The Understanding of Metacognitive Skills Among Biology Teachers and Lecturers in Makassar, South Sulawesi, Indonesia

by Akun Indonesia Belajar

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The Understanding of Metacognitive Skills Among Biology Teachers and Lecturers in Makassar, South Sulawesi, Indonesia.

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Abstract. Teachers and lecturer must can comprehend the nature of metacognition and how it can be implemented in the learning process. This study aimed to investigate to what extent Biology teachers and lecturers understand metacognitive skills. A survey with a descriptive quantitative approach was employed in this study. The data of this study were gathered using a questionnaire and an interview. The population all Biology lecturers who were teaching at the Department of Biology Education and Biology school teachers from Makassar, South Sulawesi, Indonesia. The samples were selected by using a purposive sampling technique. The samples were 46 Biology lecturers and 48 Biology school teachers. The results showed that the participants had an issue in comprehending metacognitive skills; only a few of them understood what metacognition was. In fact, the majority of the lecturers and teachers had not integrated the skills into the learning process. It is expected that the findings of this study can be contemplated as an insight to the development of the learning quality in the 21st century era.

Keywords: Biology teachers and lecturers, understanding of metacognitive skills.

INTRODUCTION

Metacognitive skills comprise the ability to and the awareness of monitoring one's own learning process [1]. Education should be able to rise this awareness in student [2]. Metacognitive skills play an essential role [3]–[5] as a compass which enables students to be responsible for their own learning [6]–[8]. Metacognitive skills help students to plan as well as to monitor their learning progress and process, problem-solving [9]–[12]

Teachers and lecturers need to be able to comprehend the nature of metacognition and how to incorporate metacognitive skills into learning [13], [14]. The teachers' and lecturers' understanding of metacognition seems to be closely related to their perception of learning strategies that can help students raise their metacognitive awareness and metacognitive abilities [15], [16]. Educators with good understanding of pedagogy can understand what needs to be taught [17]–[19] and can be more successful in improving their students' metacognitive skills [9] [20].

Empirical evidence shows that most students are willing to reflect on their learning process and adjust their learning strategies to various conditions. However, many unable to identify appropriate learning strategies nor implement a new plan [21],[22] . The students' metacognitive awareness and metacognitive skills are at the level of "*cannot really*" (cannot distinguish between what to think and how to think) and of "*at risk*" (the students do not seem to be aware that thinking is a process) [23], [24]. This shows that students experience a difficulty in measuring and managing their thinking evolution [3].

The early provision of metacognition to Biology teacher candidates is expected to give a strong foundation for their pedagogical competence. Students learn from their teachers; in this case, lecturers. Therefore, how lecturers teach

in the classrooms are the examples of how learning should be conducted. However, it has been found that learning activities at universities have not reflected the proper science learning. The classrooms are mostly dominated by lecturing, textbook reading, and power point presentation by the lecturers, while students' problem solving and higher-order thinking skills have been left untouched [25], [26]. The habits of teaching by using conventional techniques are still found in many schools. Therefore, it is less likely that students' metacognitive skills can be empowered [27].

Research conducted by Theodosiou [28] and Veenman [29] have proven that discovery learning and task-based learning had an effect on activating students' metacognitive processes. By understanding metacognition, teachers and lecturers can help their students generate their metacognitive awareness and metacognitive ability [15]. Metacognitive empowerment can stimulate reflective thinking skills, critical thinking, making effective decisions and self-confidence in class discussions and have superior performance [30]–[33]. Success in learning and education occurs when teachers, lecturers, supervisors, educational institutions design, implement and manage learning by empowering metacognitive skills [34].

The main purpose of this research was to investigate the extent to which Biology lecturers and school teachers understand concepts related to metacognition. The results of this study are expected to provide insights for improving the quality of the 21st century learning. Synergy between teachers and lectures in promoting metacognitive skills in the classroom and the early provision of metacognitive skills at universities are beneficial to improve the quality of education.

METHOD

This study was designed as a descriptive quantitative survey. The research data were obtained using a questionnaire and an interview. The population of this research was all the lecturers from Biology education program in Makassar and all Biology teachers in Makassar, South Sulawesi. The research samples were taken from the population by using a purposive sampling technique. Altogether, there were 48 teachers and 46 lecturers (12 lecturers from Universitas Islam Negeri (UIN) Alauddin Makassar; 11 lecturers from Universitas Pejuang Republik Indonesia (UPRI) Makassar; 23 Lecturers from STKIP Pembangunan Indonesia (PI) Makassar). The criteria for selecting the samples from the university were that the lecturers came from an accredited biology education program, had been serving as an associate lecturer in the department, and had been teaching Biology for more than three years. The teachers were selected based on the facts that their schools had been accredited and they had more than five years of teaching experience. Every school level was represented by on Biology teacher.

