

The Metacognition of Pre-Service Biology Teachers: Awareness, Skills, Understanding, and Practices

Ahmad Fauzi
Universitay of Muhammadiyah Malang
ahmad_fauzi@umm.ac.id

Wasiatus Sa'diyah
University of Tsukuba

Abstract. Metacognition is the basic competency to become an independent learner. Unfortunately, the level of understanding and empowering this competency are still very low in Indonesia. This mixed-method study aimed to show the metacognition level and understanding about metacognition-based learning of Pre-service teachers. The subjects of this study were 36 last-term students majoring Biology Education Program in Malang. The metacognitive awareness inventory and metacognitive skills rubric were used to collect students' metacognition level data, while open-ended questions were used to find out students' understanding about metacognition as well as metacognition-based learning. Data on students' metacognitive awareness and skills were analyzed using descriptive statistics, while qualitative coding and analysis were carried out to find out students' understanding about metacognition and metacognition-based learning. The findings showed that the level of metacognitive awareness of Pre-service biology teachers was good, while their skills were relatively low. This study also showed that many Pre-service teachers did not understand what metacognition is and how to empower it. Therefore, it needs to increase teachers' competencies regarding to metacognition in Indonesia.

Keywords: *metacognition-based learning, metacognitive awareness, metacognitive understanding, metacognitive skills, Pre-service biology teacher.*

INTRODUCTION

Metacognition is often considered as one of the most important factors, which contributes to learning achievement [1], [2]. The existence of this factor was developed since the era of Socrates [1] and introduced by Flavell decades ago [3]. Furthermore, the urgency of metacognition in teaching and learning process highly emphasizes in the recent years [4]. It is clearly indicated by the increase of metacognition studies in some journals of education [5]–[8]. As the result, most of educational frameworks regard metacognition as learning competency and outcomes that must be achieved by learners.

Metacognitive ability is closely related to other factors of success performed by independent learners [9]. Through metacognitive ability, learners will be able to observe, regulate, and control their thinking process [10], [11]. The learners can also evaluate and choose which way of study they think more effective and appropriate [7]. Based on its role in monitoring and controlling the

cognitive process, metacognition is positively correlated to self-regulation of learning [12]. In addition, metacognition is also reported to have significant correlation with motivation [1], [13] and self-efficacy [1], [14]; the most two important factors to perform good quality of learning [15]–[17].

As it is an important factor in learning process, teachers have to maximize students' metacognition and identify several factors which develop their metacognitive abilities [7]. Moreover, teachers of the 21st century are required to not only deliver materials to the students, but also train them to identify how they learn [18]. In the concept of metacognition, an effective learning process is indicated by good understanding of learners' way of learning. That is why, teachers have to comprehend their students' way of learning in order to have an effective teaching process [19]. Moreover, to build students' metacognition, teachers must be equipped with good teaching skills and techniques. In addition, an in-depth understanding about metacognition [18] and indicators to evaluate students' level of metacognition should be acquired by the teachers. If the teachers are not familiar with the concept of metacognition, they will not be able to design teaching-based-metacognition learning [20].

Furthermore, the rule says that it is impossible for a teacher to teach a skill to his students if he does not master that skill. In other words, the teachers who do not understand the concepts they will teach will not be able to easily deliver them to their students [21]. In the same way, teachers will be very difficult to optimally build students' metacognition if they do not have good metacognition ability [22]. Therefore, Pre-service Teacher program is expected to provide teachers who have a high level of metacognition ability that will be needed as one of the main competency to be a professional teacher. Teachers with a good ability in metacognition are continuously motivated to improve their skills and qualities. They will frequently evaluate and reflect their ways of teaching to adapt with the students' techniques of learning so that they will feel very comfortable [23]. Hence, it concludes that metacognition is an important factor for both teachers and students.

