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Metacognitive Awareness Profile of Students in Indonesia: Initial Study on the Development of Biology Learning Models to Support Improvement of Metacognitive Skills

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Abstract:
The research is a preliminary study aiming to analyze students' metacognitive awareness in Salatiga High School, Central Java, Indonesia. The results of this study are used as the basis for creating a learning model that can improve students' metacognitive skills. Researchers use the MAI (Metacognitive Awareness Instrument) given to 477 students and analyze it using quantitative and qualitative analysis. The results show that students' knowledge of cognitive strategies, skills, and abilities (declarative knowledge) reach 67.42%, and cognitive regulation of planning components related to the utilization of planning, strategy, design, and resources only reach 67.65%. Simultaneously, their knowledge of using the components of learning strategies (information management strategies), monitoring understanding, and assessment and learning efficiency (evaluation) only reaches 64.44%, 72.9%, and 68.62%, respectively. The analysis of each metacognitive awareness component concludes that students' metacognitive awareness is still lacking. Therefore, learning strategies and models that can increase awareness and metacognitive skills are needed.

Keywords: metacognitive awareness, metacognitive knowledge, metacognitive regulation.

印度尼西亚学生的元认知意识概况：关于开发生物学习模型以支持元认知技能改进的初步研究

摘要:
该研究是一项初步研究，旨在分析印度尼西亚中爪哇省 Salatiga 高中学生的元认知意识。本研究的结果被用作创建可以提高学生元认知技能的学习模型的基础。研究人员使用提供给 477 名学生的 MAI（元认知

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意识工具）并使用定量和定性分析对其进行分析。结果表明，学生的认知策略、技能和能力（陈述性知识）知识达到 67.42%，与规划、策略、设计和资源利用相关的规划组成部分的认知调节仅达到 67.65%。同时，他们对使用学习策略（信息管理策略）、监控理解、评估和学习效率（评估）组件的知识分别仅达到 64.44%、72.9%和 68.62%。对每个元认知意识成分的分析得出结论，学生的元认知意识仍然缺乏。因此，需要能够提高意识和元认知技能的学习策略和模型。

关键词: 元认知意识、元认知知识、元认知调节.

1. Introduction

The era of globalization and knowledge and rapid changes in the world impacts every aspect of life, one of which is education (Widihastuti, 2013). Currently, education is expected to meet the demands of the globalization era and face the challenges of the knowledge era or intellectual era. Metacognitive skills are critical thinking skills that must be added to students' education to meet the demands and challenges of future generations' globalization (Corebima, 2016; Siswati & Corebima, 2016). Improving good and positive academic learning and self-efficacy can be done using metacognitive knowledge and awareness and learning strategies by students (Okoza et al., 2013). Thus, metacognitive skills are one of the primary needs in learning.

Flavel first introduces the term metacognition in 1976 (Palmer et al., 2014; Bahri & Corebima, 2015). Metacognition is defined as information and cognition about cognitive phenomena and is conceptualized as student information about cognition itself (Hertzog & Dunslosky, 2011; Louca, 2008; Yusnaeni et al., 2017). Metacognition skills are thinking skills about thinking (Palmer et al., 2014; Nelson & Narens, 1994; Siswati & Corebima, 2016; Kisac & Slave, 2013; Jaleel & Premachandranremachandran, 2016), knowledge about knowledge, or reflection about an action (Slavin, 2009; Scraw, 1998). Weil et al. (2013) state that metacognition is the ability to reflect on one's thoughts and behavior. Yusnaeni & Corebima (2017) reiterate that metacognition is a process of thinking about how to think about using specific strategies to solve problems until finally making decisions. Also, metacognition can be defined as thoughts, beliefs, and cognitive processes that aim to assess and control one's cognition (Hertzog & Dunslosky, 2011; Akturk & Sahin, 2011), individuals' awareness of their ability to monitor and regulate their activities related to learning. Furthermore, Kisac & Slave (2013) stated that metacognition regulates one's thinking and learning processes.

Currently, many studies have developed learning models that can improve metacognitive skills. Several studies have shown that metacognitive awareness plays a role in increasing academic motivation (Oz, 2016). Metacognition activities are carried out before starting cognitive activities (planning), during learning activities (monitoring), or after learning, activities are completed (evaluation) (Oz, 2016). Cencelj, Abersek, Flogie, & Abersek (2020) also develop metacognitive models suitable for improving literacy skills in science, technology, and engineering. The model has proven successful. Bahri & Corebima's (2015) research results show that the contribution of metacognitive skills to cognitive learning outcomes is better than learning from motivation. Kristiani, Susilo, Rohman, & Corebima (2015) prove that metacognitive skills have a better effect than scientific attitudes. Pantiawati & Husamah (2017) reveal in their study that self and peer assessment in active learning can increase metacognitive awareness and cognitive abilities. Metacognitive awareness also has a direct contribution to student cognition. Palennari (2016) shows that metacognitive awareness and skills can be empowered by applying problem-based learning models. Another learning model that has successfully improved metacognitive skills is PQ4R, combined with a concept map (Ramdiah & Corebima, 2014).

Metacognitive awareness is the ability to recognize and regulate thinking skills (Scraw & Dennison, 1994; Hughes, 2017). Metacognitive awareness includes knowledge of cognition and cognition regulation (Scraw & Dennison, 1994; Scraw, 1998; Scot & Berman, 2013; Bahri & Corebima, 2015; Hughes, 2017). Weil et al. (2013) reveal that metacognitive abilities increase significantly with adolescents' highest level as humans age in adolescence. The capacity will continue to grow until adulthood.

Metacognitive knowledge refers to what an individual knows about cognition or cognition in general. Cognitive learning consists of three parts: declarative knowledge, procedural knowledge, and conditional knowledge evaluation (Scraw, 1998; Kisac & Slave, 2013). Declarative knowledge refers to knowing things about something. Declarative knowledge is the knowledge a person has about his cognitive strategies, skills, and abilities that affect learning, memory, skills, strategies, and resources needed to perform a task. Procedural knowledge refers to a person's knowledge of using technical strategies to improve performance and achieve cognitive tasks. Conditional knowledge refers to knowing the why and when aspects of cognition (Scraw, 1998). It refers to a person's knowledge of when and why to use strategies to solve problems.