A semi-open questionnaire was developed to collect the data. The participants' understanding of metacognitive skills was measured based on nine components: (1) recognition of metacognition concept; (2) understanding of the importance of metacognitive skills for students; (3) comprehension of the parameters of metacognitive skills; (4) knowledge about the characteristics of students who master metacognitive skills; (5) promotion of students' metacognitive skills in the classroom; (6) understanding the advantages of empowering students' metacognitive skills; (7) understanding the correlation between metacognitive skills and learning achievement; (8) knowing the correlation between metacognitive skills and thinking skills; and (9) difficulties in empowering students' metacognitive skills. Before the questionnaire was distributed to the participants, it was validated by a group of experts (construct validity).

The study was carried out from December-August. The data were analyzed using a descriptive quantitative analysis, and the conclusion was drawn based on percentages with the assistance of Excel for Windows. Besides, an interview was also conducted to the representatives of the participating universities and schools to obtain more detailed information on the aspects related to metacognitive skills. The components of the interview covered (1) the constraints that the teachers/lecturers faced in implementing metacognitive skills; (2) the efforts that teachers/lecturers did to improve students' metacognitive skills in the classroom; (3) learning strategy and learning methods that the teachers/lecturers often used in the classroom; (4) the teachers/lecturers self-reflection on their pedagogic competence.

FINDINGS

The results related to the teachers and lecturers' understanding of metacognitive skills can seen in Table 1.

Table 1: Teachers and Lecturers' Understanding about Metacognitive Skills

No	Variable Components	Understanding of Metacognitive Skills		
		Teacher (%)	Lecturer (%)	Average (%)
1	Recognition of metacognition concept.	20.83	28.26	24.55
2	Understanding of the importance of metacognitive skills for students.	16.67	26.09	21.38
3	Comprehension of the parameters of metacognitive skills.	14.58	23.91	19.25
4	Knowledge about the characteristics of students who master metacognitive skills.	12.50	23.91	18.21
5	Efforts to promote students' metacognitive skills in the classroom.	12.50	19.57	16.03
6	Understanding the advantages of empowering students' metacognitive skills.	10.42	19.57	14.99
7	Understanding the correlation between metacognitive skills and learning achievement.	8.33	17.39	12.86
8	Knowledge about the correlation between metacognitive skills and thinking skills.	8.33	17.39	12.86
9	Difficulties in empowering students' metacognitive skills.	12.50	19.57	16.03
	Average	12.96	12.96	21.74

The recapitulation of the survey related to the learning methods used at the universities and schools participating in this study is presented in Figure 1.

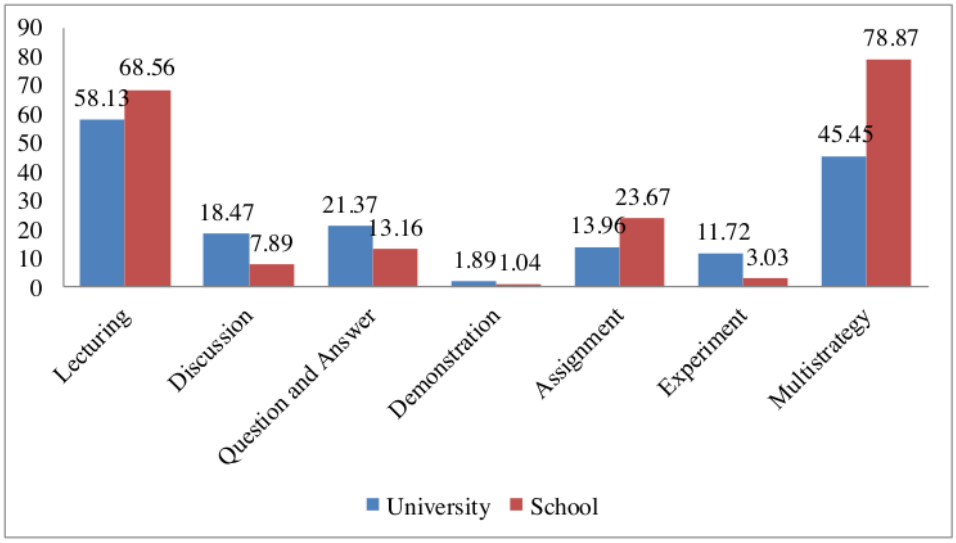

Figure 1. The Result of the Survey on Learning Methods Used in the Clasrooms

Factors that affect the participants' understanding of metacognitive skills are recorded in Table 2.

