

## PROMOTING METACOGNITION AND SELF-REGULATED LEARNING: STRATEGIES FOR ELEMENTARY SCHOOLS

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### ABSTRACT

The development of AI has the potential to have both positive and negative implications. This technological advancement will continue to progress over time. Encouraging metacognition and self-regulation can help in dealing these implications. Metacognition and self-regulation have become popular concepts in education. However, more research is needed to develop teaching strategies for different age groups and contents. This article reviews the literature on fostering metacognition and self-regulation to develop self-regulated learners in elementary schools. This strategy was developed according to the psychological needs and abilities of the students. Metacognition refers to the ability to observe and control one's cognitive processes. On the other hand, self-regulation involves monitoring and controlling emotional responses and reactions to external stimuli. These concepts work together to develop a self-regulated learner, preparing students for a future where AI will be integrated into the workforce, creating a more competitive job market. To develop self-regulated learners, it's important to have a clear and implementable framework of these concepts within Indonesia curriculum context. This strategy will help students monitor and regulate their thoughts, emotions, and behaviors to navigate the evolving landscape of technology, especially artificial intelligence (AI). The design of strategies for elementary school settings through the implementation of Kurikulum Merdeka is based on three phases: pre, intra, and post. We also include framework design for the strategy. Future design considerations may also encompass challenges and strategies from various stakeholders, including the community, educators, and students.

Keywords: *metacognition, self-regulation, self-regulated learning, AI, elementary school*

### BACKGROUND

Since Alan Turing first articulated the concept of machine thinking, there have been significant advancements in the development of machine thinking or what has been known as AI. Artificial intelligence (AI) is a tool that has been developed to assist humans or animals in achieving their needs and goals (Boden, 2016). AI or 'Artificial Intelligence' mimics human psychological abilities such as perception, association, prediction, planning, and even motor control. AI has been utilized in a lot of sectors and fields such as education, industry, medical, etc. (Boden, 2016; Gunkel David, 2012; Han et al., 2022; Zhang & Aslan, 2021). Its utilization creates a lot of opportunities as well as a lot of challenges. It creates the opportunity to reduce human tasks with automated processes, thereby reducing the overall availability of employment opportunities (Boden, 2016; Zhang & Aslan, 2021). Hence, it is important to prepare the next generation to face the uncertainty during the future integration of AI in the workplace.

Rapid advances in technology require lifelong learning, even after graduation, to enable individuals to adapt to the rapid pace of technological change and the increasing integration of AI in the workplace (Miah & Omar, 2012). To help an individual prepare for this condition is to foster one's ability to behave and react accordingly within the environment and necessity (Dörrenbächer-Ulrich et al., 2024). Two of the most crucial elements in fostering these abilities are metacognition and self-regulation. This ability

helps an individual to monitor individual cognition and behaviour to attain their goal (Dörrenbächer-Ulrich et al., 2024; Fox & Riconscente, 2008; Ohtani & Hisasaka, 2018; D. H. Schunk & Greene, 2017).

The concepts of metacognition and self-regulation are distinct but complementary. They both involve goal-directed monitoring with different emphases (Dörrenbächer-Ulrich et al., 2024). These two functions may be considered to represent the knower and the actor in consciousness. Metacognition is the awareness of one's cognitive processes, or thinking about one's thinking. Self-regulation can be defined as the ability to control the thoughts and behaviors that emerge (Dörrenbächer-Ulrich et al., 2024; Fox & Riconscente, 2008). Improving these abilities can be achieved through learning experience. Although metacognition and self-regulation are intrinsic to the individual, their formation is influenced by the environment. (Fox & Riconscente, 2008). It is therefore crucial to foster an environment that allows students to engage in metacognitive and self-regulatory learning.

Metacognitive and self-regulation training strategies should be developed according to the individual's psychological growth. Given the differences in abilities and needs across different grade levels, it is essential to develop training strategies for metacognition and self-regulation that align with the specific needs of each grade (Dörrenbächer-Ulrich et al., 2024; D. H. Schunk & Greene, 2017). These abilities start from early childhood when they learn to understand rules and control their behavior. As they grew older, their capacity to use these abilities accumulated through learning experience. The establishment of self-regulated learning and metacognition abilities happened around primary school, at the age of six and twelve years old. During these years, internalized speech and cognitive function lead to a deeper understanding of their social world. They have a deeper understanding of other's perspectives, expectations, and emotions creating a more relevant interaction between peers (Dörrenbächer-Ulrich et al., 2024). Therefore, it's important to design a training strategy where the content is appropriate for the age of the learners.

