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Metacognition Profile on Habits of Mind in Biology Learning

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Abstract

The purpose of this study was to determine the level profile of the Thinking about Thinking (Metacognition) category in the habits of mind of high school students in Biology learning. The research method used is descriptive research. The sample selection technique used stratified random sampling technique. The population in this study were all students of class XI and XII at SMAN A, SMAN B, SMAN C, and SMAN D Bandung, as many as 294 students. Data collection used an instrument in the form of a Habits of Mind's Costa and Kallick questionnaire. The results showed that the metacognition profile of class XI students was 67% (299) and class XII students was 69% (307), which means that Thinking about Thinking (Metacognition) of high school students is included in the low category. This shows that high school students in class XI and XII have not fully demonstrated good metacognitive abilities. The results of this study indicate that the metacognition category in habits of mind still needs to be introduced and accustomed to school students, especially in learning biology.

Keywords: Metacognition, Thinking about Thinking, Habits of Mind, Biology Learning

INTRODUCTION

Most formal schools in Indonesia have a large number of students in one class. This is a challenge for teachers in providing balanced and meaningful learning for each student in the class. Students have various levels of knowledge, especially about how they learn (learning how to learn). As stated by Young and Fry (2008) that students' knowledge is in three levels including active students, moderate students, and passive students. Active students are defined as those who know how to learn that is right for themselves and are able to apply what they know to various learning situations. Students with moderate levels are defined as those who work hard and are aware of their own strengths and weaknesses, but are not good enough at managing their learning. Passive students are defined for those who have low awareness of how to learn properly and how to manage their learning. This situation is known as metacognitive ability.

The term metacognition in learning is not new. Without realizing it, students and educators have implemented metacognition strategies in the learning process. One of the assignments that are often given by teachers in the form of material summaries and concept maps is one of the metacognitive strategies applied in the learning process. Metacognition according to Jaleel (2016) is thinking about one's own thoughts. According to him, there are two aspects of metacognition, namely reflection and self-regulation. Metacognition is a regulatory system that helps a person understand and control his own cognitive performance. Metacognition can also be defined as a person's ability to think about his way of thinking and how to learn.

In general, some researchers in the field of metacognition classify metacognition into two distinct but interrelated fields, namely metacognition knowledge and metacognition experiences. Metacognitive knowledge is an awareness of thinking and metacognitive strategies are the ability to manage their own thinking processes (Jaleel, 2016; Young and Fry, 2008; Yuksel, 2012).

Flavel (1979), one of the researchers who started the field of metacognition and memory, explained that metacognition is referred to as knowledge and regulation of one's cognitive activity in the learning process. Flavel also describes a model of monitoring various kinds of cognitive efforts that occur through actions and interactions between four types of phenomena including (a) metacognitive knowledge, (b) metacognitive experiences, (c) goals or tasks.), and (d) strategy (actions or strategies). Flavel also explained that there are three types of metacognitive knowledge, including Awareness of Knowledge, Awareness of Thinking, and Awareness of Thinking Strategies.

Metacognition research conducted by Jaleel (2016) suggests that metacognitive awareness in junior high school students is evenly distributed in each group (very low areness, low awareness, average awareness, high awareness, very high awareness). This indicates that the students' awareness of metacognition is not yet owned. Another study was also conducted by Young and Fry (2008) that there is a relationship between metacognitive awareness and student GPA. Cherrier et al. (2020) stated that students who were given treatment through a metacognition approach showed better self-knowledge and self-efficacy.

The National Research Council (2000) defines metacognition as a person's ability to predict his performance in various assignments and be able to monitor his current level of understanding and be able to decide when his level of understanding is inadequate. So, someone who has metacognitive abilities can know their limits and predict the extent to which someone understands what they are learning and what must be done so that the learning process becomes more effective. Someone who has been able to use metacognitive strategies in their learning is able to identify their difficulties, find problem solving, reflect and evaluate themselves. The application of metacognition strategies in learning can make someone become an independent student. Thus, metacognition indirectly supports active learning and long-life learning. One of the factors thought to have contributed to the development of students' metacognitive abilities is the teacher's behavior in facilitating learning (Kyriakides et al., 2020).