Table 2: Factors Affecting Biology Teachers and Lecturer's Understanding of Metacognitive Skills

No	Aspects	Factors Affecting Understanding		
		Teacher (%)	Lecturer (%)	Average (%)
1	Actively involved in training, national/international seminars or scientific forums related to metacognitive skills and learning innovation.	20.83	60.87	40.85
2	Implementing a variety of learning models, strategies, methods in the classroom.	16.67	41.30	28.99
3	Using authentic assessment to evaluate students' achievement.	35.42	39.13	37.27
4	Reflecting on the students' learning activities in a learning journal.	12.50	21.74	17.12
5	Monitoring the students' learning progress and thinking development.	31.25	52.17	41.71
6	Training the students' questioning skills in the learning process.	43.75	63.04	53.40
	Average	26.74	46.38	36.56

DISCUSSION AND RESULTS

The results showed that the teachers and lecturers had poor comprehension of metacognitive skills because metacognitive skills were rarely empowered through classroom activities. Most of the teachers did not understand the concept of metacognition. This has impacted their choice of learning strategies to be implemented in the biology classrooms which are mostly dominated by multistrategy learning. As a result, the students' metacognitive skills and other thinking skills are not well-developed. Educators need to develop a complex understanding of metacognitive concept and metacognitive thinking strategies in order to be able to teach their students how to improve their metacognitive skills [15].

The metacognitive skills must undergo habituation which means the skills must be trained regularly through learning. The habituation process requires full self-awareness and self-control [35]. Therefore, as a learning facilitator, teachers and lecturers have an important role in helping the students develop the habit. An effective pedagogical approach to raise students' awareness of metacognition and self-regulation in learning should be designed properly [36]. Students who can regulate themselves are more likely to perform better in metacognition [37]. Metacognitive skills can be used in problem-solving, experiment design, and investigation [20].

The finding is in line with the results of a survey conducted by Warouw [38], showing that 36.58% teachers are not familiar with metacognitive learning; 97.56% do not yet know the meaning of metacognitive skills and have not developed the skills; 100% do not yet know the importance of empowering metacognitive skills in learning. Other research findings have also indicated that science teachers from junior high schools in Jember [39] and science teachers from senior high schools in Jeneponto [40] have poor metacognitive skills. Despite the "sad" empirical evidence, teachers and lecturers still have many opportunities to help their students develop metacognitive skills by participating in metacognition training. If the educators are aware of that, the quality of Biology learning can improve accordingly.

Teachers' pedagogical competency is also a determinant factor that influence the students' success in academics. The educators' capability in implementing various learning models, approaches, strategies, methods and techniques in the classroom has a significant effect on the students' learning experience, which is expected to be able to improve their metacognitive skills. The development of metacognition skills and the variation of learning models/strategies can strengthen students' potentials [29]. Teachers' pedagogical competence can be improved through training, seminars, workshops, held by either MGMP (Subject Teacher Consultation), Department of Education, or the cooperation between the ministry and other institutions. However, all these efforts have not been apparently carried

out on the field. The training activities so far tend to emphasize on the aspects of education and learning in general and have not discussed metacognition learning [39].

The interviews have also revealed some obstacles in empowering teacher's metacognitive skills. The first obstacle is that because training, seminars, and workshops attended by the participants did not focus on metacognitive skills. In addition, the role of the supervisor in monitoring the empowerment of metacognitive skills in the classroom was not very active. School principals and school supervisors did not directly monitor the classroom learning. Teaching supervision was not regularly conducted. Instead, the focus of school assessment was normally put on administrative matters, such as the adequacy of learning media [41]. The lack of the supervision activity results in maintaining the habits of teachers to implement conventional methods in the classroom [27].

Furthermore, the observation indicate that the learning models, strategies, methods used in the classrooms are not varied (figures showed 16.67%). As a result, students' learning independence cannot be established. The activation of students' metacognitive skills could stimulate students' learning autonomy and improve students' learning achievement [42] and learning competences [43]. Independent learners are equipped with metacognitive skills. It is believed that they will become more successful in learning and in the workplace in the future [37], [44].