Metacognitive regulation is the ability to monitor learning and cognitive processes (Scot & Berman, 2013), which refers to a series of activities that help students control it. Research from experts supports the assumption that metacognitive regulation improves performance in several ways, such as better attention, learning strategies, and understanding awareness. Cognitive settings consist of five parts: planning, monitoring, organizing, debugging, and evaluating (Scraw, 1998; Kisac & Slave, 2013). Students need to plan, monitor, and evaluate the learning process to provide opportunities for themselves to monitor the effectiveness of the learning process that has been implemented (Feyzioglu et al., 2018). Self-monitoring strategies used in learning will affect student self-monitoring and the development of academic achievement levels (Arslantas & Kurnaz, 2017).

Planning includes choosing the right strategy before implementing it. It determines the time needed to perform the task, the right strategy, and the resources. It explains how to start, what to follow, what to do, what to do with attention, and so on. Monitoring is an awareness of "how I am".

Monitoring is self-awareness whether the understanding obtained is sufficient. Individuals who monitor their learning effectively can control it more effectively by choosing to repeat lessons selectively. Metacognition consists of two keys: self-monitoring and new strategies based on monitoring (Hertzog & Dunslosky, 2011). Debugging occurs when a person uses strategies to identify and correct mistakes and assumptions about the tasks and strategies implemented (Scraw, 1998; Hughes, 2017). Organizing is concerned with the information management sub-process that uses cognitive strategies and techniques to manage information. Evaluation is an assessment of performance after completing a task (Hertzog & Dunslosky, 2011). The process involves assessing the processes and outcomes of thinking and learning. Ongoing monitoring and control of cognition metacognition play a key role in reading and listening comprehension, memory performance, and independent learning in general (Destan et al., 2014).

Metacognitive skills allow students to develop themselves into independent learners because they encourage students to become managers and assessors of their thinking and learning (Syarifah & Corebima, 2016). Metacognitive skills help students solve their learning problems (Hertzog & Dunslosky, 2011; Akturk & Sahin, 2011; Oz, 2016; Yusnaeni & Corebima, 2017) and lesson questions successfully. Metacognitive skills are instrumental in improving student learning outcomes (Ardila & Corebima, 2013; Baltaci et al., 2016; Mayer, 1998) to develop knowledge (Syarifah et al., 2016) and assist them in decision making (Weil et al. al., 2013). Students with good metacognitive abilities are aware of what they have done and what they do not know.

Learning that uses a metacognitive skill approach trains and instills awareness of designing, monitoring, and controlling what students know. It relates to what is needed to do the task and how to do the task. Therefore, teachers need to pay attention to students' metacognition strategies and components to improve learning outcomes (Iskandar, 2014; Bahri & Corebima, 2015; Syarifah & Corebima, 2016). According to Flavel, the Metacognition strategy consists of three types of cognitive knowledge: 1) Conscious knowledge, which involves understanding what we know, don't know, and want to know. The category may also include awareness of other people's knowledge; 2) Mindfulness of thinking, which means the understanding of cognitive tasks and what characteristics are needed to complete a task; 3) Awareness of thinking strategy, which means understanding the direct learning approach (Jaleel & Premachandran, 2016). All students can follow several metacognition skills: 1) Knowing one's boundaries, understanding one's memory limits for specific tasks, and creating external support tools; 2) Self-monitoring, which involves self-monitoring strategies, such as concept mapping and adapting to other methods when the first strategy is ineffective; 3) Modifying means paying attention to whether someone understands something he has just read then modifying his approach if other people do not understand it; 4) Practice means skills that are often trained to acquire proficiency; 5) Self-testing, which means testing yourself regularly to see how well someone is learning something (Jaleel & Premachandran, 2016).

Not all schools have developed metacognitive skills for students and the condition results in low student learning outcomes in Indonesia (Yulianti et al., 2017; Corebima, 2016; Ardila & Corebima, 2013; Syarifah & Corebima, 2016; Keliat et al., 2014; Ramdiah & Corebima, 2014; Pantiawati & Husamah, 2017). The minimal development of students' metacognition causes poor student learning outcomes. In turn, poor learning outcomes result in low quality of education in Indonesia. Based on the results of the PISA (Program for International Student Assessment) in 2018, the reading, math, and science scores of students in Indonesia are still lower than the average score of OECD participants (The Organization for Economic Co-operation Development (OECD, 2019).

Another fact is that there are still teachers who still do not use anonymous learning or conventional learning. The learning only uses lectures, questions and answers, and assignments without exploring and developing students' metacognitive abilities (Corebima, 2016). According to research by Febriani et al. (2017), learning that uses a teacher-centered approach can cause student learning outcomes to be less than optimal.

Based on the above problems, the researcher wants to know the profile of high school students about metacognitive awareness to develop students' metacognitive awareness through a learning model that is following the student's condition. The results of this study are used as the basis for creating a learning model that can improve students' metacognitive skills.

2. Research Methodology

The research population is all high school students of Class 10 in Salatiga, Central Java, from six senior high schools. Participants in the study are all Class 10 of Satya Wacana Christian High School, Christian Senior High School 1 Salatiga, Catholic Senor High School Theresiana, State Senior High School 1, State Senior High School 2, and State Senior High School 3 Salatiga consisting of 477 students.

MAI (Metacognitive Awareness Inventory) instrument is used as the research instrument to obtain data on students' metacognitive awareness. The MAI questionnaire sheet is a data collection technique where students answered 52 true or false statements available in the MAI questionnaires.

The research data were analyzed using quantitative and qualitative analysis with a percentage technique. Each result of the questionnaire from schools was analyzed and described based on each component of metacognitive awareness. After the analysis of every school was carried out, further analysis was conducted for metacognitive awareness of all class 10 students of Senior High Schools of Salatiga.

3. Results and Discussion

Questionnaire data containing answers to students' metacognitive awareness components are analyzed one by one, based on its components. Based on the percentage graph (%) of each element of the MAI (Metacognitive Awareness Instrument), it is known that the elements of knowledge of 10th-grade high school students in Salatiga, namely declarative knowledge (DK), procedural knowledge (PK), and conditional knowledge (CK) only reaches 67.42%, 73.69%, and 78.28%. The knowledge component is students' knowledge of what they know about themselves. It includes the strategies and conditions in which they are most helpful. The regulatory part, namely planning (PL), information management strategy (MS), and evaluation (EV), only reaches 67.65%, 64.44%, and 68.62%. Meanwhile, monitoring understanding (CM) and debugging strategy (DS) accounted for 72.9% and 83.02%, respectively. The cognitive component of regulation consists of students' activities on planning strategies, implementing strategies, monitoring, correcting misconceptions, and evaluating their learning.

Figure 1 shows that metacognitive knowledge components for declarative knowledge are 67.42%. It also indicates 73.69% for procedural knowledge and 78.28% for conditional knowledge. Metacognitive knowledge is an understanding of how thinking works in general and in particular (Louca, 2008).