Amnah (2014) conducted a survey research by applying metacognitive strategies including making summaries, underlining readings, making concept maps, and making donkey bridges. The survey results show that 62.70% of students' metacognitive awareness is in the

Well-Developed stage. These data indicate that metacognitive abilities need to be trained and familiarized through metacognitive strategies starting from the process of planning (planning), controlling (monitoring), and evaluating (evaluating). This learning strategy is expected for students to be able to find the most effective strategies for independent learning and be able to design strategic goals and steps in their own learning process, known as Thinking about Thinking. Tanner (2012) describes two students who have different ways of preparing for college exams. The two students showed considerable differences in knowing how to study properly, the ability to monitor their own understanding, the ability to reflect on what was understood and what was not understood, and the ability to strategize about how to resolve confusion in their own learning process. The description explains that the two students have different abilities in applying the metacognitive approach to the learning process.

Metacognition is a very important thinking skill that cannot be separated in a learning process in an effort to achieve optimal learning outcomes. Metacognition can be a strategy and/or student link in developing knowledge, attitudes, and skills that are the goals of learning, several studies link metacognition with related learning outcomes, such as critical thinking (Sari, 2019), creativity (Puente-Díaz et al., 2021; Wahyuni., 2020), and competency tests (Ardi et al. 2018). Furthermore, research conducted by Rahmat and Chanuan (2018) facilitated the development of students' metacognitive skills through open inquiry, Ritchhart et al. (2009) through a concept map, Sabel et al. (2017) using enhanced answer keys and reflection question, and Dang et al. (2018) conducted repetitive learning activities in an effort to improve students' metacognitive skills. This shows the urgency of metacognition in students' self-development through learning. However, research that portrays aspects of metacognition as a category of habits of mind, especially in biology learning is still little done. Therefore, research on the category profile of thinking about thinking (metacognition) in habits of mind in biology learning was carried out.

METHOD

The method used is descriptive method. The descriptive method is a method that does not provide treatment, manipulation, or change to the independent variables, but describes a condition as it is (McMillan and Schumacher, 2001).

The population in this study were all students of class XI and XII at SMAN Bandung. This research was conducted in four schools based on passing grade ratings from the highest to the lowest, namely schools A, B, C, and D. The sample selected in this study used a Stratified Random Sampling technique. The sample begins with determining the SMAN clusters in the city of Bandung based on passing grade. Furthermore, schools in the cluster were randomly

selected one school from each cluster. The next step is to take one sample class from representatives of class XII. The sample used in this study were 294 students.

The research data was obtained from the instrument in the form of a Habits of Mind's Costa and Kallick questionnaire. The Thinking about Thinking category consists of four questionnaire statements. The data were further categorized based on low (< 582), medium (583 - 749), and high (> 750) levels based on the calculation of the category determination test so that the habits of mind score category was obtained, especially the thinking about thinking category of students.

RESULTS AND DISCUSSION

Thinking about Thinking (Metacognition) Profile of Students in Learning Biology

Habits of Mind according to Costa and Kallick (2008) is the highest level of learning achievement. The order of the levels starts from content, thinking skills, cognitive tasks that demand skillful thinking, and habits of mind. The facts on the ground show that the achievement of learning outcomes still makes content as a standard and reference for student graduation. One of the studies conducted by Isfiani (2014) collected data on the acquisition of learning outcomes from several types of tests conducted by teachers, ranging from daily tests, Mid-Semester Examinations, and National Examination Practices. The three types of tests are dominated by content as an indicator of the achievement of student learning outcomes.

Indeed, student learning outcomes in the form of content are a product of a series of learning processes carried out by students. However, the learning process, especially how students strategize in their way of learning, is still minimally noticed by both the teacher and the students themselves. If you look at the data on the questionnaire statements in Table 1, the four statements are quite representative to find out to what extent students apply metacognition in the learning process. The four statements are details of what is called planning, monitoring, and evaluating in students' metacognitive strategies.

