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Research Article

Metacognitive skill profile of biology education students at institute of teachers' education in South Sulawesi, Indonesia

Romi Adiansyah [a,1,*], Astuti Muh. Amin [b,2], A. Ardianto[c,3], Ahmad Yani[d,4],

[a] Biology Education Department, Faculty of Tarbiyah and Teacher Training, Universitas Muhammadiyah Bone, Jl.Abu Dg. Passolong, Bone, South Sulawesi 92716, Indonesia

[b] Biology Education Department, Faculty of Tarbiyah and Teaching Science, IAIN Ternate, Jl. Lumba-lumba, Ternate, North Maluku 97727, Indonesia.

[c] Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Bulukumba, Jl. Ir. Soekarno No. 9, Bulukumba, South Sulawesi 92513, Indonesia

[d] Biology Education Department, Faculty of Teacher Training and Education, Universitas Puangrimaggalatung, Jl. Puangrimaggalatung, No. 27, Wajo, South Sulawesi 90915, Indonesia

[1]romiadiansyah04@gmail.com*; [2]astutimuhamin@iain-ternate.ac.id; [3]ardianto@gmail.com; [4]ahyanstkip30@gmail.com

* Corresponding author

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ABSTRACT

Metacognitive skills are one of the abilities required in the twenty-first century, to achieve independent learning. However, these skills still need to review whether these skills have been empowered by educators, particularly in universities. This research was aimed at determining the metacognitive skill profile of Biology Education students at the Institute of Teachers' Education in South Sulawesi, Indonesia. This research used a descriptive quantitative method. The population of this research was all the students of the Biology Education Study Program at the non-state Institute of Teachers' Education in South Sulawesi. The samples of this research were 356 Biology Education students in the second semester who programmed the Environmental Science course in the 2020/2021 academic year. The instrument used in this research was an essay test to measure students' metacognitive skills in the Environmental Science course. The results of the data analysis indicate that the students' metacognitive skills are in the category of undeveloped as much as 89.27%. Therefore, some efforts to improve students' metacognitive skills are required by those institutes through the implementation of a learning model which can empower the metacognitive skills of the prospective Biology teacher students.

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INTRODUCTION

One of the factors determining the quality of a nation is education. Education can produce active, creative and innovative human resources. However, these cannot develop without the skills and the self-awareness in the education process. These skills are essential in order that school graduates can compete successfully in the global community (Amin et al., 2020; Redhana, 2019). Metacognitive skills become the basis for independent learning to prepare for 21st century education (Adiansyah, 2022; Scott, 2015; Shovkova &

Pasichnyk, 2019). The development of metacognitive skills can help students to develop their independent learning and to select the best learning strategies which are appropriate to the types of assignment, as well as to have the ability to control their cognitive processes (Amin et al., 2017; Eggen & Kauchak, 1996; Chalmers, 2011; Peters, 2000; Schraw & Dennison, 1994).

Metacognition is important in the learning process, and it determines the student's academic success. Metacognition enables students to be smart in learning, for example by learning new information rather than learning the previously known information (Coutinho, 2007; Slavin, 2000). Metacognition is a higher mental process involved in learning, such as making learning plans, using appropriate skills and strategies to solve problems, predict the learning outcomes, and adjusting the scope of learning (Amin & Adiansyah, 2020; Arnett & Suner, 2019; Coutinho, 2007).

Research results find that the metacognitive skill profile of prospective biology teacher students is at a very risky level with an average value of 10.67 (Amnah, 2014; Tsai & Huang, 2002; Nurman et al., 2018). Another research result also finds that the metacognitive skills of students at several universities are still not fully developed (Bahri, 2015; Muhlisin et al., 2016). Related to the results of observation carried out by Fitiani (2016) on the Environmental Science course, it was found that the classroom problems were the lack of the student's ability to manage their learning strategies which resulted in low cognitive learning outcomes. This indicates that the level of metacognitive skills and learning results produced by the Institute of Teachers' Education (ITE) is still inadequate because the quality of academic performance can be achieved if students can continually control their cognitive processes (Chalmers, 2011; Ramdiah & Corebima, 2014).

ITE is an institution that produces qualified teacher candidates and professional teacher candidates (Ahmad S, 2017) The quality of teachers needs to be considered by examining the education process, starting from the service by the administrative staff, lecturers, curriculum, places of learning to students' insights on education, and the supporting facilities for the teaching and learning process in ITE (Azhar, 2009). Prospective teachers should be professionally prepared in a particular setting. The educational environment must be designed and prepared in such a way to able to develop the expected character (Azhar, 2009). Based on the facts explained above, this research aims at revealing the profile of metacognitive skills of Biology education students at the non-state Institution of Teachers' Education (ITE) in South Sulawesi, Indonesia. Furthermore, the result of this study could be used as a reference to another metacognitive study in Indonesia.