Studies about metacognition have been carried out for years. Some studies focus on the influence of learning model implementation [24], [25] and the development of instrument [22], [26] as well as learning media [27] on

students' metacognition. Besides, some studies concern to profile or distribution level of students' metacognition [28], [29]. Most of the studies involved students as the subjects of research. Meanwhile, taking teachers as the subjects of metacognition studies is still few in numbers, even difficult to find although the findings on this kind of research are really important, especially to figure out the metacognition ability of Pre-service teachers. Based on the aforementioned explanation, therefore, the objective of this study is to analyze teachers' metacognitive ability consisting of a) their level of metacognitive awareness; b) their level of metacognitive skills; c) their level of metacognitive understanding; and d) their comprehension on teaching practice based on metacognitive process.

METHOD

This study is a mixed method study with convergent design [30]. As a mixed method study, it employed quantitative and qualitative analysis to achieve the objective. Quantitative analysis by using statistical computation was used to find out the profile of awareness and metacognitive skills of Pre-service Biology teachers. In addition, qualitative analysis was implemented to explore themes that were recognized from the understanding of the Pre-service teachers about metacognition.

This study was carried out in one of the Faculties of Teacher Training and Education in Malang starting from November 2018 to March 2019. The population encompassed Pre-service Biology teachers of a faculty and the participants were 36 students (28 female and 8 male) of Biology Education who were randomly selected from all students' of academic year 2015. All participants had completed the required subjects on education and experienced teaching apprentice program held by the department. The data of this study were collected through some instruments. First, the Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison was used to collect the data on metacognitive awareness [31]. Second, the rubric integrated with essay questions developed by Corebima was used to collect the metacognitive skills data [32]. The data average of each component of metacognitive awareness and metacognitive skills was categorized based on criteria presented in Table 1.

Table 1: The categories of metacognition level

Scores	Categories
86-100	Very good
76-85	Good
60-75	Enough
55-59	Low
0-54	Very low

In addition, four open-ended questions validated by experts of metacognition studies were also employed to figure out the participants' understanding about metacognition-based learning. Further, the data were processed using qualitative analysis. The analysis was employed through some stages: discovering patterns, identifying themes, and categorizing data. The first stage

was putting the open coding to the participants' responses obtained from the open-ended questions. The data were categorized to create a framework. Second, the related coding was collected in one theme. In this stage, identifying patterns and making connections were carried out. The themes then were analyzed to determine the more general patterns. In addition, Word Tree diagram was also implemented as the supporting instrument to analyze the data. Finally, the last stage was interpreting the analyzed data and explaining the results.

RESULT

Metacognition is the basic competence that must be acquired by teachers and taught to students. To prepare Pre-service teachers with good understanding of metacognitive concept is a must for Teacher Training and Education program. According to the findings, the Pre-service teachers had performed good level of metacognitive awareness. The eight components of their metacognitive awareness were categorized as "good" in which debugging strategies had the highest average and evaluation was the lowest. These findings were consistent with the previous studies which investigated the profile of metacognitive awareness both in senior high school [33] and higher education [34] in Indonesia. In details, the profile of metacognitive awareness of the Pre-service teachers was presented in Figure 1.

The good result of metacognitive awareness performed by the Pre-service teachers was not consistent with their metacognitive skills. Based on Figure 2, it clearly found that the level of their metacognitive skills was not satisfying, even categorized as "very low". There were no participants who performed at least "good" category in metacognitive skills. As the result, the findings of this research were completing the information about the lack of metacognitive skills of Indonesian students as reported in some grades, such as Junior High School [27] and Senior High School [29], [35].

