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Evaluation of Metacognitive Skill Level Among Pre-service Biology Teacher on Microbiology Learning

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Abstract: The 21st century skills that must be possessed by pre-service biology teachers is metacognitive skills. Metacognition refers to a person's abilities about his cognition and everything related. This descriptive study aims to describe the level of metacognitive skills of pre-service biology teachers. The data collection procedure was carried out by a metacognitive skill rubric that integrated with essay test. The subjects of this study were 70 of pre-service biology teacher at Universitas Islam Negeri Mataram in the 2021/2022 academic year. The research data were analyzed descriptively by determining the percentage of metacognitive skill levels. The results showed that the mean level of pre-service biology teachers' metacognitive skills was "starting to develop" (44.35). The pre-service teachers with "have so developed category" occupies the highest percentage (41%), while the lowest percentage is occupied by the category of "still very risky" and "very well developed" with a percentage 6% of each.

Keywords: Metacognitive skills; Pre-service biology teacher; Biology learning

Introduction

21st century learning provides many challenges that must be faced, namely empowering thinking skills. Thinking skills are needed to solve problems and various challenges (Yusnaeni et al., 2017) that are increasingly complex. To face this challenge, a prospective professional teacher namely pre-service biology teacher must have various thinking skills, especially higher order thinking skills (Sugiharto et al., 2019). According to Greenstein (2012), to deal with the development of information and technology in the 21st century, the development of thinking skills is needed, including metacognition skills.

Referring to the cognitive dimensions of Bloom's taxonomy (Krathwohl, 2017; Wilson, 2016), metacognitive knowledge is a form of knowledge that occupies the highest position, and in learning it is equivalent to the dimensions of high-level cognitive processes, namely C4, C5 and C6. This means that higher-order thinking skills are needed to be able to learn metacognitive knowledge. Metacognition has an important role in the learning process (Frenkel, 2014) including improving thinking abilities (Yusnaeni et al., 2017).

Metacognition refers to a person's ability to think and everything related to it. In addition, metacognition also refers to a person's awareness of his or her abilities in planning, monitoring, and assessing cognition and performance (Greenstein, 2012). According to Shetty (2014), metacognition is needed in processing information that occurs in the learning process. Likewise with metacognitive skills.

According to (Ijirana et al., 2018) metacognitive skills as a person's capacity to organize, manage, and alter stages in problem-solving as well as plan for accomplishing established objectives. That is to state, efforts to address problems often involve the use of metacognitive skills. The description of metacognitive skill of students gives descriptions of their cognitive capabilities and the challenges they face when trying to solve problems. These descriptions could take the shape of concepts or other knowledge that they need to solve

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difficulties, thinking level, understanding level on the primary materials of the problems, etc.

The role of metacognitive skills in the learning process is related to students' ability to analyze, complete tasks, exercise self-control, make decisions and improve performance (Madang et al., 2021; Saputri et al., 2020). These various abilities and skills can be developed in the learning process with certain models and characteristics of learning materials, according to the abilities to be developed (Dewi et al., 2018). Biology has characteristics as both a product and a process (Zubaidah et al., 2013). As a product, biology is studied through material content obtained from research results in the form of knowledge that is both factual and conceptual. As for the process, biology is studied through a series of activities or procedures or observation steps that refer to the scientific method to be able to find knowledge. In this case, various abilities and skills can be developed through Biology learning content, including microbiology learning.

Microbiology is a branch of biology that deals with micro-sized living things, and everything related to them (Tortora et al., 2018). Therefore, learning microbiology is inseparable from the characteristics of Biology as a product and process. Studying microbiology is closely related to working in the laboratory. In this context, accuracy, precision, and prudence in work are important things that must be considered. In addition, studying microbiology also requires analytical skills, the ability to find and solve problems, make conclusions, and reflect as a form of control over the work done. These activities are closely related to metacognitive skills as part of higher order thinking skills.

So far, microbiology learning at UIN Mataram takes place with a pattern of giving project assignments, class discussions and practicums. This learning pattern is applied in the hope of empowering students' thinking skills, including metacognition skills. In this regard, it is necessary to conduct an analysis that examines the metacognitive skills of prospective biology teacher, as an initial effort to determine further steps to realize higher quality biology learning, especially those related to empowering students' thinking skills. According to Dewi et al. (2017), the ability of a teacher to foster student competence will depend on his metacognitive proficiency

Method

This descriptive research was conducted in the second semester of the 2021 academic year. The population consisted of pre-service biology teacher in 6th grade of Universitas Islam Negeri Mataram. While the sample was 70 pre-service biology teachers.

