	Low
0-25	Very Low

The selection of interview samples in this study was based on the results of processing the MAI and self-efficacy questionnaire scores, which were summed and converted into percentages. Furthermore, these scores were categorized according to their level of metacognitive awareness and self-efficacy based on the criteria in a predetermined table. The students selected as interview subjects represented high, medium, and low levels in each variable. This technique aimed to obtain a more comprehensive picture of the variations in students' metacognitive awareness and self-efficacy in chemistry learning. Thus, the interview data were expected to strengthen and clarify the quantitative findings obtained from the questionnaires by directly exploring students' experiences and perspectives.

Normality tests used the Kolmogorov–Smirnov test and the Pearson Product Moment correlation test to determine the relationship between the two research variables. Interpretation of the correlation strength level refers to the criteria according to (Sugiyono, 2018).

Table 4. Correlation Level Between Metacognitive Awareness and Self-Efficacy

Coefficient Interval	Categorization
0,00–0,19	Very weak
0,20–0,39	Weak
0,40–0,59	Currently
0,60–0,79	Strong
0,80–1,00	Very strong

RESULTS AND DISCUSSION

Result

The metacognitive awareness of class 12th-grade students at MAN Pontianak was determined by distributing a questionnaire to 36 students. The questionnaire consisted of 8 indicators broken down into 45 questions and used a Likert scale. In general, metacognitive awareness can be seen in Figure 1.

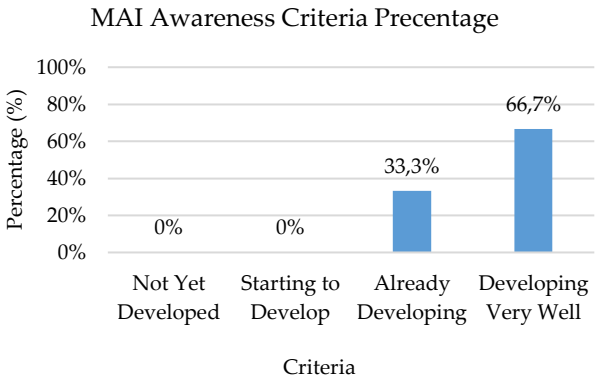

Figure 1. Percentage of Metacognitive Awareness Level of Grade XII Students of MAN Pontianak (N=36) According to Green (2002)

Based on Figure 1, 66.7% of grade XII MAN Pontianak students with a total of 24 students have very good metacognitive awareness. According to Green (2002), the level of consciousness develops very well, being able to use metacognitive skills regularly to manage their thinking and learning processes independently, being able to reflect on their thinking processes, and being able to assess themselves in learning. Based on figure 1, 33.3% of grade XII students of MAN Pontianak with a total of 12 students have metacognitive awareness with developed criteria. According to Green (2002), the level of consciousness has developed means being able to understand the way of thinking, being aware of thinking for itself and being able to distinguish the stages of elaboration of inputs and outputs from the thinking process and being able to learn independently. The category is starting to develop and there are no students who are on these criteria, indicating that students at MAN Pontianak already have and are instilled with metacognitive awareness in themselves.

The results of this study are in line with the research of Afdal et al (2023) the fact that 21.05% (N=19) of all third-level students majoring in the MAN Tanjungpinang Language department developed very well on metacognitive scores

which can indicate that some students have special talents for the topic being tested, the research of Sihombing et al (2025) also produced similar results where the average overall metacognitive orientation of students is 68.4% (N=221), categorized as developing very well.

From the results that the researcher has done, where the metacognitive level of students 66.7% (N=36) who is included in the development category is very good, it shows that most students have good metacognitive awareness during the chemistry learning process. Students who are in the very well developed category tend to be able to do lesson planning, monitor their own understanding, and assess strategies used to solve learning problems. Based on interviews, information was obtained that some students said that their best strategy before starting chemistry learning was to study at night or at dawn before facing exams or chemistry learning in class, taking lessons, practice questions, asking teachers or fellow friends about chemistry material that they did not understand, and getting used to making notes and summarizing the material that the teacher gave. This reflects the ability to regulate directed cognition, which means that students are not only able to remember information, but also be aware of how they think, control their learning process, and adapt strategies when facing learning difficulties (Wahyuni & Kuswandono, 2024).