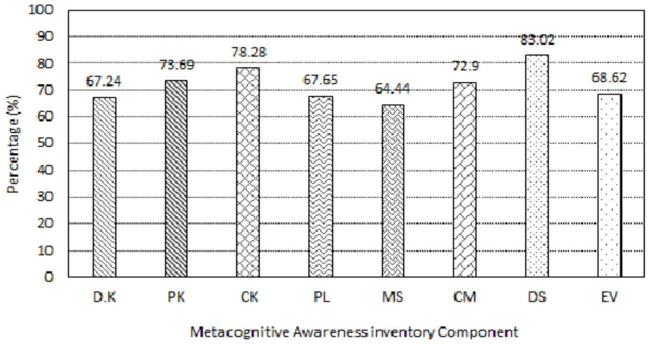

Figure 1. Graph of the percentage (%) of each MAI (Metacognitive Awareness Instrument) component of Class 10 students of senior high schools of Salatiga

Figure 2 shows that only 51.99% of students feel proficient in organizing and managing information in Biology, 48.01% feel skilled at remembering information, 61.84% think they have mastered Biology, and 59.33% of students can self-assess how well they had understood a material.

The data shows several weaknesses of students in declarative knowledge. Declarative knowledge means knowledge about a person's cognitive strategies, skills, and abilities (Contessa et al., 2015; Pifarre & Cobos, 2009). Declarative knowledge skills understand the fundamental skills a person must have to start the learning process. Students who have good declarative knowledge will know the impact of their learning, have a good awareness of what to do in doing assignments and the learning process, and are aware of their ignorance. However, the research results show that students still face many difficulties remembering, organizing, and managing information about biology, the lack of mastery of the material, and challenges in assessing mastery of the material.

Increasing the declarative knowledge process can be done by training metacognitive awareness by applying appropriate learning models and strategies (Downing & Ning, 2010; Lee et al., 2010; Seraphin et al., 2012). One of the suitable learning models to improve the ability to remember, compile and manage information on Biology material, solve problems with minimal mastery of the material, and overcome difficulties in assessing knowledge of the material is PQ4R. Students are trained to preview, question, read, reflect, recite, and review this model. Each stage will maximize all potential or students' senses so that learning outcomes can be maximized.

MAI Components	The item	Statement	Frequency	Percentag (%)
		Knowledge		
Declarative knowledge	5	I understand my intellectual strengths and weaknesses in studying Biology.	429	89.94
	10	I know what kind of information is most important to learn when studying Biology.	356	74.63
	12	I am good at organizing information in studying biology.	248	51.99
	16	I know what the teacher expects me to learn.	350	73.38
	17	I am good at remembering information.	229	48.01
	20	I have control over how well I learn.	295	61.84
	32	I am a good judge of how well I understand something.	283	59.33
	46	I learn more when I am interested in a Biology topic.	376	78.83
Procedural knowledge	3	I try to use strategies in studying Biology that have worked in the past.	417	87.42
	14	I have a specific purpose for each strategy I use.	354	74.21
	27	I am aware of what strategies I use when I study Biology	356	74.63
	33	I find myself using helpful learning strategies automatically in studying Biology.	279	58.49
Conditional knowledge	15	I learn best when I know something about the topic.	386	80.92
	18	I use different learning strategies depending on the situation.	379	79.45
	26	I can motivate myself to learn when I need to.	401	84.07
	29	I use my intellectual strengths to compensate for my weaknesses.	381	79.87
	35	I know when each strategy I use will be most effective when studying Biology.	320	67.09
		Regulation		
Planning	4	I pace myself while learning in order to have enough time.	216	45.28
	6	I think about what I really need to learn before I begin a task.	383	80.29
	8	I set specific goals before I begin a task.	298	62.47
	22	I ask myself questions about the Biology material before I begin.	255	53.46
	23	I think of several ways to solve a problem and choose the best one.	429	89.94
	42	I read instructions carefully before I begin my Biology assignment.	385	80.71
	45	I organize my time to best accomplish my goals of studying Biology.	293	61.43
Information management strategies	9	I slow down when I encounter important information.	278	58.28
	13	I consciously focus my attention on important information when studying Biology.	349	73.17
	30	I focus on the meaning and significance of new information when studying Biology.	391	81,97
	31	I create my own examples to make information more meaningful.	228	47.80
	37	I draw pictures or diagrams to help me understand while studying Biology.	191	40.04
	39	I try to translate new information into my own words.	414	86.79
	41	I use the organizational structure of the text to help me study existing texts in Biology.	220	46.12
	43	I ask myself if what I'm reading is related to what I already know.	375	78.62
	47	I try to break studying down into smaller steps.	380	79.66
	48	I focus on overall meaning rather than specifics.	248	51.99
Comprehension monitoring	1	I ask myself periodically if I am meeting my goals.	339	71.07
	2	I consider several alternatives to a problem before I answer.	442	92.66
	11	I ask myself if I have considered all options when solving Biology problems.	322	67.51
	21	I periodically review to help me understand important relationships.	302	63.31
	28	I find myself analyzing the usefulness of strategies while I was studying Biology.	298	62.47
	34	I find myself pausing regularly to check my comprehension of the Biology material.	402	84.28
	49	I ask myself questions about how well I am doing while I am learning something new Biology material.	329	68.97
Debugging strategies	25	I ask others for help when I don't understand a biology topic.	443	92.87
	40	I change strategies when I fail to understand a biological subject.	399	83.65
	44	I reevaluate my assumptions when I get confused.	388	81.34
	51	I stop and go back over new information that is not clear.	339	71.07
	52	I stop and reread when I get confused about a topic of biological material.	411	86.16
Evaluation	7	I know how well I did once I finish a Biology test.	364	76.31
	19	I ask myself if there was an easier way to do things after I finish a Biology assignment.	394	82.60
	24	I summarize what I've learned after I finish.	243	50.94
	36	I ask myself how well I accomplish my goals once I'm finished studying Biology.	321	67.30
	38	I ask myself if I have considered all options after I solve a problem.	329	68.97
	50	I ask myself if I learned as much as I could have once I finish a Biology assignment	313	65.62

Figure 2. Percentage analysis (%) of each item of statement components of MAI (metacognitive awareness instrument)

The procedural knowledge component data shows that 58.49% of students realize that they automatically used learning strategies to study biology. Procedural knowledge refers to a person's ability to use strategies or techniques to improve their performance and complete cognitive tasks. A person with good procedural knowledge will have the ability to use specific strategies to complete a task. It will make it easier for students to complete a task related to their cognition because they know what techniques, strategies, or steps are needed and must be done to complete the task.