Previous research has designed a metacognitive learning model from Kurikulum Merdeka Elementary School (Jumanto & Mustofa, 2023; Nurhafisah et al., 2024). However, the study does not explicitly describe the step-by-step training in metacognition and self-regulation through Kurikulum Merdeka Elementary School. Jumanto & Mustofa (2023) The objective is to develop a learning design based on metacognitive strategies for fourth-grade science lessons. The findings of the study validate the educational material presented by experts in the fields of education and metacognition. Furthermore, the study highlights the efficacy of the designed learning design. Nevertheless, the learning design is not sufficiently explained, making it challenging for practitioners to follow. Previous research has not comprehensively explained the theoretical and empirical concepts related to metacognitive training strategies. Other learning designs did not include a strategy for self-regulated learning and metacognition in Kurikulum Merdeka (Nurhafisah et al., 2024). Therefore, this research aims to explain the theoretical and empirical concepts through an integrative review. These findings will be used to develop applicable metacognition and self-regulation training which will be implemented using Kurikulum Merdeka. There are few of research questions in this article, namely:

- What theories that are used in educational settings about metacognition and self-regulated learning training
- What is the effective way to promote metacognition and self-regulation to create self-regulated learner in elementary school?
- How to promote metacognition and self-regulation strategy using Kurikulum Merdeka elementary school?

## **RESEARCH METHOD**

To create suitable training on the application of metacognition and self-regulation training in the context of elementary school Kurikulum Merdeka, we conducted a literature search in qualified academic journals from PubMed, APA PsycNet, ERIC (peer-reviewed), and Sci-Direct to ensure high

level of quality review due to rigorous peer review process. We searched the articles using keywords of metacognition and self-regulated learning. Both theoretical and empirical studies were used in this review.

To be considered, we imposed conditions on articles: (1) Main focus on metacognition and/or self-regulation learning; (2) explicitly address metacognition and self-regulation training (3) includes subject interest of elementary school or children on the age between 6-12; (4) Neurotypical subject (5) the theme on metacognition and self-regulation should be in education or development setting (6) open access due to limited access to certain articles; (7) published up to 2018 (8) published in English.

We used Mendeley to filter out the articles gradually based on title (duplication and context), abstract, and then the context of the articles according to this research questions. We then divided the selected articles into two sections, theoretical and empirical. We synthesize and analyze theoretical articles to gain understanding about metacognition and self-regulated learning, while empirical articles were synthesized and analyzed to gain understanding of effective metacognition and self-regulated learning training. We then create thorough and applicable strategies to train metacognitive and self-regulation in the context of Kurikulum Merdeka. We managed the empirical research data in a table that includes information about the study, methods, and key findings.

We gained 671 articles from the journals. We filtered the articles gradually from title, abstract, and content to match the inclusion criteria of our study. We selected 18 articles that match our inclusion criteria. The articles was categorized, analyzed and synthesized to create a new framework according to selected articles.

## RESEARCH FINDINGS

This study begins with an overview of metacognition and self-regulated learning theories, followed by analysis and synthesis of selected literature for review. **Table 2** shows the review of selected articles. The findings of this study present a design for an instructional program aimed at enhancing students' metacognitive and self-regulated learning abilities at the elementary school level. Subsequently, the discussion section explains strategies for metacognitive and self-regulated learning training for elementary students based on Kurikulum Merdeka.

**Table 1.** Selected articles based on inclusion criteria

	Theoretical	Empirical
<b>Metacognitive</b>	Heyes et al., 2020, Ain et al., 2023, Lee et al., 2018, Ozturk, 2024, Teng, 2024	Engel, 2021, Halim et al., 2020, Babashamasi et al., 2022, Labak et al., 2024, Bogdanović et al., 2022, Chen et al., 2022
<b>Self-regulated learning</b>	Liu et al., 2024, Lin & Chang, 2023, Molenaar, 2022	M. Lee et al., 2023, Sergi et al., 2023, Núñez et al., 2022, Lawson et al., 2023, F. Teng, 2020

### *Theoretical Framework of Metacognition*

Metacognition can be defined as the ability to be aware of one's own cognitive processes. Such processes include the control of cognitive processes occurring within the individual, such as organizing, monitoring, and adapting (Flavell, 1979; Nelson & Narens, 2000; Schraw & Dennison, 1994). Metacognition is comprised of three primary components: metacognitive experience, metacognitive knowledge, and metacognitive regulation (Flavell, 1979; Wu, 2024). Metacognitive knowledge refers to an understanding of the factors that can affect goal attainment (Ozturk, 2024). This knowledge includes person-related, task-related, and strategy-related information. Person knowledge is defined as knowledge about the self, which includes abilities, deficiencies, and learning processes. Next, task knowledge is the ability to identify the tasks and procedures that need to be performed to achieve the