Students' needs are not limited only to cognitive domains, but also other domains related to the ability to control and communicate learning results individually to develop understanding and learning attitude [45]. Research conducted by Dipalaya [46] showed that most of schools in Makassar only concentrated on developing and testing students' memory of Biology concepts [47] observed that most biology teachers spent half of the lesson explaining theories and ignore other practical aspects that have the potential to develop students' objective reasoning ability. Teachers often used the expository model, so that biology learning became less meaningful [48]. Meanwhile, at the university level, 58.13% learning was still dominated by lecturing method [49]. It, thus, can be concluded that the empowerment of the students' metacognitive skills in the classrooms was still at its slightest. Teachers and lecturers should be able to help students develop their metacognitive knowledge through the implementation of learning strategies, and help them understand how to apply the procedural knowledge into real-life situations [21].

Another important issue to address is that teachers and lecturers need to monitor the development of students' thinking skills. They have to increase their involvement in the empowerment of students' metacognitive skills. Livingston [50] states that metacognitive activities, such as problem-solving, comprehension control, and progress monitoring can be beneficial for students' cognitive processes. When students' metacognitive skills have improved, the students' awareness to learn, to control the learning process, to evaluate self-efficacy, and to evaluate their strengths and weaknesses will also experience progress [42]. This will also help teachers and lecturers to assess the students' learning achievement through authentic assessment. However, before establishing a learning environment and implementing an appropriate learning strategy that can accelerate the development of students' metacognitive skills, the principles and conditions that determine metacognitive behaviors must first be determined [51].

Blakey [52] put forward the steps to improve students' metacognitive skills (behaviors), including: (1) identifying what is known and not known; (2) talking about thinking; (3) making a thinking journal; (4) making self-planning and regulation; (5) reporting the thinking process; (6) self-evaluation. However, the observation showed that Biology teachers and lecturers in Makassar rarely wrote a learning journal to reflect on the process of learning. Writing a journal can increase retention, while analysis of writing can improve students' thinking ability [53].

Students should be involved in reflecting learning behaviors to increase their metacognitive awareness [36], [54]. The quality and the quantity of students' involvement in structured assignments should be increased. Specific individual tasks should be given to students. Metacognition can also be integrated into students' daily activities [55]. The role of teachers and lecturers in teaching and facilitating ideas and activities provides positive acceptance for students in training their metacognitive skills [56].

Students' metacognitive skills can also be improved through writing tasks [53]. Students need to be actively engaged in the classroom discussion where they are given an opportunity to answer and ask questions. Research reports that 43.75% teachers and 63.04% lecturers train their students' questioning skills in the learning process. Teachers and lecturers should be able to increase interaction through discussion and evaluate the learning process [13], [57]. The right questioning technique can provide a more meaningful learning experience for students and establish a direct interaction between teacher and students [2], [58]. Students' metacognitive skills can also be empowered by training the students' questioning skills. Research conducted in Turkey, Singapore, Japan showed a relationship between problem problem-ability with students' metacognition skills [59]. Metacognitive skills have an important role in controlling the cognitive processes of students in order to think reflectively, effectively and efficiently [15], [60]. Learning should be equipped with a student monitoring and evaluation assessment component that supports metacognitive skills and scientific literacy [61], [62]. The higher the metacognitive skills of students, the better the ability for self-reflection [63].

The success of the empowerment of metacognitive skills at the university level highly depends on the lecturer's professionalism. Lecturers must be able to create activities that stimulate students' metacognitive skills. The results of the interviews conducted with Biology lecturers from Makassar have uncovered five major obstacles to improving students' metacognitive skills. The first one is the lecturer's lack of understanding of metacognitive process. They also admitted that classroom management and monitoring were two important skills that had to be mastered by the lecturers. In addition, lack of supervision and evaluation of lecturers' performance might result in the lecturer's poor understanding of students' metacognitive skills. It was also difficult for the lecturers to monitor students' metacognitive skills with a non-standardized instrument. The diversity of student backgrounds (age, gender, culture, academic, social, and economic level) was also an issue. Based on these findings, it is obvious that the stakeholders need to facilitate the development of lecturer professionalism.

All in all, it can be concluded that teachers and lecturers' lack of knowledge of metacognitive skills may result in selecting inappropriate strategies to develop students' metacognitive skills. Although some of them have already possessed a good understanding of the concept of metacognition, most of them have not empowered students' metacognitive skills during the learning process. Therefore, it is recommended for the teachers and lecturers to always improve their pedagogical and professional competence as educators.