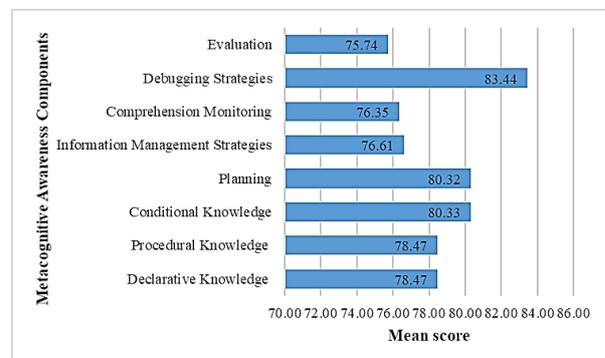


Figure 1: The profile of Pre-service teachers' metacognitive awareness

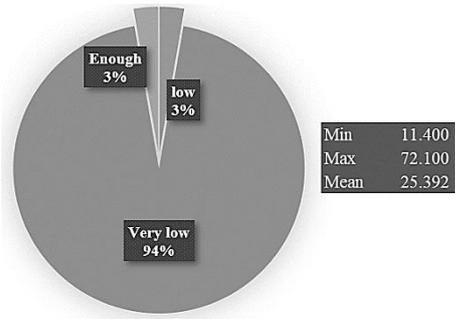


Figure 2: The distribution of metacognitive skills level of Pre-service teachers

The various understandings about metacognitive concept were obtained through the content analysis to the responses of the participants. That was figured out by using Word Tree diagram as presented in Figure 3. Based on the result of analysis, most of the Pre-service teachers regarded metacognition from the perspective of cognitive regulation. Some of them perceived that metacognition was closely related to the ability of a person to regulate his way of thinking. Some correlated metacognition with the ability of a person to evaluate his learning process and some others connected metacognition to the awareness of planning the learning strategies. Unfortunately, the Pre-service teachers did not explain metacognition from the domain of cognitive knowledge. Furthermore, there were only three students who explained metacognition in the domain of declarative knowledge. Moreover, the other two of cognitive knowledge were never taken into account by the Pre-service teachers.

However, it was also found that the majority of Pre-service teachers did not explain what mean by metacognition accurately. There were various misconceptions they performed, such as defining metacognition as the level of learning materials acquisition and equalizing metacognition with critical thinking ability. In more details, the distribution of metacognition domain and the Pre-service teachers' misconceptions could be seen in coding map at Figure 4. The finding of this study was in line with the information given by Dewi et al. who claimed that the Indonesian teachers were lack of metacognition knowledge [36].

The understanding of Pre-service teachers about metacognition could be also indicated by their comprehension to explain the improvement of metacognitive level during participating in the Teacher Training program. Most of them claimed that their level of metacognition had significantly improved. However, the findings showed that the evidences they gave were not the indicators and components of metacognition. They believed that their metacognitive level had improved because they equalized the improvement of metacognition with the increasing numbers of their concepts of understanding on subjects.

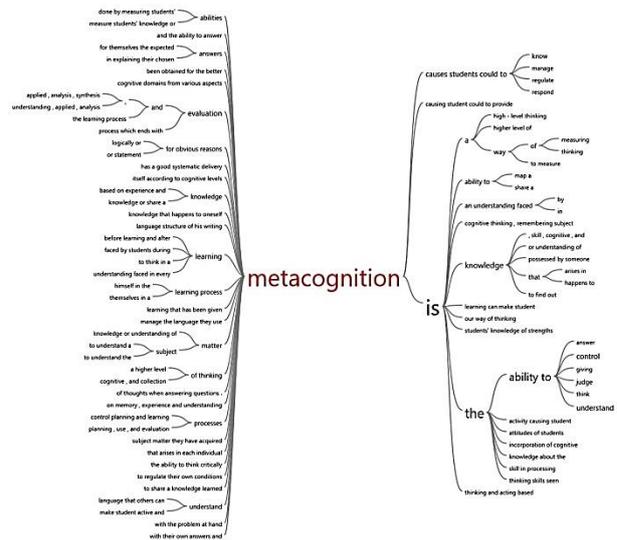


Figure 3: Word Tree diagram which is depicting Pre-service teachers understanding about metacognition