desired outcome. Finally, strategic knowledge is the understanding of the strategic actions that can be taken to achieve a desired outcome (Flavell, 1979; Wu, 2024). Metacognition experience can be defined as a novel combination of feelings and knowledge acquired through past experiences (Flavell, 1979). Such metacognitive experiences can result in the acquisition of new knowledge derived from past experiences, thereby enabling individuals to adapt their strategies in response to new circumstances. Metacognitive experience is defined as the manner in which an individual encounters a stimulus or trigger that results in the acquisition of new experiences, thereby facilitating the development of insight and the formation of metacognitive knowledge (Flavell, 1979; Ozturk, 2024). Metacognition regulation can be defined as the manner in which an individual exercises control and monitors their own cognitive processes in order to achieve a desired outcome (Nelson & Narens, 2000; O'Leary & Sloutsky, 2019; Schraw & Dennison, 1994). Metacognitive control refers to the ability to regulate one's thoughts in order to initiate, modify, or terminate a given action. Nevertheless, in order to control something, the individual must monitor the relevant conditions, gather information, and then make the necessary adjustments to achieve their desired outcome (Bellon et al., 2020; O'Leary & Sloutsky, 2019).

These metacognitive components facilitate goal attainment through the processes of monitoring, regulating, and planning in accordance with the required goal-directed actions. Metacognition is a valuable skill to develop because individuals who possess metacognitive skills are better equipped to use information effectively in problem solving (Dörrenbächer-Ulrich et al., 2024). This skill also facilitates the ability of students to adapt to a variety of learning strategies. Consequently, metacognitive learning is a crucial aspect of education. The following discussion will highlight the strategies that can be used to enhance metacognition.

### *Theoretical Framework of Self-Regulated Learning*

Self-regulated learning can be defined as the capacity of an individual to engage in self-directed learning activities and behaviors that are aligned with their learning objectives. The concept of self-regulated learning is based on the understanding that students are active learners, capable of both learning and relating to their environment (Boekaerts, 1999; Dörrenbächer-Ulrich et al., 2024; D. Schunk & Zimmerman, 2012; Zimmerman, 2015). The term "self-regulation" is not a personal attribute, but rather a process that can be observed in individuals. The phenomenon of self-regulation is not exclusive to any particular individual, including those who are perceived to be helpless learners. The distinction between novice and expert learners lies in their differing approaches to utilizing this process in order to achieve a desired outcome (Zimmerman, 2015). Self-regulated learning consists of three components: cognitive, motivational, and metacognitive (Dörrenbächer-Ulrich et al., 2024; Zimmerman, 2015). The cognitive component refers to the understanding of concepts and learning strategies, as well as the application of these strategies. Motivation serves as the driving force that initiates and maintains learning through internal and external resources. Metacognition is a component that engages in planning, monitoring, and regulation of the learning process (Dörrenbächer-Ulrich et al., 2024). The concepts of self-regulated learning and metacognition are distinct. Nevertheless, these two concepts are closely interrelated. The capacity for self-regulated learning cannot be developed in the absence of metacognitive abilities (Dörrenbächer-Ulrich et al., 2024). This is because metacognition constitutes one of the components of self-regulated learning (Dörr & Perels, 2019; Zimmerman, 2015).

Consequently, this article distinguishes between these two concepts in order to provide a more detailed insight into metacognitive training and self-regulated learning. The cultivation of self-regulated learning and metacognition are essential skills for individuals to develop in order to achieve their objectives through cognitive, metacognitive, and motivational processes. Those who possess these two abilities are capable of identifying the ways in which they can achieve their desired outcomes and regulating their own behavior to achieve those outcomes. These two concepts are mutually reinforcing, collectively facilitating the development of a self-regulated learner.

**Table 2.** Review of selected articles

<b>METACOGNITION</b>			
<b>Study</b>	<b>Methods</b>	<b>Sample</b>	<b>Key Findings</b>
(Engel, 2021)	Qualitative	Elementary school teachers	The objective is to investigate the application of metacognitive strategies in everyday learning contexts. Six metacognitive strategies facilitate student learning. These are: In order to facilitate learning, it is essential to prepare students for the learning process. One effective approach is to explicitly communicate the learning objectives. Additionally, it is crucial to assess students' understanding, which can be achieved through impactful questioning. Furthermore, teachers should strive to create an equity learning environment and increase awareness when increasing the level of difficulty.
(Halim et al., 2020)	Mixed-method	20 seven years old elementary school students	The objective of this study is to investigate the efficacy of metacognitive reading strategies (MRS) and peer tutoring. This will be achieved through the administration of questionnaires and interviews. The findings of this study indicate that MRS and PT are not effective in enhancing academic performance. This is due to the influence of other factors on the learning performance of others.
(Labak et al., 2024)	Survey	147 primary school students and 145 secondary school students	The researchers analyzed a biology learning video with the objective of enhancing students' metacognitive abilities. The findings indicate that some educators are not adequately incorporating strategies that enhance metacognition in their pedagogical practices. The article offers several evaluations and recommendations.
(Bogdanović et al., 2022)	Quasi-experiment	110 sixth grade students	This study examines the impact of the Know-Want-Learn (KWL) method with a TQHL chart on students' metacognitive abilities in physics education. The results demonstrate an enhancement in metacognitive abilities among students who employed the mKWL strategy in their learning process.
(Chen et al., 2022)	Quasi-experiment	5-6 years old students	The objective of this study is to examine the impact of metacognition play on students' learning processes and daily activities. The study employed the Circling Curriculum for Metacognition Training (CCMT) program. The results demonstrate that CCMT is an effective intervention for enhancing metacognitive abilities.
(Heyes et al., 2020)	Review	-	Metacognition is a capacity that is acquired from one's environment or cultural learning. The formation of metacognition is influenced by cultural selection, which occurs through