The instrument used in this study was an integrated metacognitive skill rubric of essay tests (Corebima, 2009). The questions that are used to measure metacognitive skills refer to the dimensions of cognitive processes in Bloom's taxonomy which are included in the category of higher order thinking skills. In addition to the accuracy of the answers given, the parameters measured include answers to questions using their own sentences, systematically arranged, logically, grammatical accuracy, and answers with reasons. The guideline for scoring metacognition skills starts from zero (0) to 7, while the level of metacognition skills refers to the guidelines used by (Nurman et al., 2018) which are shown in Table 1.

Tabel 1. Level of Metacognitive Skill Guide

Score	Category
81 ≤ X - 100	Very Well Developed
61 ≤ X < 80	Well developed
41 ≤ X < 60	Starting to develop
21 ≤ X < 40	Not So Developed
X < 20	Still Very Risky

Furthermore, the research data were analyzed descriptively, namely by determining the category of metacognitive skill level which was then arranged in the form of a percentage so that the condition of the metacognitive skills of the research subjects could be clearly described.

Result and Discussion

One of the executive function processes, which is important to the learning process, is metacognition. The students will be able to successfully regulate their learning styles and determine the best times to learn if they possess metacognitive skills (Fauzi et al., 2019). For lecturers, knowing the initial description of students' metacognitive abilities is advantageous since it can guide them in choosing the most effective teaching methods, procedures or strategies employed to lessen their difficulties. The ability to think, articulate ideas explicitly, and comprehend something is referred to as metacognition (Zubaidah et al., 2018). In the context of this study, students' metacognitive skills are described in relation to their comprehension of the subject matter, which is the subject of microbiology courses, as well as their capacity to articulate ideas in solving microbiology problems discovered.

The data of these research shows that the metacognitive skills of prospective biology teachers are in several categories ranging from the lowest level (still very risky) to the highest level, which is very well developed. The description of the distribution of metacognitive skills values is presented in Table 2.

Tabel 2. The Description of Metacognitive Skills Score

Option	Score
The highest score	95.24
The lowest score	14.29
Mean	44.35
Percentage below mean score	57%
Percentage above mean score	43%

Referring to Table 2, it is known that the mean score of the metacognitive skills of pre-service biology teachers who are the subject of this study is 44.35 with the highest score of 95.24 and the lowest score of 14.29. The percentage of pre-service biology teachers with scores below the mean score is 57%. Higher than the number of pre-service biology teachers with metacognitive skills scores above the mean score. Based on the level analysis of the category of metacognitive skills, prospective biology teachers at the Universitas Islam Negeri Mataram are in the category of starting to develop. This finding is higher than the results of previous studies on the metacognitive skills of prospective biology teachers (Nurman et al., 2018). The percentages of each level of metacognition skills in this study are presented in Table 3.

Table 3. Percentage of Metacognitive Skill Level

Level of Metacognitive Skill Category	Frequency	Percentage (%)
Still Very Risky	4	6
Not So Developed	29	41
Starting to develop	23	33
Well Developed	10	14
Very Well Developed	4	6

Based on Table 3, the metacognitive skills of prospective biology teachers with the category of "not so developed" have the highest percentage (41%), almost half of the number of prospective biology teachers who are research subjects. Furthermore, the category of metacognitive skills with the lowest percentage is the category that is still very risky and developing very well.

Comparison of the percentage of categories of metacognitive skill levels of prospective biology teachers is shown in Figure 1.

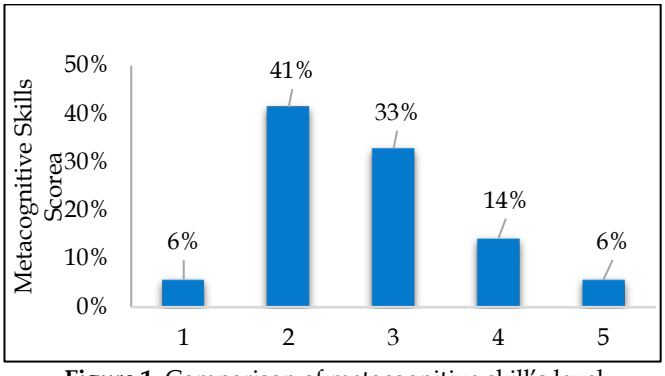

Figure 1. Comparison of metacognitive skill's level

Description: 1. Still Very Risky
2. Not So Developed
3. Starting to Develop
4. Well Developed
5. Very Well Developed

These results indicate that in the microbiology learning process, the metacognitive skills of prospective biology teacher have not been empowered properly. This is evidenced by the number of prospective biology teachers in the category that has "not so develop" and "starting to develop", occupying a percentage of almost 75% (not so develop 41% and starting to develop 33%). These results show that the metacognitive skills of aspiring biology teachers are still at the level of awareness of thinking processes and the capacity to develop them, as well as the recognition of thinking strategies. This is in reference to the aspects of metacognition that must be instilled in students. The five components of metacognitive competence are: conceptual understanding linked with procedural experience; awareness of thinking process and capacity to develop it; introduction of thinking strategies; evaluative procedural reflection; application of knowledge and procedural experiences in other contexts (Dewi et al., 2018; Robillos et al., 2022).