However, the facts show that students still have difficulty using learning strategies appropriate to their subjects and learning difficulties. The difficulties will impact student learning outcomes because they cannot maximize the learning process.

The conditional knowledge component data shows that 67.09% of students know when to use the most effective biology strategy. Conditional knowledge refers to a person's knowledge of when and why strategies are chosen to complete the task. In this case, a person can use and choose the right strategy to complete a task related to cognition. However, the facts show that some students have difficulty choosing and determining effective learning strategies when studying a biology subject matter.

The ability to have declarative knowledge and procedural knowledge about applying appropriate learning strategies and knowledge about using the right strategies have become abilities that individuals must have when starting the learning process. It can be trained to be better by applying learning strategies or models by teachers in the classroom.

The components of cognition regulation include students' activities on planning and implementing strategies, monitoring, correcting misconceptions, and evaluating their learning. The planning, monitoring, and organizing processes involve two levels of interaction. The first level is creative, associative, and imaginative, and the second level is being an executive or someone who always completes tasks. As shown in Figure 1, the planning component only reaches 67.65%, the information management strategy only reaches 64.44%, monitoring understanding reaches 72.9%, the debugging strategy achieves the best results, namely 83.02%, and evaluation only reaches 68.62%.

The components of planning cognition regulation show that 45.28% try to be a fast learner, 62.47% set specific goals before starting to work on a task, 53.46% ask themselves before studying the material, and 61.43% of students manage their time as best as possible to achieve the goals of studying Biology.

Cognitive regulation refers to activities that help students plan and control their learning process (Setiawati & Corebima, 2018). Planning is concerned with planning, strategy, goal setting, and the resources associated with completing tasks that affect one's performance. The results show that students experienced difficulties in managing the time allocation needed in learning. Students are weak in setting and determining learning objectives. Son & Metcalfe (2000) state that time allocation is influenced by the learning objectives and the material of interest. The problem is that few students set learning goals before they start studying Biology. The condition will cause students difficulties when starting learning because they cannot evaluate learning outcomes based on the objectives.

According to Son & Metcalfe (2000), several factors cause students not to determine learning objectives and not manage time allocations when studying a subject matter. The factors include material that is considered complex or less attractive. Students do not monitor their learning and prefer material that is considered easy for them. It is a challenge that must be faced in the classroom. Teachers must provide motivation and stimulation to students in learning by applying appropriate and attractive learning models and strategies to improve their academic and metacognitive achievement. Students need to be taught to control their learning. Therefore, teachers need to train students to plan, implement, and evaluate strategies and approaches in learning, especially in solving material problems (Palincsar, 1986).

Salatiga Senior High School students' cognitive regulation shows that only 67.65% of students have good planning skills. Planning is used to describe a person's ability to choose the right strategy, set goals, and allocate resources. It impacts students' inability to plan appropriate strategies, goals and allocate existing resources to affect performance, and consequently, learning outcomes are not optimal. The low ability of students in planning can be caused by insufficient declarative knowledge and procedural knowledge.

Students' inability to understand cognition and its weaknesses and strengths, understand the learning objectives, and use strategies and techniques to solve a problem or task will cause students not to have a good learning plan that will result in poor learning outcomes. According to Scraw (1998), improving student performance can be done by planning, sequencing, and monitoring the learning process. It can only be done well if students have good metacognitive awareness.

The component data of information management strategy shows that 58.28% of students slow down their performance when finding the necessary information. Students take this action so that they have time to analyze the subject matter or important information they can attach to long-term memory to increase understanding of the subject matter. However, the study also finds that only 47.80% of students make their examples so that the information obtained is more meaningful, 40.04% make pictures, or diagrams, to help them understand, 46.12% used organizational structures. text to assist them in studying Biology texts, and 51.99% of students focus on the overall meaning rather than the specific meaning

Information management strategy is an active process of organizing, delineating, summarizing, and selectively focusing on information essential for cognitive restructuring due to cognitive dissonance. The ability of information management strategies is needed when students learn a subject matter. The application of metacognitive strategies can improve students' academic quality and empower students' metacognitive abilities (Diaz, 2015; Dagal & Bayindir, 2016). The process is expected to provide good results if all student learning abilities are maximized. Research by experts proves that high metacognitive awareness will result in good academic achievement (Baltaci et al., 2016). But in reality, students still have difficulty maximizing the learning strategies so that the results are not optimal.

The comprehension monitoring component shows that 67.51% of students ask themselves whether they consider all options when solving problems, 63.31% review their learning to understand essential relationships, 62.47% are aware of the importance of analyzing benefiting from strategy, and 68.97% ask themselves how well they are progressing in learning new Biology material.

Monitoring refers to the student's ability to assess cognition and the effectiveness of the strategies that have been carried out during the learning process. In other words, monitoring is the arrangement and monitoring of student learning activities and progress (Setiawati & Corebima, 2018). Monitoring activities can be an essential tool for practical cognitive function in everyday life (Hertzog & Dunslosky, 2011. According to Hertzog & Dunslosky (2011), practicing good monitoring skills can improve student performance in learning.

From the evaluation component, it is found that 50.94% of students make a summary of the biology material; 67.30% ask themselves how well they have achieved their goals after finishing studying; 68.97% ask themselves whether they consider all the available options after solving problems, and 65.62% ask themselves if they learned as much as they could when completing a biology task.

Evaluation refers to evaluating student products and learning efficiency. One example is re-evaluating learning and assessing learning activities' progress (Setiawati & Corebima, 2018). The activity of summarizing or taking notes is one of the learning strategies that can improve metacognitive abilities. This activity will improve students' understanding and memory in the long term. The evaluation activity at the end of the lesson is an important activity to do. Through the activity, students can evaluate the learning that has been done as a whole. The evaluation activity results can be used as a reflection for the next steps or strategies in learning.

The process of reflection and monitoring cognitive activities to develop correct learning strategies requires metacognitive awareness and good self-regulation (Okoza et al., 2013). The learning process efficiency can be improved through behavioral control in monitoring strategies and learning activities (Destan et al., 2014). Developing meaningful learning is challenging to achieve and time-consuming, as it requires many different skills to build and master (Chevron, 2014).

Learning in secondary schools has not been intentionally linked to empowering thinking skills, including metacognitive skills, or the importance of empowering skills (Corebima, 2016). The lack of metacognitive development occurs as teachers face difficulties in developing learning using metacognitive models. As a result, classroom learning tends to be conventional and dominated by teachers. As a result, students who are still unable to manage their learning independently still excel passively in classroom learning even though they are not fully involved in the learning process.