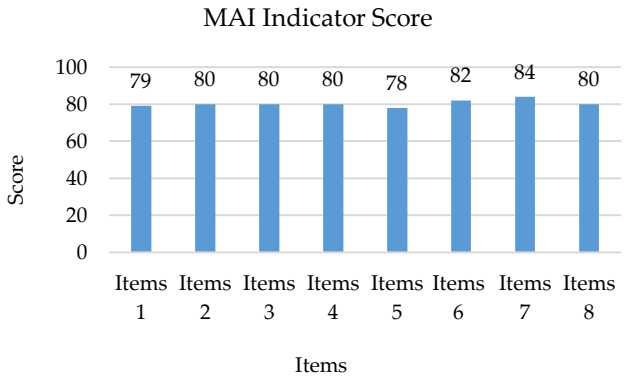

Figure 2. MAI Indicators' Scores (Item 1: Declarative Indicator, Item 2: Procedural Knowledge, Item 3: Conditional Knowledge, Item 4: Planning, Item 5: Information Management Strategy, Item 6: Understanding Monitoring Indicator, Item 7: Improvement Strategy, Item 8: Evaluating Indicator)

Based on figure 2, it can be seen that items 1 and 5, namely declarative indicators and information management, show the lowest achievement than other indicators. Which is in accordance with the results of the interview, many students have difficulties in determining the focus of information, processing learning concepts and determining important parts that must be understood in chemistry learning. The low achievement of this indicator can have an impact on the decline of students' confidence in their own abilities, especially when faced with abstract chemistry materials that require a high conceptual understanding (Sitompul, 2022).

Metacognitive awareness is an important indicator of student learning success. Students with metacognition with a very well developed category tend to be able to apply reflective and evaluative strategies in learning, so that they are better able to understand complex concepts such as in chemistry materials. According to Flavell (1979), individuals with metacognitive awareness are very well able to be aware of what they know and do not know, and can adjust learning strategies effectively. As noted by Jia et al. (2019) and Rivai (2022) in (Sihombing et al., 2025), students' knowledge and control over their cognitive processes enhances learning, making metacognition a key factor that must be developed carefully.

The development of metacognitive awareness, especially in declarative knowledge indicators and information management strategy indicators, needs to be considered on an ongoing basis because these strategies play an important role in increasing students' metacognitive awareness. When students are able to determine the focus of learning to manage information well, they will be more confident in understanding the material, working on problems, and facing learning challenges, which can ultimately improve students' learning outcomes (Ohtani & Hisasaka, 2018).

Item 7 (improvement strategy) showed the highest score, which was 84. The high score on this indicator shows that most students have good metacognitive abilities in making improvements to the learning process undertaken. Students are able to realize errors or shortcomings in their understanding, then take corrective actions, such as repeating the material, improving the learning method, or trying other strategies when the learning results obtained are not in accordance with expectations.

The difference between low scores on declarative knowledge indicators and information management strategies and high

scores on improvement strategies shows that although students still have difficulty in understanding and organizing learning information at the beginning, they already have the awareness to correct mistakes after the learning process has taken place. This indicates that students' reflective awareness is more developed at the evaluation and improvement stage than at the initial understanding and information processing stages.

According to Ohtani and Hisasaka (2018), improvement strategies are an important part of metacognitive regulation that allows learners to adjust learning strategies when facing failures or difficulties. Students who have good corrective strategy skills tend not to stop at the mistakes experienced, but use them as reflection material to improve further understanding. This is also in line with the conditions of chemistry learning that demand a repetitive learning process, especially in abstract and complex materials.