According to Nunaki et al. (2019), Palennari (2016), Palennari et al. (2018) in every learning process, metacognitive skills need to be developed. To increase students' high-level capabilities, which will enhance the quality of education, metacognitive skills must be cultivated and strengthened in students (Dewi et al., 2018). The development and empowerment of metacognitive skills is carried out with the aim of forming student independence in learning. This independence is closely related to students' cognitive abilities (Nurman et al., 2018). Therefore, if the learning process does not empower metacognitive skills, it will influence the level of student cognition. In this case, students are not trained enough to know the extent of their ability to use, manage and control their thinking abilities.

There are 6% of students whose metacognitive skills are in the category of still very at risk. This condition is thought to be related to the habits of students who are still not adapted to the academic culture in higher education which requires students' independence in learning beyond their independence when they were at the previous education level. Thus, when students are not independent enough in their learning, they will have difficulty in following the learning process. The initiative of students to prepare themselves well before taking part in the lecture process also affects this. Students who have prior knowledge before the lecture process takes place are believed to be

able to more easily understand the lecture material and build their knowledge more easily (Bahri et al., 2017)

The ability of students to manage and assess their style of thinking and learning is crucial for student independence in learning. Metacognition, particularly metacognitive regulation, is intimately related to self-regulation and appraisal. Palennari (2016) stated that planning, information management strategy, monitoring, correction, and assessment were the metacognitive regulation indications.

These results also indicate that maximum attention and effort is needed in the microbiology lecture process, to improve the metacognitive skills of prospective biology teacher students. Mamu (2014), stated that the development of students' self-potential in thinking can be a basis for consideration in planning, implementing, and evaluating the learning process. Some efforts that can be done are by maximizing the application of learning models that are able to empower metacognitive skills. Several previous studies have reported that various types of learning models are proven to be able to improve metacognitive skills, whether these learning models are applied independently or in combination with other learning models. Among these learning models are project-based learning, problem-based learning, inquiry learning, and cooperative learning combined with metacognitive strategies (Aloysius, 2016; Kristiani et al., 2015; Listiana et al., 2016; Nunaki et al., 2019; Ramdiah et al., 2014).

Project-based learning models can improve students' metacognitive skills because in this learning model students are required to be able to design and plan a project to obtain the desired results (Mahasneh et al., 2018; Musa et al., 2012). In this activity students are forced to think, use their abilities in analyzing, controlling project implementation, and making decisions more optimally. These activities are thinking activities that become indicators of metacognitive skills (Greenstein, 2012).

In addition to applying the learning model, certain learning strategies that match the characteristics of the biological material can also be applied to improve students' metacognitive skills. One of the deciding variables in this situation is the teacher's capacity to select and determine learning activities through the application of appropriate learning models or strategies. The learning process, as well as the growth of thinking and metacognitive skills and the achievement of student learning outcomes, will all be impacted by the choice of appropriate learning activities (Blajvaz et al., 2022; Putri et al., 2022).

Teachers can practice a metacognitive culture that encourages greater learning by giving students opportunities to identify their difficulties, asking them to find difficulties and admit them, and integrate their reflections into their learning assignments (Madang et al., 2021). The STEM approach is a method that can be used to teach metacognitive skills. Research that shows the effect of STEM integration in problem-based learning practices shows that it is suitable for improving students' cognitive abilities thus metacognitive skill (Cencelj et al., 2020; Putri et al., 2022). Furthermore Listiana et al. (2016), revealed that investigation group learning combined with the Think Talk Walk (TTW) strategy was able to improve metacognitive skills. The strategy of making a summary of reading results, making questions, predicting, and clarifying answers are learning strategies that can be applied to empower metacognitive skills (Mamu, 2014).

Conclusion

The metacognitive skills of pre-service biology teacher at Universitas Islam Negeri Mataram are on average at the level of starting to develop. The group of pre-service teachers with the category of metacognitive skills that have not so develop occupies the highest percentage, while the lowest percentage is occupied by the group with the category of still very at risk and developing very well.

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