				environmental adaptation, including processes such as discrimination, interpretation, and communication.
(Ain et al., 2023)	Systematic review	-		Peer tutoring is an effective method for developing students' cognitive skills. Peer tutoring enables students to enhance their metacognitive awareness and evaluate their learning environment. The peer tutoring method is an effective approach that can be implemented in a variety of settings, including between students of the same age and between students of different ages (cross-age).
(Y. Lee et al., 2018)	Meta-analysis	-		Review the effectiveness of metacognitive training. Metacognition effectively increases algebraic reasoning.
(Ozturk, 2024)	Review	-		This paper presents a review of Flavell's theory of metacognition. This review highlights the theoretical framework proposed by Flavell that can be used in the design of metacognitive interventions.
(M. F. Teng, 2024)	Review	-		The objective is to elucidate the implications and opportunities presented by virtual reality (VR) games for enhancing students' metacognitive and autonomous abilities.

#### SELF-REGULATED LEARNING

Study	Methods	Sample	Key Findings	
(LIU et al., 2024)	Systematic review	-	The objective of this study is to conduct a systematic review of the literature on the establishment of an environment that promotes self-regulated learning in the flipped classroom. The results of this review are somewhat mixed. Furthermore, the study offers recommendations for designing SRL-oriented interventions within the flipped classroom framework.	
(Lin & Chang, 2023)	Theoretical framework	-	This study presents the CHAT-ACTS framework and its potential for personalizing chatbots to support students engaged in self-regulated learning (SRL), improving motivation and learning outcomes. The model allows students to engage in reciprocal interactions, providing feedback, setting goals, and facilitating the implementation of active learning techniques.	
(Molenaar, 2022)	Prototype	-	The objective of this study was to create a prototype of HHAIR that would facilitate SRL capabilities within the context of adaptive learning technology. This study presents a theoretical, empirical, and intervention design framework for the creation of adaptive AI to support students' self-regulated learning (SRL) development.	
(M. Lee et al., 2023)	Quasi-experiment	214 elementary students	upper school	This study compares self-regulated learning strategies of students in a regular classroom (REG) with those who have undergone self-regulated learning training and students in a self-regulated learning training program with domain-specific strategies (STR). The results demonstrate that the

			STR + SRL approach enhances the utilization of SLR strategies and exhibits superior performance and greater focus compared to the REG + SRL method.
(Sergi et al., 2023)	Qualitative	52 elementary students (7-11 years old)	This study compares the use of SRL and metacognitive strategies when completing tasks on paper and on a computer. The findings indicate that students exhibited greater use of SRL and metacognition when working with paper-based materials compared to computer-based resources.
(Núñez et al., 2022)		758 elementary student (third and fourth grade)	The objective of this study is to investigate the efficacy of the SRL strategy in enhancing academic achievement. The results indicate that the SRL strategy mediates the impact on academic achievement interventions. Moreover, the intervention resulted in an increase in the use of SRL strategies and reading comprehension.
(Lawson et al., 2023)	Quasi-experiment	89 pre-service and in-service teachers from elementary and kindergarten school	This study aims to investigate the level of cognitive engagement in learning environments. The intervention was designed by educators, by using ICAP approach. The learning design emphasizes SRL activities that are related to cognitive processes.
(F. Teng, 2020)	Quasi-experiment	108 elementary school (6 <sup>th</sup> grade)	The objective of this study is to investigate the impact of incorporating text structure modelling as an additional component of the SRL strategy. The experimental design employed three distinct treatment groups: SRSD + CMTS, CMTS, SRSD, and a control group receiving traditional instruction. The results demonstrate that the SRSD + CMTS intervention is the most effective and efficacious method for enhancing comprehension abilities and writing quality.

### *The Nature of Metacognition and Self-regulated Learning*

Metacognitive training is a form of training that incorporates processes and strategies related to metacognition. Metacognition is a capacity that can be acquired from one's surrounding environment (Heyes et al., 2020). Although this ability is intrinsic, it can also be acquired through interaction with the environment, such as feedback and modelling (Ain et al., 2023; Halim et al., 2020). This occurs as a result of social interaction, which shapes specific patterns of thought (Ain et al., 2023; Heyes et al., 2020; Ozturk, 2024).