Table 1. Questionnaire Statement Category Thinking about Thinking in Habits of Mind

Statement	*Thinking about Thinking (Metacognition)*
P1	I always ready to face the Biology Exam because I master all the material
P2	I confused which Biology material I should learn first
P3	When I get a bad grade in Biology, I always do self-reflection on my study habits.
P4	I know which Biology material I need to study more deeply

Observing the data in Table 2 regarding the questionnaire results from the four metacognitive statements, there are two statements that achieve the lowest score percentage of 59% for class XI and 61% for class XII (P1) and 54% for class XI and 55% for class XII (P2). The remaining two statements are sufficient to achieve a percentage score of 76% for class XI and 78% for class XII (P3) and 78% for class XI and 80% for class XII (P4). One thing that is

unfortunate from the data is that all metacognitive statements do not reach a percentage score of 90%. These results prove that metacognition has not been fully realized and applied by students during the learning process. Research conducted by Isfiani (2016) states that metacognition is a category of Habits of Mind which is included in the order of the lowest category compared to other categories of Habits of Mind.

Table 2. Questionnaire Data for Class XI and XII Category Thinking about Thinking

Category Habits of Mind	Statement Number	Class XI		Class XII		Total	
		Score	Percentage	Score	Percentage	Score	Percentage
Thinking about Thinking (metacognition)	P1	265	59%	290	61%	555	63%
	P2	240	54%	231	55%	471	53%
	P3	339	76%	355	78%	694	79%
	P4	350	78%	353	80%	703	80%

The lowest score was found in P2, namely "I confused which Biology material I should learn first" which explains that students have not applied the right learning strategies to study Biology material. The characteristics of Biology material which contains many theories and concepts make students feel confused about the right steps to make it easier to learn Biology material. The lack of students' attention in developing ways or strategies in learning may also affect students' readiness to face the exam (P1). When the test is finished and the test results have been announced by the teacher, then that's when the students only know where the shortcomings are and which material must be studied again in depth (P3 and P4). It can be concluded that students have not been able to reflect on themselves before the results of their studies are announced.

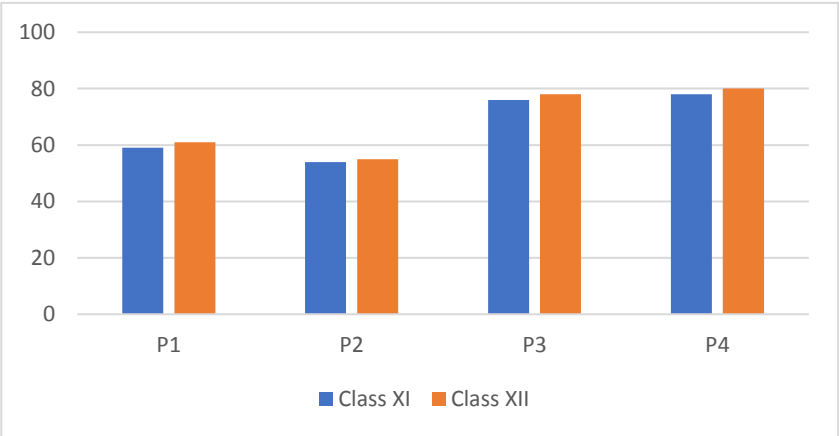

Figure 1. Comparison of Results Percentage Score Category HoM Thinking about Thinking (Metacognition) between Class XI and Class XII

In addition, the description of the research data as shown in Figure 1, all the results show that class XII has a higher score than class XI. This is likely to occur because of the different learning situations between class XI and XII, namely that class XII students will be faced with

a national-scale exam that determines students' graduation during high school level. As stated by Isfiani (2016) that the role of habits of mind and cognitive anxiety can be responded positively or negatively by students depending on mental conditions and thinking habits that affect students' responses to the emergence of responses as an effort to respond to stimuli. According to Winkel (1996), how to learn attitude in learning that a stimulus will give a response in the form of a response in the form of a positive or negative attitude. The stimulus that emerged in class XII was the implementation of the National Examination and responded with various learning strategies. These external factors are used as motivation to give maximum effort for yourself in achieving optimal graduation results.