METHOD

This research is descriptive quantitative research. The population of this research was all the students of the Biology Education Study Program at ITE in South Sulawesi, Indonesia. The samples of this research were 356 Biology Education students in the second semester who programmed the Environmental Science course in the 2020/2021 academic year. The research samples were spread in STKIP Muhammadiyah Bone, STKIP Prima Sengkang, Universitas Muslim Maros, Universitas Muhammadiyah Makassar, STKIP Pembangunan Makassar, and Universitas Muhammadiyah Pare-Pare. This research was conducted from March until May 2021.

The research samples were selected by using the purposive sampling technique because this technique was suitable for the criteria of the samples in this research. Those criteria were (1) a non-state ITE that has Biology Education Study Program in South Sulawesi; (2) a non-state ITE which has the curriculum for the Environmental Science course in the even semester. The distribution of the research samples can be seen in Table 1.

Table 1. Research sample

No.	Name of ITE	Number of Students
1	STKIP Muhammadiyah Bone	Class A: 33 students
		Class B: 35 students
2	STKIP Prima Sengkang	Class A: 28 students
3	Universitas Muslim Maros	Class A: 35 students
4	Universitas Muhammadiyah Makassar	Class A: 35 students
		Class B: 28 students
5	STKIP PI Pembangunan Makassar	Class A: 33 students
		Class B: 33 students
		Class C: 34 students
6	Universitas Muhammadiyah Pare-Pare	Class A: 35 students
		Class B: 31 students
Total Mean		**365 Students**

The data collected in this research consisted of metacognitive skill data. An essay test of environmental science consisting of 14 question items was used as a research instrument to measure students' metacognitive skills. The instrument had been validated by two experts (material experts and learning instrument development experts), and it had been empirically validated before it was used. The empirical validation was carried out on biology education students of STKIP PI Pembangunan with a total of 99 students.

The results of the construct validity of the essay test by some experts obtained an average value of 3.80 (very valid category). The validity test of the instrument was done by performing confirmatory factor analysis, and it was obtained that the factor weighting value was > 0.3 and a T-value of ± 1.96 (all items of the metacognitive skill instrument were declared valid). The coefficient of Cronbach's Alpha of the metacognitive skill instrument showed a value of 0.959 (consistent and reliable). The score of the students' metacognitive skills was obtained by using a metacognitive skill scoring rubric consisting of a 7 scale (0-7) of Corebima (2009) as presented in Table 2.

Table 2. Metacognitive skills assessment rubric

Score	Description
7	The answer is written in their own sentences. The order of answer is harmonious as well as systematic. The answer is logic in correct grammar, supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is correct.
6	The answer is written in their own sentences. The order of answer is harmonious as well systematic. The answer is logic in less correct grammar, supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is correct.
5	The answer is written in their own sentences. The order of the answer is less/unharmonious as well as less/unsystematic. The answer is less/ not logic in less correct grammar, supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is correct.
4	The answer is not written in their own sentences. The order of answer sentences is harmonious as well as systematic. The answer is logic in correct grammar, supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is correct.
3	The answer is not written in their own sentences. The order of answer sentences is less/unharmonious as well as less/unsystematic. The answer is less/not logic, in less correct grammar, supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is correct.
2	The answer is not written in their own sentences. The order of answer sentences is less/unharmonious as well as less/unsystematic. The answer is less/not logic, in less correct grammar, not supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is less correct.
1	The answer is not written in their own sentences. The order of answer sentences is less/unharmonious as well as less/unsystematic. The answer is less/not logic, in less correct grammar, not supported by explaining reason (analytic, evaluative, or creative explanation), and the answer is not correct.
0	There is no answer at al.

The scores obtained from the rubrics were calculated using the following metacognitive skill Formula (1) (Corebima, 2009):

$$\frac{y1 + 2x}{a} = y2 \quad (1)$$

where y1= concept gaining score; y2= combined score between concept gaining and metacognitive skills,; and x = metacognitive skill score.

The metacognitive skill category was determined by using a scale by Green (2007). The score interpretations are as follows: 81 ≤ X ≤ 100 develop very well, 61 ≤ X ≤ 80 develop well, 41 ≤ X ≤ 60 starts to develop, 21 ≤ X ≤ 40 not yet develop, X ≤ 20 still very risky. The data were analyzed descriptively by determining the mean and percentage obtained by each respondent.

RESULTS AND DISCUSSION

The recapitulation of the metacognitive skill score percentage of the biology students can be seen in Table 3.