Metacognition training encompasses all three components of metacognition: knowledge, experience, and regulation (Flavell, 1979). Training programs that are commonly used to enhance metacognition include those that facilitate the improvement of one's knowledge about selves (including understanding, resources, and needs), task understanding (including difficulty level and task understanding), and strategy development (including identification of appropriate and effective strategies) (Labak et al., 2024; Y. Lee et al., 2018). Moreover, training that can enhance metacognitive regulation entails instructing individuals to monitor the information present in their surroundings and regulate their thoughts based on the information they possess (Nelson & Narens, 2000).

In addition, training that can enhance metacognitive experience involves providing students with opportunities to practice and refine existing knowledge in a novel environment (Flavell, 1979). Moreover, eliciting metacognitive responsiveness is an effective method for fostering metacognition. While numerous metacognitive training programs highlight the training of metacognitive knowledge and metacognitive strategy, there is still a lack of literature explaining the training of metacognitive responsiveness. Metacognitive responsiveness plays an instrumental role in prompting individuals to engage in cognitive processes and utilize their metacognitive abilities (Ozturk, 2024).

For individuals to engage in a metacognitive experience, they must engage in a process of thinking (Boekaerts, 1999; Flavell, 1979; Nelson & Narens, 2000). The emergence of metacognitive responsiveness can be facilitated by providing stimuli and treatments that align with the subject (individual), tool (skills, language, resources), task characteristics (complexity, load, demands), environment (interaction, feedback, collaboration), and context (integration across subjects) (Ozturk, 2024). In the absence of an appropriate stimulus, the individual lacks the motivation to engage in metacognition as they fail to comprehend the provided stimulus. Providing reasons such as learning objectives, engaging contexts, and appropriate tools is crucial for fostering metacognition (Chen et al., 2022; Heyes et al., 2020; Ozturk, 2024).

In addition to metacognition, self-regulated learning is also a skill that can be developed through training. Self-regulated learning is a tool that can be used rather than a personality trait (Zimmerman, 2015). The difference between competent and incompetent learners lies in their use of self-regulated learning as a means of achieving their goals. Therefore, self-regulated skill can be attained by training (Latva-aho et al., 2024; D. Schunk & Zimmerman, 2012; Zimmerman, 2015).

Self-regulated training is typically integrated with other subject areas as part of a self-regulated learning program. Training in self-regulated learning encompasses the cognitive, metacognitive, and motivational components (Dörrenbächer-Ulrich et al., 2024). Training in the component of cognition typically entails instruction in the utilization of top-down processing techniques, such as attention and information processing. Metacognition also typically involves planning and reflection. Motivation, on the other hand, involves training individuals to regulate their motivation in order to persevere in completing tasks, such as setting goals (D. Schunk & Zimmerman, 2012). The concept of self-regulated learning views the student as an active learner who is able to regulate his or her own learning processes. Nevertheless, this skill must be developed and learned in accordance with the specific needs and developmental stages of the individual student (D. Schunk & Zimmerman, 2012; Zimmerman, 2015).

Therefore, self-regulated learning and metacognitive training can be acquired by using specific strategies. The strategy should consider the components of metacognition and self-regulated learning. Moreover, the strategy should capture students' attention and prompt them to engage in the processes. The following section provides an overview of the effective strategy for promoting self-regulated learning and metacognitive skills in elementary school students.

#### *Strategies for Improving Metacognition*

There are numerous types of metacognitive training, delivered via a variety of media. The reviewed articles indicate that certain training programs enhance individuals' metacognitive abilities. Several strategies have been identified for enhancing students' metacognitive skill at the elementary

school level. These include the IMPROVE method (Y. Lee et al., 2018), the Circling Curriculum for Metacognition Training (Chen et al., 2022), Know-What-Learn and TQHL charts (Bogdanović et al., 2022), and peer tutoring (Ain et al., 2023; Halim et al., 2020). Additionally, several metacognitive strategies are employed in language and reading instruction, including GLOB, SUP, and PROB (Halim et al., 2020). The media and methodologies for metacognitive strategies are also diverse, encompassing approaches such as games (M. F. Teng, 2024), traditional classroom instruction with metacognitive strategies (Bogdanović et al., 2022; Engel, 2021; Labak et al., 2024; Y. Lee et al., 2018), and computer-based learning (M. F. Teng, 2024).