REFERENCE

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The Understanding of Metacognitive Skills Among Biology Teachers and Lecturers in Makassar, South Sulawesi, Indonesia.

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Abstract. Teachers and lecturer must ~~be able to~~can comprehend the nature of metacognition and how it can be implemented in the learning process. This study aimed to investigate to what extent Biology teachers and lecturers understand metacognitive skills. A survey with a descriptive quantitative approach was employed in this study. The data of this study were gathered using a questionnaire and an interview. The population ~~of this study consisted of~~are all Biology lecturers who were teaching at the Department of Biology Education and Biology school teachers from Makassar, South Sulawesi, Indonesia. The ~~research~~ samples were selected ~~from the population~~ by using a purposive sampling technique. The samples were 46 Biology lecturers and 48 Biology school teachers. The results ~~of the study~~ showed that the participants had an issue in comprehending metacognitive skills; only a few of them understood what metacognition was. In fact, the majority of the lecturers and teachers had not integrated the skills into the learning process. It is expected that the findings of this study can be contemplated as an insight to the development of the learning quality in the 21st century era.

Keywords: Biology teachers and lecturers, understanding of metacognitive skills.

INTRODUCTION

Metacognitive skills comprise the ability to and the awareness of monitoring one's own learning process [1]. Education should be able to rise this awareness in students [2]. Metacognitive skills play an essential role [3], [4], [5] as a compass which enables students to be responsible for their own learning [6], [7], [8]. Metacognitive skills help students to plan as well as to monitor their learning progress and process, problem-solving [9], [10], [11], [12].

Teachers and lecturers need to be able to comprehend the nature of metacognition and how to incorporate metacognitive skills into learning [13], [14]. The teachers' and lecturers' understanding of metacognition seems to be closely related to their perception of learning strategies that can help students raise their metacognitive awareness and metacognitive abilities [15], [16]. Educators ~~who have a~~with good understanding of pedagogy ~~are able to~~can understand what needs to be taught [17], [18], [19] and ~~are normally~~can be more successful in improving their students' metacognitive skills [9, 20].

Empirical evidence shows that most students are willing to reflect on their learning process and adjust their learning strategies to various conditions. However, many ~~of them are~~ unable to identify appropriate learning strategies nor implement a new plan [21], [22]. The students' metacognitive awareness and metacognitive skills are at the level of "*cannot really"* (cannot distinguish between what to think and how to think) and of "*at risk"* (the students do not seem to be aware that thinking is a process) [23], [24]. This shows that students experience a difficulty in measuring and managing their thinking evolution [3].

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The early provision of metacognition ~~for students as~~to Biology teacher candidates is expected to give a strong foundation for ~~the students'~~their pedagogical competence. Students learn from their teachers; in this case, lecturers. Therefore, how lecturers teach in the classrooms are the examples of how learning should be conducted. However, it has been found that learning activities at universities have not reflected the ~~appropriate~~ proper science learning. The classrooms are mostly dominated by lecturing, textbook reading, and power point presentation by the lecturers, while students' problem solving and higher-order thinking skills have been left untouched [25], [26]. The habits of teaching by using conventional techniques are still found in many schools. Therefore, it is less likely that students' metacognitive skills can be empowered [27].

Research conducted by [28], [29] have proven that discovery learning and task-based learning had an effect on activating students' metacognitive processes. By understanding metacognition, teachers and lecturers can help their students generate their metacognitive awareness and metacognitive ability [15]. Metacognitive empowerment ~~in classroom learning~~ can stimulate reflective thinking skills, critical thinking, making effective decisions and self-confidence in class discussions and have superior performance [30], [31], [32], [33]. Success in learning and education occurs when ~~together~~ teachers, lecturers, supervisors, educational institutions design, implement and manage learning by empowering metacognitive skills [34].

The main purpose of this research was to investigate the extent to which Biology lecturers and school teachers understand concepts related to metacognition. The results of this study are expected to provide insights for improving the quality of the 21st century learning. Synergy between teachers and lectures in promoting metacognitive skills in the classroom, ~~as well as~~and the early provision of metacognitive skills at universities are beneficial to improve the quality of education.