Table 3. the score percentage of biology students' metacognitive Skills based on metacognitive Skill Category

No	Names of ITE	Metacognitive Skill Score (X) at each Category				
		A (%)	B (%)	C (%)	D (%)	E (%)
1	STKIP Muhammadiyah Bone	0	0	7.51	83.18	9.31
2	STKIP Prima Sengkang	0	0	3.57	92.86	3.57
3	Universitas Muslim Maros	0	0	2.86	94.28	2.86
4	Universitas Muhammadiyah Makassar	0	0	10.00	88.21	1.79
5	STKIP PI Pembangunan Makassar	0	0	5.02	88.00	6.98
6	Universitas Muhammadiyah Pare-Pare	0	0	10.90	89.10	0
	Total Mean	**0**	**0**	**6.64**	**89.27**	**4.09**

where A = Develop very well, 81 ≤ X ≤ 100**;** B = Develop well, 61 ≤ X ≤ 80**;** C = Start to develop, 41 ≤ X ≤ 60**;** D = Not yet develop, 21 ≤ X ≤ 40**;** E = Still very risky, X ≤ 20**; and** X = Metacognitive skills score

Table 3 shows the score percentage of metacognitive skills of the biology students in the non-state ITE in South Sulawesi. It indicates that around 89.27% are in the not yet develop category, around 6.64% are in the start to develop category, and around 4.09% are in the still very risky category.

The profile of the students' metacognitive skills

The profile of the metacognitive skills of biology students in the non-state ITE in South Sulawesi (Table 2) falls into three categories, namely start to develop, not developed yet, and still very risky. The data of this research show that the metacognitive skills of biology students at non-state ITE in South Sulawesi have not been properly empowered. The lecturers have not optimally implemented the empowerment of metacognitive strategies in the learning activities. This condition made the students have low responsibility and confidence to be actively involved in the learning process and the problem-solving activities.

The findings of this research are in line with the research results conducted by Amnah (2014) reporting that 60.55% of the students had not been trained to use metacognitive strategies when they were in high school, which resulted in a low level of metacognitive skills in the learning process. Nurman et al. (2018) also argued that one of the causes of students' low metacognitive skills was due to problems related to the learning material in the previous educational level which had not been completed.

Biology learning nowadays has not been able to optimally empower metacognitive skills in problem-solving (Amin et al., 2022; Pratama, 2018). The results of the research conducted by Yustina and Vebrianto (2009) reveal that the biology learning process in Indonesian is still dominated by one-way teacher activities. The teacher often explains and gives information about phenomena and biological concepts verbally, less contextual, and the teacher often poses low-level questions. Biology learning is still oriented toward mastery of concepts, and it lacks students' active involvement in the learning activities (Amin, 2017; Suryawati et al., 2010; Yustina et al., 2011). The results of those research indicate that the empowerment of students' metacognitive skills has not been optimally carried out.

Metacognitive skills have an important role in the success of learning activities. Therefore, it should be considered in the teaching and learning activities and the development of lifelong learning theories (Amin et al., 2016b; Corebima, 2006b; Mesaros et al., 2012). Metacognitive skills should be empowered so that students become independent learners (Corebima, 2009; Louca, 2003). Students who learn with the support of metacognitive skills can develop their thinking processes, and they can apply specific learning strategies to think independently through challenging and complex tasks (Amin & Corebima, 2016; Slavin, 2000).

Referring to this fact, a learning strategy that can significantly empower the metacognitive skills of prospective biology teacher students is required, so that the students can manage their learning. Biology lecturers should train metacognitive strategies to their students to improve their metacognitive skills, in order that they become more active and independent learners. If teachers/lecturers continue to design tasks that can stimulate and enhance students' metacognitive impressions, their academic performance can increase (Aurah, 2013). The empowerment of students' metacognitive skills is expected to improve students' cognitive learning results.

The empowerment of metacognitive skills in ITE

There has not been much research investigating metacognitive skills at university levels, especially at ITE in South Sulawesi, Indonesia. Thus, specific references related to the empowerment of metacognitive skills in classroom learning at universities, especially in the Environmental Science course, are rarely found.

Reid (2006) stated that the empowerment of metacognitive skills could be a powerful strategy for increasing students' thinking and learning abilities. Metacognitive skills are an important factor in controlling students' cognitive abilities through training that covers planning, controlling, understanding, communicating, paying attention, keeping retention, solving learning problems, and evaluating strengths and weaknesses (Bahri & Corebima, 2015; Corebima, 2006a; Eggen & Kauchak, 1996; Howard, 2004). It is essential that metacognitive skills be empowered in the learning process because these skills enable the students to manage information and their behavior in solving problems so that learning activities become easier (Coutinho, 2007; Downing, 2009).