Also, the poor student learning outcomes and the quality of learning in schools are caused by a lack of critical thinking efforts in reading, listening, formulating questions, answering questions by themselves, correcting answers, and making summaries (Ramdiah, 2015).

Veenman & Elshout (1999) prove that beginners' metacognition skills, although partially correlated with intelligence, also contribute to learning outcomes. Metacognitive awareness is a process that encourages individuals to activate their abilities, understand their advantages, know how to achieve success in learning, and know why to use particular strategies in learning (Akin, 2016).

4. Conclusion and Implications

The study provides an overview of students' metacognitive awareness, requiring attention from teachers and education observers. The learning process needs to involve all students' learning abilities to maximize the results obtained. Metacognitive knowledge consists of declarative, procedural, and conditional knowledge, which shows a relatively good percentage. Unfortunately, all aspects are still at a low level, so that it needs improvement. The percentage of metacognitive regulation, which consists of planning components, information management strategies, monitoring understanding, debugging techniques, and student evaluations, is still low. Students need to be trained to improve these components by applying the appropriate approach or learning models. The results of this study support the creation of a learning model to improve metacognitive skills.

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Authors' Contributions

This article is the result of collaborative research and analysis by the authors. The first author has contributed to drafting, methodology, investigation, writing, data analysis, data curation. The second author has carried out a formal analysis, writing, review, editing, supervision, funding acquisition process. The third author also plays a role in writing-review editing, supervision, and funding acquisition. The fourth author has worked on formal analysis, writing-review editing, supervision, and funding acquisition.

References

[1] OECD, O. f.-o. (2019). *Programme for international student assessment (PISA) results From PISA 2018.* Paris: PISA, OECD Publishing. https://oecd.org/pisa/publications/PISA2018_CN_IDN.pdf

[2] AKIN, E. (2016). Examining the relation between metacognitive understanding of what is listened to and metacognitive awareness levels of secondary school students. *Educational Research and Reviews, 11*(7), 390-401. doi:10.5897/ERR2015.2616

[3] AKTURK, A. O., & SAHIN, I. (2011). Literature review on metacognition and its measurement. *World Conferences on Educational Sciences.15*, pp. 3731-3736. Elsevier. doi:10.1016/j.sbspro.2011.04.364

[4] ARDILA, C., & COREBIMA, A. D. (2013). *The relationship between metacognitive skills and learning outcomes of Biology and retention of class X students applying strategies for empowering thinking through questions (PBMP) in Senior High School 9 Malang. State University of Malang, FMIPA, Malang.* Retrieved from http://jurnal-online.um.ac.id/da

[5] ARSLANTAS, S., & KURNAZ, A. (2017). The effect of using self-monitoring strategies in social studies course on self-monitoring, self-regulation and academic achievement. *International Journal of Research in Education and Science, 3*(2). Retrieved from ijres.net/index.php/ijres/article/view/240

[6] BAHRI, A., & COREBIMA, A. D. (2015). The contribution of learning motivation and metacognitive skill to the student's cognitive learning outcome within different learning strategies. *Journal of Baltic Science Education, 14*(4), 487-500. Retrieved from http://www.scientiasocialis.lt/jbse/files/pdf/vol14/487-500.Bahri_JBSE_Vol.14_No.4.pdf

[7] BALTACI, S., YILDIZ, A., & OZCAKIR, B. (2016). The relationship between metacognitive awareness levels, learning styles, genders, and mathematics grades of fifth graders. *Journal of Education and Learning, 5*(4). doi:10.5539/jel.v5n4p78

[8] CENCELJ, V., ABERSEK , B., FLOGIE, A., & ABERSEK, M. K. (2020). Metacognitive model for developing science technology and functional engineering literacy. *Journal of Baltic Science Education, 19*(2), 220-233. doi:10.33225/jbse/20.19.220

[9] CHEVRON, M. P. (2014). A metacognitive tool: theoretical and operational analysis of skills exercised in structured concept maps. *Science direct, 2*, 45-54. doi:10.1016/j.pisc.2014.07.001

[10] CONTESSA, J., KYRIAKIDES, T. C., & NADZAM, G. (2015). Does the assessment of self-regulated learning and metacognition in surgical residents provide insight into performance on high takes standardized examinations? a pilot study. *Clinical Medical Reviews and Case Reports, 2*(8). doi:10.23937/2378-3656/1410047

[11] COREBIMA, A. D. (2016). Biology learning is not for living. 13th National Seminar on Biology Education. 13, pp. 8-22. Surakarta: Sebelas Maret University. Retrieved from https://jurnal.uns.ac.id/prosbi/article/view/5640/5008

[12] DESTAN, N., HEMBACHER, E., GHETTI, S., & ROEBERS, C. M. (2014). Early metacognitive abilities: the interplay of the monitoring and control process in 5 to 7-year-old children. *Journal of Experimental Child Psychology, 126*, 213-228. doi:10.1016/j.jecp.2014.04.001

[13] DIAZ, I. (2015). Training in metacognitive strategies for students' vocabulary improvement by using learning journals. *PROFILE Issues in Teachers' Professional Development, 17*(1), 87-102. doi:10.15446/profile.v17n1.41632

[14] DOWNING, K., & NING, F. (2010). Impact of problem-based learning on student experience And metacognitive development. *Multicultural Education & Technology Journal, 5*(1), 55-69. doi:10.1108/17504971111121928

[15] FEBRIANI, H. I., KELIAT, N. R., & HASTUTI, S. P. (2017). The application of a project-based learning model with sharing galleries on the excretion system to improve learning outcomes for Biology class VIIIF at Public Junior High School 5 Salatiga in the 2016/2017 academic year. 2nd National Seminar on Science Education. Salatiga: Biology Education.

[16] FEYZIOGLU, E. Y., AKPINAR, E., & TATAR, N. (2018). Effects of technology-enhanced metacognitive learning platform on students' monitoring accuracy and understanding of electricity. *Journal of Baltic Science Education, 17*(1), 43-64. Retrieved from http://oaji.net/articles/2017/987-1519059947.pdf

[17] HERTZOG, C., & DUNSLOSKY, J. (2011). Metacognition in later adulthood: spared monitoring can benefit older adults' self-regulation. *Curr Dir Psychol Sci, 20*(3), 167-173. doi:10.1177/0963721411409026

[18] HUGHES, A. (2017). Educational complexity and professional development teachers' need for metacognitive awareness. *Journal of Technology Education, 29*(1), 25-44. doi:10.21061/jte.v29i1.a.2

[19] ISKANDAR, S. (2014). Metacognitive skills approach in learning science in the classroom. *Erudio, 2*(2), 13-20. Retrieved from https://www.google.co.id/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwj8qv-Dq_3XAhUFp48KHcCTAwwQFggpMAA&url=http%3A%2F%2Fwww.erudio.ub.ac.id

[20] JALEEL, S., & PREMACHANDRAN, P. (2016). A study on the metacognitive awareness of secondary school students. *Universal Journal of Educational Research, 4*(1), 165-172. doi:10.13189/ujer.2016.040121

[21] KELIAT, N. R., DJULIA, E., & EDY, S. (2014). Analysis of students of Public Senior High School I Lubukpakam North Sumatra's metacognitive skills in learning Biology. 2014 National Biology Seminar. Semarang: Biology Education Study Program, State University of Malang.