Thus, the high achievement in the indicators of improvement strategies becomes a positive potential that can be used to improve other metacognitive indicators, especially declarative knowledge and information management strategies. If students are directed to make improvements not only after experiencing difficulties, but also from the early stages of learning, then students' overall metacognitive awareness can develop more optimally.

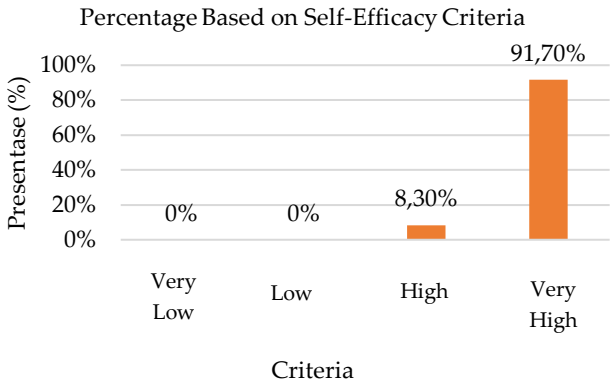

Figure 3. Percentage of Self-Efficacy Level of Class 12th-grade students of MAN Pontianak (N=36) according to Ridwan (2010).

The level of self-efficacy of grade XII MAN 2 Pontianak students was known by distributing questionnaires to 36 students. The questionnaire consisted of 3 indicators which were described into 30 questions and used a Likert scale. In general, self-efficacy can be seen in Figure 3.

Based on Figure 3, 91.7% of students in grade XII of MAN Pontianak have very high self-efficacy criteria, 8.3% of students are at high self-efficacy criteria. These results show that in general, students have high to very high self-confidence and are directed in facing the chemistry learning process.

The dominance of the very high self-efficacy category indicates that most students have strong confidence in their academic abilities. Oktariani (2024) explained that the high and very high categories reflect conditions where respondents have positive confidence in their ability to complete tasks, face difficulties, and maintain their business when experiencing obstacles (Oktariani, 2024b). High self-efficacy is an important factor in supporting learning success (Vonitasari & Amir, 2025). This is corroborated by the results of interviews where some students said that they always try and believe in themselves to solve difficult problems, always feel proud when they succeed in solving difficult chemistry problems, know that their chemistry learning results are good because they are consistent in studying every day.

High self-efficacy in students means having confidence in their abilities so that they can solve all problems in their learning activities, so that the learning results are maximized (Fitriani, 2019). The results of this study are in line with the research of Lestari & Wulandari, (2025) which states that data from the self-efficacy questionnaire of grade IV of SD Negeri Gugus R.A Kartini Boyolali Regency can be categorized very high, this finding indicates that in general the variables measured in this study, both metacognitive awareness and self-efficacy, have developed very well in most students.

According to Azwar (2010), the high category describes individuals who have scores above the group average, which indicates a strong mastery or tendency towards the constructs being measured. In the context of chemistry learning, this shows that students have been able to optimize their internal abilities, such as the management of thinking processes and belief in their abilities, in dealing with learning materials and tasks. Meanwhile, the presence of two students in the high category indicates that some students are still in the developmental stage and need reinforcement where according to the results of the interview there are some students who have

a sense of wanting to give up when facing learning or chemistry problems that they consider difficult.

Overall, the relatively balanced distribution of outcomes between the very high and high categories suggests a variation in ability among students. This indicates that even though students are already in the high category, teachers still need to provide continuous learning support to improve the abilities of students who are still in the high category. Learning strategies that encourage reflection, strengthen confidence, and gradual problem-solving exercises need to be developed so that all students can achieve a high category of self-efficacy.