METHOD

This study was designed as a descriptive quantitative survey. The research data were obtained using a questionnaire and an interview. The population of this research was all the lecturers from Biology education program in Makassar and all Biology teachers in Makassar, South Sulawesi. The research samples were taken from the population by using a purposive sampling technique. Altogether, there were 48 teachers and 46 lecturers (12 lecturers from Universitas Islam Negeri (UIN) Alauddin Makassar; 11 lecturers from Universitas Pejuang Republik Indonesia (UPRI) Makassar; 23 Lecturers from STKIP Pembangunan Indonesia (PI) Makassar). The criteria for selecting the samples from the university were that the lecturers came from an accredited biology education program, had been serving as an associate lecturer in the department, and had been teaching Biology for more than ~~3~~ three years. The teachers were selected based on the facts that their schools had been accredited and they had more than five years of teaching experience. Every school level was represented by on Biology teacher.

A semi-open questionnaire was developed to collect the data. The participants' understanding of metacognitive skills was measured based on nine components, ~~namely~~: (1) recognition of metacognition concept; (2) understanding of the importance of metacognitive skills for students; (3) comprehension of the parameters of metacognitive skills; (4) knowledge about the characteristics of students who master metacognitive skills; (5) promotion of students' metacognitive skills in the classroom; (6) understanding the advantages of empowering students' metacognitive skills; (7) understanding ~~of~~ the correlation between metacognitive skills and learning achievement; (8) knowing the correlation between metacognitive skills and thinking skills; and (9) difficulties in empowering students' metacognitive skills. Before the questionnaire was distributed to the participants, it was validated by a group of experts (construct validity).

The ~~present~~ study was carried out from December-August. The data were ~~then~~ analyzed using a descriptive quantitative analysis, and the conclusion was drawn based on percentages with the assistance of Excel for Windows ~~Program~~. Besides, an interview was also conducted to the representatives of the participating universities and schools to obtain more detailed information on the aspects related to metacognitive skills. The components of the interview covered (1) the constraints that the teachers/lecturers faced in implementing metacognitive skills; (2) the efforts that teachers/lecturers did to improve students' metacognitive skills in the classroom; (3) learning strategy and learning methods that the teachers/lecturers often used in the classroom; (4) the teachers/lecturers self-reflection on their pedagogic competence.

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FINDINGS

The results ~~of the study~~ related to the teachers and lecturers' understanding of metacognitive skills can seen in Table 1.

Table 1: Teachers and Lecturers' Understanding about Metacognitive Skills

No	Variable Components	Understanding of Metacognitive Skills		
		Teacher (%)	Lecturer (%)	Average (%)
1	Recognition of metacognition concept.	20.83	28.26	24.55
2	Understanding of the importance of metacognitive skills for students.	16.67	26.09	21.38
3	Comprehension of the parameters of metacognitive skills.	14.58	23.91	19.25
4	Knowledge about the characteristics of students who master metacognitive skills.	12.50	23.91	18.21
5	Efforts to promote students' metacognitive skills in the classroom.	12.50	19.57	16.03
6	Understanding ~~of~~ the advantages of empowering students' metacognitive skills.	10.42	19.57	14.99
7	Understanding ~~of~~ the correlation between metacognitive skills and learning achievement.	8.33	17.39	12.86
8	Knowledge about the correlation between metacognitive skills and thinking skills.	8.33	17.39	12.86
9	Difficulties in empowering students' metacognitive skills.	12.50	19.57	16.03
	Average	12.96	12.96	21.74

The recapitulation of the survey ~~results~~ related to the learning methods used at the universities and schools participating in this study is presented in Figure 1.

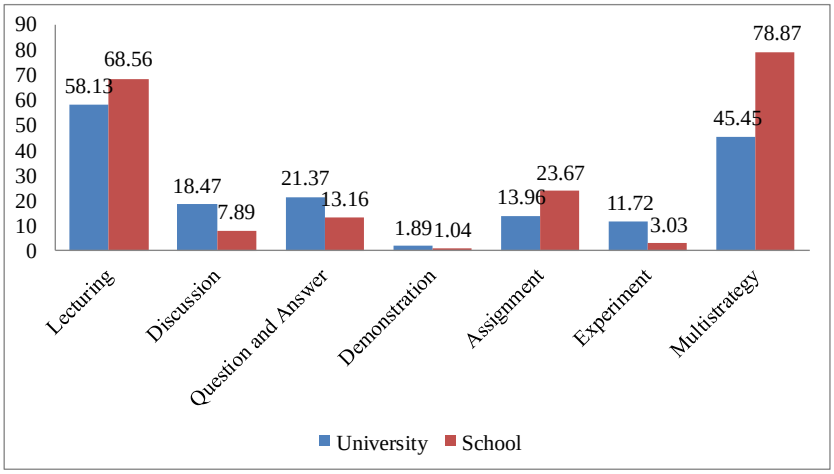

Figure 1. The Result of the Survey on Learning Methods Used in the Clasrooms

Factors that affect the participants' understanding of metacognitive skills are recorded in Table 2.