Table 3. Habits of Mind Category Average Score: Thinking about Thinking

Category Habits of Mind	Average Score		
	XI	XII	Total
Thinking about Thinking (metacognition)	299 (67%)	307 (69%)	606 (69%)

In Table 3, the consistency of the data shows that the average metacognition score for students in grades XI, XII, and overall is below 70%. As seen in Table 4, it can be observed that students' metacognitive abilities are in the low to medium category. These results mean that the metacognition of habits of mind in the student learning process has not been maximally pursued and applied. Meanwhile, teacher involvement is very important to be able to realize good habits of mind in students. Costa and Kallick (2008) suggest that it takes a lot of experience, discovery, reflection, practice, repetition, and teaching in an effort to form habits of mind. Research conducted by Nederhand et al. (2021) stated that awareness of metacognition in middle school students and college students is still low.

Table 4. Recapitulation of Questionnaire Data Category Thinking about Thinking

Category Habits of Mind	Statement Number	Statement Score	Percentage Score (%)	Criteria	Category Score	Criteria
Thinking about Thinking (metacognition)	P1	555	63	Low	606	Medium
	P2	471	53	Low		
	P3	694	79	Medium		
	P4	703	80	Medium		

Metacognition Strategies for Teachers and Students in Biology Learning

The term learning how to learn is indirectly related to what is referred to as the concept of metacognition. Novak and Gowin (1996) in their book entitled “Learning How to Learn” also explains that concept maps and V diagrams are metacognitive tools that can facilitate meaningful learning. This theory is also based on a learning theory developed by Ausubel regarding meaningful learning. Oakley and McConville (2018) mention one strategy in studying a book is the "picture walk" technique. The picture walk stage is important to do with

the aim of seeing the picture and the title of the section as a whole before starting to read the book in depth. This activity helps to organize thoughts and facilitate understanding. Ekanara et al. (2018) stated that the habit of learning to reason by students is directly proportional to their strategy in preparing explanations and/or arguments.

Another metacognitive strategy was also applied by Amnah (2014) by giving examples of how to make concept maps, explaining how to make summaries, how to underline readings, and how to make donkey bridges. The application of metacognition strategies in the student learning process is certainly expected to improve understanding and achievement of learning outcomes. Students can think about their thinking processes and apply certain strategies in solving problems or difficulties encountered. According to Slavin (2019), there is a type of teaching, namely reciprocal teaching in which the teacher develops metacognitive skills with the aim of improving the reading performance of students who have poor comprehension.

In the book Learning How to Learn (Oakley and McConville, 2018), neuroscientists have discovered that the brain works in two different ways: a focused mode and a diffuse mode. Both of these modes play an important role in the learning process. In focus mode, when someone is about to learn something new, they must first focus on "turning on" some parts of the brain and starting the learning process. In diffuse mode, a person uses other parts of the brain to help make imaginative connections from each idea. Diffuse mode is widely used to generate creativity. Science fact proves that focus mode and diffuse mode must be used interchangeably for learning to be more effective. When a person calms the mind and does not focus on a particular thing (diffuse mode), then the solution will come more easily. This theory is in line with the strategy pursued in metacognition. This theory can also be the basis for finding out the most effective way in student learning.

Looking at the metacognitive profile data of high school students (Table 3), it is very important to be considered by both teachers and students in starting to use metacognitive strategies during the learning process. The low metacognition profile of students shows that students have not been able to know their potential regarding their thoughts, strategies, feelings, actions, and their influence on others. Students tend to be still not familiar with reflecting on the efforts that have been made in learning Biology so that students find it difficult to know their own shortcomings and efforts to develop them (Isfiani, 2016).

Biology material that is felt to be difficult will be solved in its own way using certain learning strategies. Students will easily find out which Biology material they feel is lacking and how to develop it. The long-term goal is that students will study Biology less burdened and better prepared to face any test for cognitive assessment. The expected result is habits of mind,

especially metacognition that is very good, will support the acquisition of good Biology learning outcomes as well.

CONCLUSION

The results showed that the metacognitive profile of class XI students was 67% (299) and class XII students was 69% (307). These data indicate that students have not fully implemented metacognition in the learning process. Students do not understand how to apply planning, monitoring, and evaluating in learning. The results of this study indicate that metacognition in habits of mind still needs to be introduced and accustomed to school students, especially in learning biology. Metacognition strategies which are then applied by students are expected to be able to facilitate students in understanding Biology material and be able to increase Biology learning achievement.

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