[22] KISAC, I., & BUDAK, Y. (2013). Metacognitive strategies of the university students concerning their perceived self-confidence levels about learning. *World Conference on Educational Sciences (WCES). 116*, pp. 3336-3339. Elsevier Ltd. doi:10.1016/j.sbspro.2014.01.759

[23] KRISTIANI, N., SUSILO, H., ROHMAN, F., & COREBIMA, A. D. (2015). The contribution of students' metacognitive skills and scientific attitude towards their academic achievements in Biology learning implementing thinking empowerment by questioning (TEQ) learning integrated with inquiry learning (TEQI). *International Journal of Educational Policy Research and Review, 2*(9), 113-120. doi:10.15739/IJEPRR.020

[24] LEE, H. W., LIM, K. Y., & GRABOWSKI, B. L. (2010). Improving self-regulation, learning strategy use, and achievement with metacognitive feedback. *Educational Technology Research and Development, 58*(6), 629-648. doi:10.1007/s11423-010-9153-6

[25] LOUCA, E. P. (2008). *Metacognition and theory of mind.* Angerton Garden, Newcastle, United Kingdom: Cambridge Scholars.

[26] NELSON, T. O., & NARENS, L. (1994). Why investigate metacognition. In I. J. Metcalfe, & A. P. Shimamura, *Metacognition Knowing About Knowing* (pp. 1-25). The MIT Press. Retrieved from www.imbs.uci.edu

[27] OKOZA, J., ALUEDE, O., & SOGOLO, O. O. (2013). Assessing students' metacognitive awareness of learning strategies among secondary school students in Edo State, Nigeria. *Research in Education, 90*, 82-97. doi:10.7227/RIE.90.1.6

[28] OZ, H. (2016). Metacognitive awareness and academic motivation: a cross-sectional study in teacher education context of Turkey. *International Conference on Teaching and Learning English as an Additional Language.232*, pp. 109-121. Antalya: Elsevier. doi:10.1016/j.sbspro.2016.10.035

[29] PALENNARI, M. (2016). Exploring the correlation between metacognition and cognitive retention of students using some Biology teaching strategies. *Journal of Baltic Science Education, 15*(5), 617-629. Retrieved from

http://journals.indexcopernicus.com/abstract.php?icid=1224392

[30] PALMER, E. C., DAVID, A. S., & FLEMING, S. M. (2014). Effects of age on metacognitive efficiency. *Consciousness and Cognition, 28*, 151-160. doi:10.1016/j.concog.2014.06.007

[31] PANTIAWATI, Y., & HUSAMAH (2017). Self and peer assessment in the active learning model to increase metacognitive awareness and cognitive abilities. *International Journal of Instruction*, *10*(4), 185-202. doi:10.12973/iji.2017.10411a

[32] PIFARRE, M., & COBOS, R. (2009). Evaluation of the development of metacognitive knowledge supported by the available system. *Educational Technology Research and Development*, *57*, 787-799. doi:10.1007/s11423-009-9118-9

[33] RAMDIAH, S. (2015). The potential stages of the PQ4R strategy are combined with concept maps in Biology learning to improve metacognitive skills and critical thinking. *Journal of Mathematics and Science Education*, *3*(1), 33-44.

[34] RAMDIAH, S., & COREBIMA, A. D. (2014). Learning strategy equalizing students' achievement, metacognitive, and critical. *American Journal of Educational Research*, *2*(8), 577-584. doi:10.12691/education-2-8-3

[35] SCOT, B. M., & BERMAN, A. F. (2013). Examining the domain-specificity of metacognitive using academic domains and task-specific individual differences. *Australian Journal of Educational & Developmental Psychology*, *13*, 28-43. Retrieved from https://files.eric.ed.gov/fulltext/EJ1016118.pdf

[36] SCRAW, G. (1998). Promoting general metacognitive awareness. *Instructional Science*, *26*, 113-125. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.587.4353&rep=rep1&type=pdf

[37] SERAPHIN, K. D., PHILIPPOFF, J., KAUPP, L., & VALLI, L. M. (2012). Metacognition as a means to increase the effectiveness of inquiry-based science education. *Science Education International*, *23*(4), 366-382. Retrieved from https://files.eric.ed.gov/fulltext/EJ1001630.pdf

[38] SETIAWATI, H., & COREBIMA, A. D. (2018). Improving students' metacognitive skills through science learning by integrating PQ4R and TPS strategies at a senior high school in Parepare, Indonesia. *Journal of Turkish Science Education*, *15*(2), 95-106. Retrieved from https://tused.org/index.php/tused/article/view/219/170

[39] SISWATI, B. H., & COREBIMA, A. D. (2016). The relationship between metacognitive skills and cognitive learning outcomes of Science and Biology of Middle and High School Students in Malang on Think Pair Share (TPS) learning. National Seminar on Biology, Science and Learning. 16, pp. 378-384. Malang: State University of Malang. Retrieved from http://jurnal-online.um.ac.id/data/artikel/artikelEE88BC4B01504CB71615F1D280FAF7AE.pdf

[40] SLAVIN, R. (2009). *Educational psychology. Theory and practice.* New Jersey: Pearson Education, inc.

[41] SON, L. K., & METCALFE, J. (2000). Metacognitive and control strategies in study-time allocation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(1), 204-221. doi:10.1037/0278-7393.26.1.204

[42] SYARIFAH, H. I., & COREBIMA, A. D. (2016). Differences in metacognitive skills and motivation of male and female students in grade 10 at State Senior High Schools in Malang City through the learning strategy of Reading Questioning and Answering combined with Think Pair Share (TPS). Journal of Educational Theory, Research and Development, *1*(5), 1-5. Retrieved from http://journal.um.ac.id/index.php/jptpp/article/view/6259/2675

[43] WEIL, L. G., FLEMING, S. M., DUMONTHEIL, I., KILFORD, E. J. et al. (2013). The development of metacognitive ability in adolescence. *Journal Consciousness and Cognition*, *22*, 264-271. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3719211/.