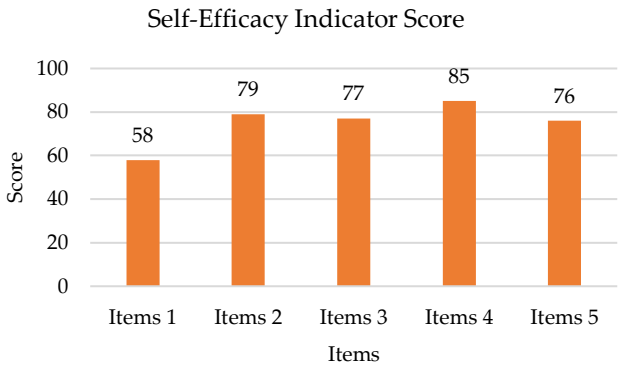

Figure 4. Scores for Each Self-Efficacy Indicator (Item 1: Confident in Completing Tasks, Item 2: Confident in Being Able to Motivate Yourself in Completing Tasks, Item 3: Confident in Being Able to Work Hard and Be Persistent, Item 4: Confident in Persisting in the Face of Obstacles and Difficulties, Item 5: Confident in Being Able to Complete the Tasks You Have)

It can be seen in the graph above that item 2, item 3, item 4, and item 5 are at a high score with a score above 75, but in item 1, which is an indicator of feeling confident in completing the task, showing low achievement in some students of class XII chemistry MAN 2 Pontianak. Based on interviews, information was obtained that many students are still unsure of themselves to be able to complete chemistry tasks that are considered difficult, and have feelings of wanting to give up before they can complete it. This low achievement can affect students who will avoid many tasks, especially challenging and difficult ones, while students with high self-efficacy will do challenging and difficult tasks, because they will try harder to complete these tasks than students with low self-efficacy (Bandura, 1997b).

In addition, Item 4 (confident in surviving in the face of obstacles and difficulties) showed the highest score compared to other indicators, which was a score of 85, which was included in the very high category. The high score on this indicator indicates that most students have a strong belief to survive when facing obstacles and difficulties in learning chemistry. Students do not give up easily when they experience difficulties, but tend to try to find other ways, such as asking teachers or friends, repeating material, and trying to complete difficult tasks again.

The difference between Item 1 which had a low score and Item 4 which had the highest score showed that although learners were not yet fully confident in their ability at the beginning to complete a chemistry task, they had good resilience and persistence when they were in difficult situations. This shows that the aspects of students' perseverance and fighting power are more developed than the initial belief in their own abilities. According to Bandura (1997), individuals with high self-efficacy in the aspect of resilience will be better able to manage pressure, survive in difficult conditions, and not easily give up even in the face of failure.

Thus, the high score in Item 4 is a positive potential that can be developed by teachers to improve other indicators, especially students' confidence in completing the assignment in item 1. If learners are helped to realize that they are capable of persevering and overcoming difficulties, then their confidence in completing challenging chemistry tasks can also increase gradually.

The results of this study also show that there are students who have a high level of metacognitive awareness, but the level of self-efficacy is in the low category. This condition indicates that students' ability to understand, plan, monitor, and evaluate their learning processes is not always accompanied by confidence in completing chemistry learning tasks. This indicates that mastery of cognitive strategies does not always go hand in hand with belief in one's own abilities. Schraw and Dennison (1994) argue that high metacognitive does not necessarily mean high self-efficacy to form affective beliefs about one's success in completing tasks. Bandura (1997) emphasized that self-efficacy develops through success experiences, social reinforcement, and individual

interpretations of learning experiences, not solely from cognitive abilities. Thus, students who are metacognitively skilled in managing their learning process do not necessarily have high self-confidence if they lack success experience, often experience failure, or have a negative perception of their academic abilities, especially in abstract and challenging chemistry learning. Thus, these findings suggest that high metacognitive awareness is not necessarily followed by high self-efficacy. This condition emphasizes that the development of metacognitive abilities needs to be balanced with efforts to increase self-efficacy through the provision of meaningful learning experiences, positive feedback, and teacher support.