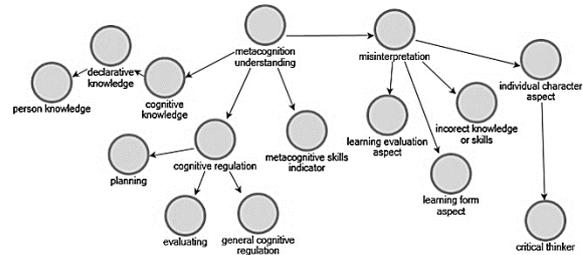


Figure 4: Coding map build from Pre-service teachers' response about metacognition

The understanding of Pre-service teachers about metacognition determines if they will be able to build the students' metacognition in the process of teaching and learning. Some of them stated that they never consider metacognition into the process of teaching because of some reasons, i.e. having difficulty to implement metacognition-based teaching, acquiring lack of metacognitive concepts, and assuming metacognition as an unimportant subject. Some others said that they have designed and carried out the metacognition-based teaching in their classroom. Unluckily, their teaching designs were not recommended to train the students' metacognition, for example teacher-centered learning. In addition, some of the participants informed that the metacognition-based learning designs that were implemented consisted of classroom presentation and discussion. When the Pre-service teachers were asked to share their experiences in improving the metacognitive level during taking the Teacher Training program, most of them provided inappropriate examples, such as implementing teacher-centered and presentation techniques. In fact, such conventional learning reportedly inhibits the empowerment of student metacognition [37]. This finding indicated that most of the Indonesian Pre-service teachers are not well-equipped with adequate knowledge of building metacognition.

On the other hand, some Pre-service teachers have designed appropriate learning. Some of the learning designs include project-based learning, mind mapping, and reflection activities. These learning forms have been shown to empower students' metacognition [38]–[40]. In addition, several students have also been able to identify the existence of metacognition-based learning as long as they study on the lecture bench. Some of the learning experiences include self-reflection, problem solving activities, and preparation of scientific articles. These various lecturing activities are also reported could improve metacognitive abilities [40]–[42]. However, only a handful of Pre-service teachers can provide precise examples of metacognition-based learning, both based on teaching experience and their learning experience.

The whole findings of this study show that the metacognitive awareness of Pre-service teachers is categorized as good, however, they are lack of the metacognitive skills, the understanding of metacognitive concepts, and the knowledge of metacognitive practices. This finding proves the Pre-service teacher program is still not effective to produce prospective teachers who are genuinely able to develop students' metacognitive ability. The other interpretation of the research findings indicated that the concept of metacognition is not familiar for teacher training and educational program in Indonesia. The lack of understanding about metacognition is consistent with the previous researches carried out in the world, which reported that the metacognitive concepts were not known well by the elementary school teachers [43]. It is undeniable that teachers' inadequate understanding of metacognition is the main reason of the stagnant development of students' metacognitive ability [36].

Learning experiences have improved during the process of lecturing. The lecturers are responsible to create meaningful learning experiences, and their ability of teaching assures the quality of learning process [25]. As highlighted in this study, the lecturers does not only design teaching activities which develop the Pre-service teachers' metacognitive level, but also enhance their knowledge about the nature, indicators, urgency, and development of metacognition. According to Iwai, if the Pre-service teachers are not well-prepared to teach a certain competency, they will not be able to teach that competency to their students [44]. That is why, the lecturers of Teacher Training program are highly required to introduce, develop, and improve the urgency of metacognitive concepts through teaching activities to their students who will be the candidates of professional teachers.

CONCLUSION

The results of this study inform that the metacognitive awareness of the Pre-service Biology teachers was categorized as good, but their metacognitive skills are contrary because they lack of understanding about metacognition. Therefore, the quality of Pre-

service teacher program in Indonesia should be improved to equip the future teachers with both good understanding of metacognitive concepts and adequate knowledge of designing and implementing metacognition-based learning. Related to the metacognitive awareness of the Pre-service teachers that did not go hand in hand with their skills and understanding, more studies focusing on the effectiveness of MAI as instrument in Indonesia are needed to conduct.

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