Table 2: Factors Affecting Biology Teachers and Lecturer's Understanding of Metacognitive Skills

No	Aspects	Factors Affecting Understanding		
		Teacher (%)	Lecturer (%)	Average (%)
1	Actively involved in training, national/international seminars or scientific forums related to metacognitive skills and learning innovation.	20.83	60.87	40.85
2	Implementing a variety of learning models, strategies, methods in the classroom.	16.67	41.30	28.99
3	Using authentic assessment to evaluate students' achievement.	35.42	39.13	37.27
4	Reflecting on the students' learning activities in a learning journal.	12.50	21.74	17.12
5	Monitoring the students' learning progress and thinking development.	31.25	52.17	41.71
6	Training the students' questioning skills in the learning process.	43.75	63.04	53.40
	Average	26.74	46.38	36.56

DISCUSSION AND RESULTS

The results ~~of the survey~~ showed that the teachers and lecturers had poor comprehension of metacognitive skills because metacognitive skills were rarely empowered through classroom activities. ~~The majority~~Most of the teachers did not understand the concept of metacognition. This has impacted their choice of learning strategies to be implemented in the biology classrooms which are mostly dominated by multistrategy learning. As a result, the students' metacognitive skills and other thinking skills are not well-developed. Educators need to develop a complex understanding of metacognitive concept and metacognitive thinking strategies in order to be able to teach their students how to improve their metacognitive skills [15].

The ~~development of~~ metacognitive skills must undergo ~~a process of~~ habituation which means the skills must be trained regularly through learning. The habituation process requires full self-awareness and self-control [35]. Therefore, as a learning facilitator, teachers and lecturers have an important role in helping the students develop the habit. An effective pedagogical approach to raise students' awareness of metacognition and self-regulation in learning should be designed properly [36]. Students who can regulate themselves are more likely to perform better in metacognition [37]. Metacognitive skills can be used in problem-solving, experiment design, and investigation [20].

The finding ~~of this study~~ is in line with the results of a survey conducted by [38], showing that 36.58% teachers are not familiar with metacognitive learning; 97.56% do not yet know the meaning of metacognitive skills and have not developed the skills; 100% do not yet know the importance of empowering metacognitive skills in learning. Other research findings have also indicated that science teachers from junior high schools in Jember [39] and science teachers from senior high schools in Jeneponto [40] have poor metacognitive skills. Despite the "sad" empirical evidence, teachers and lecturers still have many opportunities to help their students develop metacognitive skills by participating in metacognition training. If the educators are aware of that, the quality of Biology learning can improve accordingly.

Teachers' pedagogical competency is also a determinant factor that ~~might~~ influence the students' success in academics. The educators' capability in implementing various learning models, approaches, strategies, methods and techniques in the classroom has a significant effect on the students' learning experience, which is expected to be able to improve their metacognitive skills. The development of metacognition skills and the variation of learning models/strategies can strengthen students' potentials [29]. Teachers' pedagogical competence can be improved through training, seminars, workshops, held by either MGMP, Department of Education, or the cooperation between

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the ministry and other institutions. However, all these efforts have not been apparently carried out on the field. The training activities so far tend to emphasize on the aspects of education and learning in general and have not discussed metacognition learning [39].

The ~~results of the~~ interviews have also revealed some obstacles ~~that can be found~~ in ~~the process of~~ empowering teacher's metacognitive skills. The first obstacle is that because training, seminars, and workshops attended by the participants did not focus on metacognitive skills. In addition, the role of the supervisor in monitoring the empowerment of metacognitive skills in the classroom was not very active. School principals and school supervisors did not directly monitor the classroom learning. Teaching supervision was not regularly conducted. Instead, the focus of school assessment was normally put on administrative matters, such as the adequacy of learning media [41]. The lack of the supervision activity results in maintaining the habits of teachers to implement conventional methods in the classroom [27].

Furthermore, the ~~results of the~~ observation indicate that the learning models, strategies, methods used in the classrooms are not varied (figures showed 16.67%). As a result, students' learning independence cannot be established. The activation of students' metacognitive skills could stimulate students' learning autonomy and improve students' learning achievement [42] and learning competences [43]. Independent learners are equipped with metacognitive skills. It is believed that they will become more successful in learning and in the workplace in the future [37, 44].