Normality of metacognitive awareness data and self-efficacy results obtained are normal. This result is obtained from the significance value of metacognitive awareness and self-efficacy, which is > 0.05, which is 0.075 for metacognitive awareness and 0.091 for self-efficacy, can be seen in table 5.

Table 5. Normality test table

	Kolmogorov-Smirnov		
	Statistic	**df**	**Sig.**
Metacognitive Awareness	.075	36	.200*
Self-Efficacy	.091	36	.200*

The correlation between metacognitive awareness and self-efficacy significance obtained, presented in Table 6, is 0.144. The value 0.144 > 0.05 indicates that there is a positive but not significant relationship between metacognitive awareness and self-efficacy in the chemistry subject for XII MAN Pontianak students, as shown in Table 6.

Table 6. Correlation Test

Correlation			
		MAI	**Self-Efficacy**
Metacognitive Awareness	**Pearson Correlation**	1	.249
	Sig. (2-tailed)		.144
	N	36	36
Self-Efficacy	**Pearson Correlation**	.249	1
	Sig. (2-tailed)	.144	
	N	36	36

The strength of the relationship between metacognitive awareness and students' self-efficacy is indicated by the correlation coefficient (r = 0.249), which falls within the weak category. This weak and statistically insignificant relationship suggests that metacognitive awareness is not the sole determinant of students' self-efficacy in chemistry learning, as it is influenced by multiple factors, including mastery experiences, social persuasion, emotional states (Bandura, 1997), learning environment, and the level of material difficulty.

In the context of chemistry, which involves abstract and cognitively demanding concepts, students may continue to experience difficulties despite possessing adequate metacognitive regulation. These challenges can, in turn, weaken their confidence in their ability to successfully engage with chemistry learning tasks.

Nevertheless, the positive association found in this study indicates that metacognitive awareness still has the potential to support the development of students' self-efficacy, although its contribution appears to be relatively limited. This result is consistent with previous studies (e.g., Suherman et al., 2018), which reported that the relationship between metacognition and self-efficacy tends to be weak, although positive associations have also been identified in other studies (Riyadi, 2018; Aprilia, 2025; Deliya Novita et al., 2023).

These findings suggest that metacognitive awareness still plays an important role in shaping students' confidence in their learning abilities. Students with higher metacognitive awareness tend to demonstrate better control over their thinking processes, greater understanding of their strengths and weaknesses, and the ability to select appropriate learning strategies, which can contribute to the development of self-efficacy, even if the strength of the relationship is limited.

In chemistry learning, students may not always apply appropriate learning strategies and often experience difficulties in solving abstract problems, which can hinder the development of their confidence. This condition further weakens

the relationship between the two variables. This indicates that the relationship between metacognitive awareness and self-efficacy is context-dependent, particularly influenced by the abstract and cognitively demanding nature of chemistry learning.

Therefore, the findings of this study highlight the need for learning approaches that not only develop students' metacognitive awareness but also explicitly support the enhancement of self-efficacy through meaningful learning experiences, constructive feedback, and supportive classroom environments.

CONCLUSION

This study concludes that although students demonstrate high levels of metacognitive awareness and self-efficacy, the relationship between these two variables is weak and not statistically significant. This indicates that metacognitive awareness alone is insufficient to predict students' self-efficacy in chemistry learning. Therefore, both cognitive and affective aspects should be developed simultaneously to enhance learning outcomes. This highlights the need for integrated instructional approaches that simultaneously address cognitive regulation and students' belief systems.

RECOMMENDATION

Future research is recommended to employ experimental or quasi-experimental designs to examine the causal effect of metacognitive strategy interventions on students' self-efficacy. Additionally, future studies should consider including mediating or moderating variables such as learning motivation, academic achievement, and classroom environment.

From a practical perspective, teachers are encouraged to design instructional strategies that integrate metacognitive training with self-efficacy enhancement, such as problem-based learning, reflective activities, scaffolding, and the provision of positive feedback. Educational policymakers may also consider incorporating these aspects into curriculum design to support holistic student development.

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