[44] WIDIHASTUTI. (2013). Character Education Strategies in Higher Education through the Application of Assessment for Learning Based on High Order Thinking Skills. *Journal of Character Education*, *3*(1), 38-52.

[45] YULIANTI, V. D., KELIAT, N. R., & KRAVE, A. S. (2017). Application of project-based learning models and portfolio strategies to improve the biology learning outcomes and metacognitive skills of 11th graders of Natural Science 2 State Senior High School 1 Beringin. National Seminar on Science Education (pp. B22-B31). Surabaya: UNESA Postgraduate Program.

[46] YUSNAENI, & COREBIMA, A. D. (2017). Empowering students' metacognitive skills on SSCS learning model integrated with metacognitive strategy. *The International Journal of Social Sciences and Humanities Invention*, *4*(5), 3476-3481. Retrieved from https://valleyinternational.net/index.php/theijsshi/article/view/781

[47] YUSNAENI, COREBIMA, A. D., SUSILO, H., & ZUBAIDAH, S. (2017). Creative thinking of low academic student undergoing search solve create and share learning integrated with metacognitive strategy. *International Journal of Instruction*, *10*(2), 245-262. Retrieved from http://www.e-iji.net/dosyalar/iji_2017_2_16.pd

参考文:

[1] 经合组织，O. f.-o. (2019)。国际学生评估计划 (比萨) 结果来自比萨 2018。巴黎：比萨，经合组织出版。https://oecd.org/pisa/publications/PISA2018_CN_IDN.pdf

[2] AKIN, E. (2016)。考察对所听内容的元认知理解与中学生元认知意识水平之间的关系。教育研究与评论，11(7)，390-401。土井:10.5897/ERR2015.2616

[3] AKTURK, A. O., & SAHIN, I. (2011)。元认知及其测量文献综述.世界教育科学会议。15，第 3731-3736 页。爱思唯尔。土井:10.1016/j.sbspro.2011.04.364

[4] ARDILA, C., & COREBIMA, A. D. (2013)。元认知技能和生物学学习成果与 X 班学生在玛琅高中 9 中应用通过问题授权思考的策略 (PBMP) 的保留之间的关系。玛琅州立大学，FMIPA，玛琅。取自 http://jurnal-online.um.ac.id/da

[5] ARSLANTAS, S., & KURNAZ, A. (2017)。在社会研究课程中使用自我监控策略对自我监控、自我调节和学业成绩的影响。国际教育与科学研究杂志，3(2)。取自 ijres.net/index.php/ijres/article/view/240

[6] BAHRI, A., & COREBIMA, A. D. (2015)。学习动机和元认知技能在不同学习策略下对学生认知学习成果的贡献。波罗的海科学教育杂志，14（4），487-500。取自 http://www.scientiasocialis.lt/jbse/files/pdf/vol14/487-500.Bahri_JBSE_Vol.14_No.4.pdf

[7] BALTACI, S., YILDIZ, A., & OZCAKIR, B. (2016)。五年级学生元认知意识水平、学习方式、性别与数学成绩的关系。教育与学习杂志，5(4)。土井:10.5539/jel.v5n4p78

[8] CENCELJ, V., ABERSEK, B., FLOGIE, A., & ABERSEK, M. K. (2020)。发展科学技术和功能工程素养的元认知模型。波罗的海科学教育杂志，19（2），220-233。土井:10.33225/jbse/20.19.220

[9] 雪佛龙, M. P. (2014)。元认知工具：对结构化概念图中所练习技能的理论和操作分析。科学直接，2, 45-54。土井:10.1016/j.pisc.2014.07.001

[10] CONTESTSA, J., KYRIAKIDES, T. C., & NADZAM, G. (2015)。外科住院医师自我调节学习和元认知的评估是否提供了对高考标准化考试表现的洞察？一项试点研究。临床医学评论和病例报告，2(8)。土井:10.23937/2378-3656/1410047

[11] COREBIMA, A. D. (2016)。生物学习不是为了生活。第十三届全国生物教育研讨会。 13，第 8-22 页。苏拉卡尔塔：塞贝拉斯·马雷特大学。取自 https://jurnal.uns.ac.id/prosbi/article/view/5640/5008

[12] DESTAN, N., HEMBACHER, E., GHETTI, S., & ROEBERS, C. M. (2014)。早期元认知能力：5 至 7 岁儿童监测和控制过程的相互作用。实验儿童心理学杂志，126，213-228。土井:10.1016/j.jecp.2014.04.001

[13] 迪亚兹，I.（2015）。使用学习日志训练学生词汇量提高的元认知策略。简介教师专业发展中的问题，17（1），87-102。土井:10.15446/profile.v17n1.41632

[14] DOWNING, K., & NING, F. (2010)。基于问题的学习对学生体验和元认知发展的影响。多元文化教育与技术杂志，5（1），55-69。土井:10.1108/17504971111121928

[15] FEBRIANI, H. I., KELIAT, N. R., & HASTUTI, S. P. (2017)。2016/2017 学年公立初中 5 萨拉蒂加生物班 VIIIF 的学习成果。第二届全国科学教育研讨会。萨拉蒂加：生物教育。

[16] FEYZIOGLU, E. Y.、AKPINAR, E. 和 TATAR, N. (2018)。技术增强元认知学习平台对学生电量监测准确度和理解的影响[J].波罗的海科学教育杂志，17（1），43-64。取自 http://oaji.net/articles/2017/987-1519059947.pdf

[17] HERTZOG, C., & DUNSLOSKY, J. (2011)。成年后期的元认知：免于监测可以有益于老年人的自我调节。咖喱心理科学博士，20（3），167-173。土井:10.1177/0963721411409026

[18] 休斯，A.（2017）。教育复杂性和专业发展教师对元认知意识的需求。技术教育杂志，29（1），25-44。doi:10.21061/jte.v29i1.a.2

[19] ISKANDAR, S. (2014)。在课堂上学习科学的元认知技能方法。博学，2（2），13-20。取自 https://www.google.co.id/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwj8qv-Dq_3XAhUFp48KHcCTAwwQFggpMAA&url=http%3A%2Fudio。酸

[20] JALEEL, S., & PREMACHANDRAN, P. (2016)。中学生元认知意识的研究.教育研究环球杂志，4(1)，165-172。土井:10.13189/ujer.2016.040121

[21] KELIAT, N. R., DJULIA, E., & EDY, S. (2014)。公立高中我卢布卡姆北苏门答腊学生学习生物学的元认知技能分析。2014 年全国生物学研讨会。三宝垄：玛琅州立大学生物教育研究计划。