The lack of development and empowerment of metacognitive skills in universities is still one of the indicators of the low quality of the learning process in Indonesia (Setiawan & Susilo, 2015). The results of the research by Herlanti et al. (2012) found that in general lecturers gave one-way information. This is in line with the research results by Bahri (2016) which found that the learning pattern in the Biology Department of FMIPA in Universitas Negeri Makassar was still dominated by conventional learning processes. The learning strategies which empower the students' potential, such as the empowerment of thinking and metacognition, have not been optimally applied so the learning process becomes less optimal.

Students tend to be passive in the classroom learning activities, tend to be silent, only listen, take notes, memorize, and even the students might feel bored in the classroom and are not enthusiastic and not serious to follow the learning process. This boredom has a serious impact on students' motivation, behavior, strategies, and academic performance (Amin et al., 2016a; Tze et al., 2015). The difference in conceptions between students and lecturers about the teaching and learning process is a substantial problem that must be immediately solved (Amin, 2022; Virtanen & Lindblom-Ylänne, 2009). Lecturers need to improve students' metacognitive skills through practice and by creating a metacognition-supporting environment.

Metacognitive skills include the process of evaluating and managing cognitive processes, and it tends to be unstable (Stolp & Zabrucky, 2009). Designing students' metacognitive skills can involve basic approaches to support metacognition, such as (1) training metacognitive strategies; (2) creating a social environment that supports metacognition (Lin, 2001). Experiences that encourage metacognition will provide a potential environment for the development of students' metacognitive strategies by promoting problem-solving skills in learning (Aurah, 2013). Students who have good metacognitive skills in the learning process will have a positive effect on their cognitive learning results.

Learning difficulties and learning problems might occur due to the mismatch between the student's learning styles and the learning programs taken (Amin & Adiansyah, 2018; Kinshuk et al., 2009). The results of the interviews with several biology lecturers at the non-state ITE in South Sulawesi show that the students have low motivation for learning. Their willingness or capability to do an assignment independently and to finish it on time is relatively low. Students in general have not been able to manage and to organize their learning strategies and study time well, especially, when they are at home or outside of the class hours. Hardianto (2014) argued that most students were not accustomed to re-studying what have been studied. They generally only study when they are having examinations, assignment deadline, or a quiz. These learning difficulties and learning problems are what the lecturers at non state ITE should address so that the prospective teachers to become globally competent and competitive.

ITE as an institution of teachers' education should be able to produce competent graduates and pay attention to the aspects of the learning goals. ITE needs to equip its graduates with insight, attitudes, skills, mastery of teaching materials, understanding of students, teaching skills, and the ability to carry out tasks professionally (Soetjipto & Kosasi, 1994). Relevant research by Rahayu (2012) found that the teachers' pedagogic competence in learning management was good, but the implementation of the learning management that met the scientific standards was not optimal yet. In the learning process, teachers only explain the concepts of the learning material to the students without proving the validity of the concepts. Similarly, the research by Arfandy (2014) found that the professional competence of certified teachers in elementary schools, junior high schools, and senior high schools was not maximum. In addition, it may also be caused by the limited number of research reports and scientific articles which can be used as a teaching reference.

Biology education has three inseparable aspects which become the objectives of science learning, namely process, product, and attitude (Naimnule & Corebima, 2018). Therefore, the role of ITE is to produce prospective teachers who can accommodate these aspects which become the objectives of science learning.

The efforts to improve these metacognitive skills can be done through metacognitive skill training and the implementation of creative and innovative learning strategies and models.

This research is limited to the analysis of survey results to measure students' metacognitive skills in the Environmental Science course at six non-state ITEs in South Sulawesi, Indonesia. The indicators of metacognitive skills used in this research are (1) being aware of the thinking processes and able to describe them, (2) developing thinking strategies, (3) reflecting on a procedure evaluatively, (4) transferring knowledge or experiences into other contexts, and (5) connecting conceptual knowledge with procedural experience.

Based on the results of this research, it is recommended that educators implement creative and innovative learning strategies or learning models so that students' metacognitive skills can be optimally empowered in the learning process. The findings of this research are expected to give important information to education observers, educators (teachers and lecturers), education offices, and the ministry of education to improve the quality of prospective teachers as well as to produce highly competent human resources that are globally competitive.

CONCLUSION

Based on the results of the data analysis in this research, it can be concluded that the profile of metacognitive skills of biology students in non-state ITEs in South Sulawesi, Indonesia is at the level of not yet developed, starting to develop, and still very risky. Thus, this research becomes a reference material to find alternative solutions to improve students' metacognitive skills including the use of strategies, models, or media in the implementation of learning.

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