IMPROVE represents a metacognitive strategy employed in the context of mathematical learning. Review by Y. Lee et al., (2018) shows that several strategies could improve mathematic abilities. One of the strategies used for elementary students is IMPROVE. IMPROVE strategy has enhanced students' learning effectiveness compared to traditional classroom methods that do not incorporate metacognitive approaches. It was implemented with students in the third and sixth grades. The IMPROVE program incorporates several metacognitive exercises, including the following: 1) Comprehension: The students can comprehend and explain the issues in their language. 2. Connection: The third step is to link the current issue to past problems that have arisen in the past. The fourth step is to determine effective strategies for resolving the issue. Determine an effective strategy for resolving the issue and justify why it is an effective strategy. 4) Reflection: Reflection on one's role as a problem solver includes both the process and the outcome. One must inquire of oneself whether the solution is logical. Might an alternative strategy be employed? The method is provided in the form of cards. Before implementing this method, the teacher explains how to answer metacognitive questions through modelling.

The Circling Curriculum for Metacognition Training (CCMT) by Chen et al., (2022) represents a specific learning strategy for metacognition. This method is integrated with play and implemented with students in the early elementary school years. This method has been demonstrated to be an effective means of enhancing students' metacognitive abilities. CCMT represents a form of intervention that employs metacognitive components, including knowledge, regulation, and monitoring. The intervention is divided into three phases, each corresponding to a specific period. The first phase, designated as "Pre-play," involves a reflective dialogue between the teacher and the student, guiding the student to formulate a plan and make predictions about the upcoming activity. This process aims to establish a metacognitive foundation for future play activities. 2) In-play: It is important to observe and record the cognitive regulations employed by students during play. 3) Post-play: the use of different pedagogical strategies to help students recall the cognitive processes used during the act of play. The objective is to foster the development of evaluative and reflective skills. The application offers a high degree of flexibility, allowing students to determine their activities. This also helps the teacher to modify strategy according to needs.

The Know-What-Learn-How (KWLH) strategy by Bogdanović et al., (2022) is a metacognitive approach to active learning. This approach can enhance students' metacognitive awareness. The KWL model consists of four stages: recalling prior knowledge, identifying desired knowledge, recalling learned material, and seeking further learning opportunities. The KWL and TQHL models can be combined. The TQHL concept is broadly similar to that of the KWL, namely T: What do I think? Q: What do I question? H: How do I achieve it? L: What I learned? These strategies help the individual become more aware of their knowledge, strategies, and regulations.

In addition to the above strategy, several regular classroom strategies can help promote metacognition. This includes activating existing schemas (Engel, 2021; Labak et al., 2024), explaining the topic and the desired outcomes (Ain et al., 2023; Engel, 2021; Halim et al., 2020), modelling metacognitive processes (Engel, 2021), engaging in discussion, reflection, and questioning, providing space for students to process and regulate their cognition (Labak et al., 2024; M. F. Teng, 2024),

conducting follow-up and feedback, and so forth. These strategies may be employed in various ways and media, including peer tutoring, collaborative learning (Ain et al., 2023; Halim et al., 2020), computer-based learning, play, or even game-based learning (M. F. Teng, 2024). It is crucial to use these strategies in appropriate contexts and to tailor them to individuals in a manner that encourages the development of metacognitive abilities.

#### *Self-regulated Learning Strategy*

There are several strategies that can be used to increase an individual's capacity for self-regulated learning. These strategies entail incorporating self-regulated learning components into the learning context. The selected articles demonstrate that self-regulated learning can be acquired through storytelling (F. Teng, 2020), integrated into regular classes (Lawson et al., 2023; M. Lee et al., 2023; Núñez et al., 2022; Sergi et al., 2023), or flipped class (LIU et al., 2024). There is strategy that conceptualized self-regulated learning within an eight-phase cyclical model (M. Lee et al., 2023). Additionally, another strategy categorizes self-regulated learning activities that encompasses beliefs, emotions, motivations, metacognition, cognition, environments, and social factors (Lawson et al., 2023).

The study conducted by F. Teng, (2020) highlights the difference between integrating storytelling with a self-regulated learning strategy and integrating storytelling with a reading comprehension strategy. The findings indicate that a reading comprehension strategy is more effective in enhancing students' reading abilities. This is due to the fact that the use of self-regulated learning is still in its early stages in younger children. It is therefore necessary for teachers to provide models and guidance on self-regulated learning strategies. Furthermore, Self-regulated learning requires a lengthy developmental process in younger children for it to take effect immediately.

Another study by M. Lee et al., (2023) presents an eight-phase cyclical model of self-regulated learning. The model is comprised of three phases, each of which is subdivided into constituent parts. The initial phase, designated as the "forethought phase," encompasses a series of essential processes, including self-assessment, task analysis, goal setting, and strategic planning. This phase allows students to take a moment to pause and analyze the task at hand before proceeding with its completion. This is followed by the performance control phase in which the student performs the task according to the established strategy or adapts to a novel strategy as needed. This phase comprises the implementation of the strategy, monitoring of the strategy, and adjustment of the strategy. The final phase is the self-reflection phase, during which students reflect on the knowledge they have acquired. This phase comprises an outcome evaluation, which encompasses feedback and future improvement.