[22] KISAC, I., & BUDAK, Y. (2013)。大学生对学习自信心水平的元认知策略.世界教育科学大会 (世界消费电子展). 116，第 3336-3339 页。爱思唯尔有限公司. 土井:10.1016/j.sbspro.2014.01.759

[23] KRISTIANI, N.、SUSILO, H.、ROHMAN, F. 和 COREBIMA, A. D.（2015）。学生的元认知技能和科学态度对他们在生物学习中的学术成就的贡献，实施通过提问（TEQ）学习与探究学习（特奇）相结合的思维授权。国际教育政策研究与评

论杂志，2(9)，113-120。doi:10.15739/IJEPRR.020

[24] LEE, H. W., LIM, K. Y., & GRABOWSKI, B. L. (2010)。通过元认知反馈改善自我调节、学习策略的使用和成就。教育技术研究与发展，58(6), 629-648。土井:10.1007/s11423-010-9153-6

[25] LOUCA, E. P. (2008)。元认知与心理理论。英国纽卡斯尔安格顿花园：剑桥学者。

[26] NELSON, T. O., & NARENS, L. (1994)。为什么要研究元认知。在 I. J. Metcalfe, & A. P. Shimamura, 元认知 (第 1-25 页)。麻省理工学院出版社。检索自 www.imbs.uci.edu

[27] OKOZA, J., ALUEDE, O., & SOGOLO, O. O. (2013)。评估尼日利亚埃多州中学生对学习策略的元认知意识。教育研究，90, 82-97。土井:10.7227/RIE.90.1.6

[28] OZ, H. (2016)。元认知意识和学术动机：土耳其教师教育背景下的横断面研究。英语作为附加语言的教学和学习国际会议。232，第 109-121 页。安塔利亚：爱思唯尔。土井:10.1016/j.sbspro.2016.10.035

[29] PALENNARI, M. (2016)。运用一些生物教学策略探索学生元认知与认知保留的相关性。波罗的海科学教育杂志，15（5），617-629。取自 http://journals.indexcopernicus.com/abstract.php?icid=1224392

[30] PALMER, E. C., DAVID, A. S., & FLEMING, S. M. (2014)。年龄对元认知效率的影响。意识与认知，28, 151-160。土井:10.1016/j.concog.2014.06.007

[31] PANTIAWATI, Y., & HUSAMAH (2017)。主动学习模型中的自我和同伴评估，以提高元认知意识和认知能力。国际教学杂志，10（4），185-202。土井:10.12973/iji.2017.10411a

[32] PIFARRE, M., & COBOS, R. (2009)。评估由可用系统支持的元认知知识的发展。教育技术研究与开发，57, 787-799。土井:10.1007/s11423-009-9118-9

[33] 拉姆迪亚, S. (2015)。PQ4R 策略的潜在阶段与生物学习中的概念图相结合，以提高元认知技能和批判性思维。数学与科学教育杂志，3（1），33-44。

[34] RAMDIAH, S., & COREBIMA, A. D. (2014)。平衡学生成就、元认知和批判性的学习策略。美国教育研究杂志，2(8)，577-584。doi:10.12691/education-2-8-3

[35] SCOT, B. M., & BERMAN, A. F. (2013)。使用学术领域和特定任务的个体差异检查元认知的领域特异性。澳大利亚教育与发展心理学杂志，13, 28-43。取自 https://files.eric.ed.gov/fulltext/EJ1016118.pdf

[36] SCRAW, G. (1998)。促进一般元认知意识。教学科学，26, 113-125。取自 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.587.4353&rep=rep1&type=pdf

[37] SERAPHIN, K. D., PHILIPPOFF, J., KAUPP, L., & VALLI, L. M. (2012)。元认知作为提高探究式科学教育有效性的一种手段。国际科学教育，23（4），366-382。取自 https://files.eric.ed.gov/fulltext/EJ1001630.pdf

[38] SETIAWATI, H., & COREBIMA, A. D. (2018)。通过在印度尼西亚准备的一所高中整合 PQ4R 和 TPS 策略，通过科学学习提高学生的元认知技能。土耳其科学教育杂志，15（2），95-106。取自 https://tused.org/index.php/tused/article/view/219/170

[39] SISWATI, B. H., & COREBIMA, A. D. (2016)。认为配对共享(TPS)学习中玛琅中学生科学与生物元认知技能与认知学习成果的关系。全国生物学、科学和学习研讨会。16，第 378-384 页。

[40] 斯拉文，R.（2009）。教育心理学。理论与实践。新泽西州：培生教育公司.

[41] SON, L. K., & METCALFE, J. (2000)。学习时间分配中的元认知和控制策略。实验心理学杂志：学习、记忆和认知，26（1），204-221。doi:10.1037/0278-7393.26.1.204

[42] SYARIFAH, H. I., & COREBIMA, A. D. (2016)。玛琅市国立高中 10 年级男女学生元认知技能和动机的差异通过阅读问答结合思考对分享（TPS）的学习策略。教育理论研究与发展杂志，1(5)，1-5。取自 http://journal.um.ac.id/index.php/jptpp/article/view/6259/2675

[43] WEIL, L. G., FLEMING, S. M., DUMONTHEIL, I., KILFORD, E. J. 等。 (2013)。青春期元认知能力的发展。期刊意识与认知，22, 264-271。取自 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3719211/。

[44] 维迪哈斯图蒂。 (2013)。高等教育中的品格教育策略通过基于高阶思维技能的学习评估的应用。品格教育杂志，3（1），38-52。

[45] YULIANTI, V. D., KELIAT, N. R., & KRAVE, A. S. (2017)。应用基于项目的学习模型和组合策略来提高自然科学 2 州立高中 1 白令宁 11 年级学生的生物学学习成果和元认知技能。国家科学教育研讨会（第乙 22-乙 31 页）。泗水：联合国环境事务署研究生课程。

[46] YUSNAENI, & COREBIMA, A. D. (2017)。在结合元认知策略的 SSCS 学习模型中增强学生的元认知技能。国际社会科学与人文发明杂志，4(5)，3476-3481。取自 https://valleyinternational.net/index.php/theijsshi/article/view/781

[47] YUSNAENI, COREBIMA, A. D., SUSILO, H., & ZUBAIDAH, S. (2017)。低学历学生的创造性思维进行搜索解决创造和分享与元认知策略相结合

的学习。国际教学杂志，10（2），245-262。取 自 http://www.e-iji.net/dosyalar/iji_2017_2_16.pd