Students' needs are not limited only to cognitive domains, but also other domains related to the ability to control and communicate learning results individually to develop understanding and learning attitude [45]. Research conducted by [46] showed that ~~the majority~~most of schools in Makassar only concentrated on developing and testing students' memory of Biology concepts [47] observed that most biology teachers spent half of the lesson explaining theories and ignore other practical aspects that have the potential to develop students' objective reasoning ability. Teachers often used the expository model, so that biology learning became less meaningful [48]. Meanwhile, at the university level, 58.13% learning was still dominated by lecturing method [49]. It, thus, can be concluded that the empowerment of the students' metacognitive skills in the classrooms was still at its slightest. Teachers and lecturers should be able to help students develop their metacognitive knowledge through the implementation of learning strategies, and help them understand how to apply the procedural knowledge into real-life situations [21].

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Another important issue to address is that teachers and lecturers need to monitor the development of students' thinking skills. They have to increase their involvement in the empowerment of students' metacognitive skills. [50] states that metacognitive activities, such as problem-solving, comprehension control, and progress monitoring can be beneficial for students' cognitive processes. When students' metacognitive skills have improved, the students' awareness to learn, to control the learning process, to evaluate self-efficacy, and to evaluate their strengths and weaknesses will also experience progress [42]. This will also help teachers and lecturers to assess the students' learning achievement through authentic assessment. However, before establishing a learning environment and implementing an appropriate learning strategy that can accelerate the development of students' metacognitive skills, the principles and conditions that determine metacognitive behaviors must first be determined [51].

[52] put forward the steps to improve students' metacognitive skills (behaviors), including: (1) identifying what is known and not known; (2) talking about thinking; (3) making a thinking journal; (4) making self-planning and regulation; (5) reporting the thinking process; (6) self-evaluation. However, the ~~results of the~~ observation showed that Biology teachers and lecturers in Makassar rarely wrote a learning journal to reflect on the process of learning. Writing a journal can increase retention, while analysis of writing can improve students' thinking ability [53].

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Students should be involved in reflecting learning behaviors ~~in order~~ to increase their metacognitive awareness [36, 54]. The quality and the quantity of students' involvement in structured assignments should be increased. Specific individual tasks should be given to students. Metacognition can also be integrated into students' daily activities [55]. The role of teachers and lecturers in teaching and facilitating ideas and activities provides positive acceptance for students in training their metacognitive skills [56].

Students' metacognitive skills can also be improved through writing tasks [53]. Students need to be actively engaged in the classroom discussion where they are given an opportunity to answer and ask questions. Research reports that 43.75% teachers and 63.04% lecturers train their students' questioning skills in the learning process. Teachers and lecturers should be able to increase interaction through discussion and evaluate the learning process [13, 57]. The right questioning technique can provide a more meaningful learning experience for students and establish a direct interaction between teacher and students [58]. Students' metacognitive skills can also be empowered by training the students' questioning skills. Research conducted in Turkey, Singapore, Japan showed a relationship between problem problem ability with students' metacognition skills [59]. Metacognitive skills have an important role in controlling the cognitive processes of students in order to think reflectively, effectively and efficiently [15], [60]. Learning should be equipped with a student monitoring and evaluation assessment component that supports

metacognitive skills and scientific literacy [61], [62]. The higher the metacognitive skills of students, the better the ability for self-reflection [63]

The success of the empowerment of metacognitive skills at the university level highly depends on the lecturer's professionalism. Lecturers must be able to create activities that stimulate students' metacognitive skills. The results of the interviews conducted with Biology lecturers from Makassar have uncovered five major obstacles to improving students' metacognitive skills. The first one is the lecturer's lack of understanding of metacognitive process. They also admitted that classroom management and monitoring were two important skills that had to be mastered by the lecturers. In addition, lack of supervision and evaluation of lecturers' performance might result in the lecturer's poor understanding of students' metacognitive skills. It was also difficult for the lecturers to monitor students' metacognitive skills with a non-standardized instrument. The diversity of student backgrounds (age, gender, culture, academic, social, and economic level) was also an issue. Based on these findings, it is obvious that the stakeholders need to facilitate the development of lecturer professionalism.

All in all, it can be concluded that teachers and lecturers' lack of knowledge of metacognitive skills may result in selecting inappropriate strategies to develop students' metacognitive skills. Although some of them have already possessed a good understanding of the concept of metacognition, most of them have not empowered students' metacognitive skills during the learning process. Therefore, it is recommended for the teachers and lecturers to always improve their pedagogical and professional competence as educators.

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