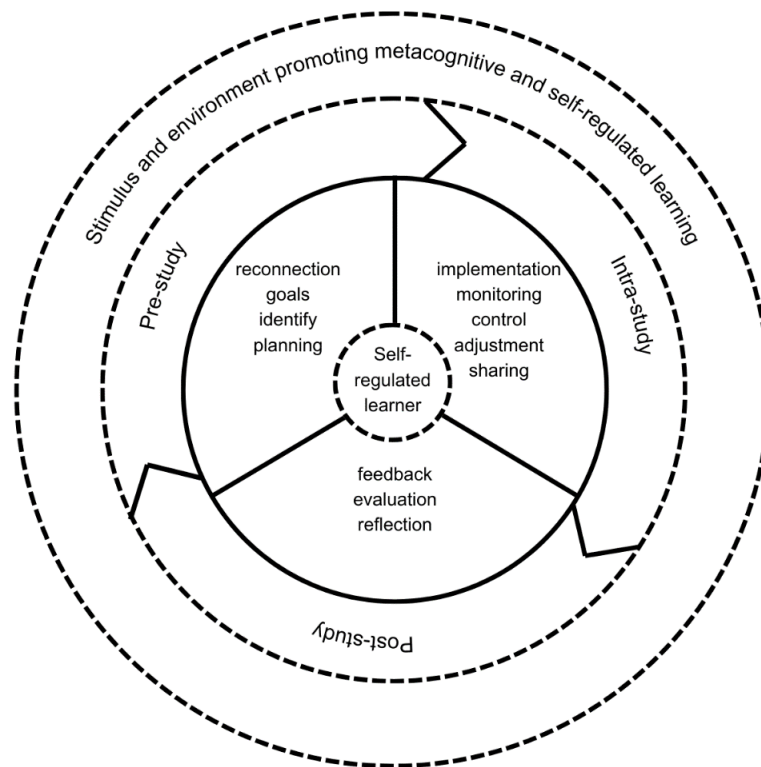
Research by (Lawson et al., 2023) describes a seven-part structure of activities related to the self-regulated learning strategy. Lawson's study illustrates that these activities consist of emotional components, specifically related to one's feelings about academic subjects, personal characteristics, and the environment. Next, motivational activities related to preferences and commitment are discussed. This activity is conducted with the objective of instilling confidence, providing feedback, or establishing learning objectives. In addition, metacognitive activities relate to the formulation of plans, reflection, and the identification of gaps in one's knowledge in the context of learning. Another strategy is the management of the learning environment, which includes time management, the use of tools, and the creation of an optimal learning environment. Then, the concept of belief can be defined as an understanding of the values that an individual holds. Subsequently, cognition is defined as a top-down process comprising attention, organization, memory, and so forth. The final category is social, which involves social interaction with people in one's social circle.

Furthermore, self-regulated learning can be facilitated through a variety of pedagogical approaches, including the flipped classroom (LIU et al., 2024), collaborative and individual settings (Lawson et al., 2023). Self-regulated learning can also be conducted with a variety of media. However, previous research indicates that younger students tend to utilize self-regulated learning more effectively

on paper than on a computer (Sergi et al., 2023). Another emerging medium is the use of AI chatbots that can be personalized to assist students in developing self-regulated learning (Lin & Chang, 2023; Molenaar, 2022).

## DISCUSSION

Metacognition and self-regulated learning are abilities that can be taught to students. This ability is taught through the implementation of various strategies that encompass the components of metacognition and self-regulated learning (Dörrenbächer-Ulrich et al., 2024; Ozturk, 2024). These two components are typically integrated into classroom learning through the implementation of various strategies. The results of the review allow for the creation of a framework related to metacognitive training and self-regulated learning strategies. The construction of the framework is divided into three phases (pre-, intra-, and post-) to facilitate the implementation of interventions in the classroom. It is important to note, however, that all processes of self-regulated learning and metacognition occur during the act of learning and are not fixed. In addition, the classroom environment must also be managed in a manner that is appropriate for the specific class and context in order to facilitate the emergence of metacognitive and self-regulated learning processes (Engel, 2021; Ozturk, 2024). The framework for the strategy is illustrated in **Picture 1**.



**Picture 1.** Framework of the self-regulated learning and metacognition strategy

The implementation of this strategy is feasible within the context of the Indonesian curriculum, which is commonly referred to as "Kurikulum Merdeka." The Kurikulum Merdeka is a curriculum taught through a diverse range of learning methods. The flexibility of the Kurikulum Merdeka allows educators to design classroom learning experiences that align with students' individual needs. This curriculum can facilitate the implementation of adaptive metacognitive and self-regulated learning strategies, tailored to the specific needs and abilities of students, due to its flexible learning approach

(Kemendikbud, 2022; Nurani et al., 2022). The integration of metacognition and self-regulated learning strategies within the framework of the Kurikulum Merdeka can effectively promote these processes.

The initial step is to prepare the stimulus and environment in a manner that is conducive to the development of metacognition and self-regulated learning. The preparation of stimuli should be tailored to the subject, tools, task, environment, and object in question (Ozturk, 2024). This will prompt students to engage in cognitive processes and utilize their metacognitive and self-regulated learning abilities. Moreover, the learning environment can be designed to incorporate a variety of instructional approaches, including flipped classroom (LIU et al., 2024), collaborative classroom (F. Teng, 2020), play (Chen et al., 2022), games (M. F. Teng, 2024), peer tutoring (Ain et al., 2023; Halim et al., 2020), storytelling (F. Teng, 2020), or regular class integrated with metacognitive and self-regulated learning strategies (Lawson et al., 2023; M. Lee et al., 2023). Furthermore, the classroom environment should be designed to instill students with a sense of self-assurance, provide a secure space for learning, and encourage students to ask questions (Engel, 2021). Moreover, the implementation of scaffolding and modeling by the instructor can facilitate the creation of a conducive learning environment that enhances metacognitive abilities and self-regulated learning (Labak et al., 2024).

The pre-study phase represents a strategy employed during instructional period before initial study begin. In this phase, the teacher explains clearly about the topic to be studied and collaborates with the students in establishing learning plan. Previous research explained by clearly explain the topics and learning goals, it will emerge metacognition and self-regulated learning process (Bogdanović et al., 2022; Engel, 2021; Labak et al., 2024; M. Lee et al., 2023; Sergi et al., 2023). This is also done in order to engage the motivational component of self-regulated learning. The establishment of goals has been demonstrated to enhance motivation and facilitate the attainment of those goals (Lawson et al., 2023). In this phase, the teacher also encourages students to recall experiences related to the subject matter, thereby activating existing scheme (Bogdanović et al., 2022; Engel, 2021; Labak et al., 2024). The students are also requested to identify both the known and unknown aspects of the learning material. This process involves metacognitive components of knowledge and experience.

The intra-study strategy is employed during the course of study. In this phase, teacher requests that students to implement the learning plan and monitors the learning process. Additionally, students are instructed to make adjustments if the strategy proves ineffective (M. Lee et al., 2023; Sergi et al., 2023). During this time, teacher should gradually release students to think on their own with their activities. This is done to allow the students to give control over their own cognitive process (Engel, 2021; M. F. Teng, 2024). Teacher should encourage asking questions by modelling curiosity to the students. Teacher should also ask impactful question to students to invoke their interest and reconnection to their daily lives (Engel, 2021; Labak et al., 2024). Students are also encouraged to discuss and share their cognitive processes with one another. This is done to provide students with insight into the learning processes of their peers and to enable them to evaluate their own learning processes (Ain et al., 2023; Halim et al., 2020),

The post-study phase represents the period after the learning process. This process includes feedback, evaluation, and reflection. This process should be guided by teachers as reflective and evaluation skill only explicitly appears around fourteen years old (Veenman et al., 2004). Feedback should be clear and thought-evoking but concrete enough for elementary student. Providing feedback allowing them on reflecting and evaluation the learning process (Labak et al., 2024; M. Lee et al., 2023). Teacher should also model on how to do evaluation and reflection so the students will be able to follow example (Labak et al., 2024). It is also necessary to encourage and reinforce on their effort and progress doing the learning process to evoke motivation and engagement to the process (Lawson et al., 2023; Molenaar, 2022; Sergi et al., 2023).

## CONCLUSION

This review highlights strategies that can be used by elementary school students to enhance metacognitive skills and self-regulated learning. In addition, we provide a framework of synthesized metacognitive strategies based on the synthesis of several reviewed articles. The framework has been developed in accordance with the phases of time, with the aim of facilitating the practical application of the framework in the classroom. Furthermore, the framework emphasizes the importance of an environment that encourages students to engage in self-regulated learning and metacognition. The framework includes several layers, the first of which is an environment that facilitates the process, and the second is a strategy based on a time schedule. The time scheme is comprised of three phases: pre-learning, intra-learning, and post-learning. Each section explains the strategies that can be used by elementary school students. It is hoped that this study will contribute to the enhancement of metacognitive abilities and self-regulated learning among elementary school teachers.

## LIMITATION AND FUTURE RESEARCH

It should be noted that this review is subject to certain limitations. Firstly, this review is limited to open access articles due to the restricted access available to subscribed articles. Moreover, the efficacy of the framework design remains unknown. Future researchers may use this framework to evaluate its effectiveness. Although the framework is flexible and requires few resources, the challenges that may arise remain unknown. Future researchers may report on the challenges encountered in implementing this strategy. A lack of research on the self-regulated learning and metacognitive strategies on primary school makes it difficult to find open access articles that meet the inclusion criteria. Hence, the lack of article selected in this review.

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