Correlation Analysis of Metacognitive Skills with Students Learning Outcomes on Reproductive System Materials

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Abstract. To adapt to the rapid development of the 21st century, students must possess solid soft and hard skills. Metacognitive skills can enable students to learn freely and comprehend topics more thoroughly, making them one of the most crucial components in promoting successful learning. This study intends to examine the association between metacognitive skills and student learning results in class XI MAN 3 Tasikmalaya's reproductive system content. Class XI MIA consists of 140 individuals, and the sample size is class XI MIA 3, composed of 34 individuals. The correlational approach is employed to conduct this study. Collected samples using the method of purposive sampling. The instrument utilized in this investigation was an integrated metacognitive skill test for learning outcomes with 12 reproductive system material description questions. With a significance level of 5%, correlation regression is employed to analyze the data. Based on the results of the data processing study and hypothesis testing, it was determined that there was a correlation between metacognitive skills and student learning outcomes in the material for class XI MAN 3 Tasikmalaya concerning the reproductive system. 29.9% of learning outcomes can be attributed to metacognitive abilities. The link is relatively significant, as the correlation coefficient is 0.547.

Keywords: Metacognitive Skills · Learning Outcomes · Reproductive System

1 Introduction

In facing global competition, every individual needs to be equipped with qualified abilities including soft skills and hard skills. This will make it easier for individuals to blend in in society. To obtain these abilities, one of the paths that can be taken is through education. Education is a process of humanizing humans in preparing students to face life in society. Life in society is constantly changing with the times. So that education

is not just dissolved in changes in society, education must have a directed goal so that it can be seen the achievement of the educational process.

The achievement of educational objectives is stated in The Minister of Education and Culture, No. 20, 2016 concerning Competency Standards for Graduates of primary and secondary education which states that high school, islamic high school, and disabled high school graduates need to have factual, conceptual, procedural and metacognitive knowledge at a technical, specific, detailed, and complex level with regard to science, technology, art, culture and humanities" [1]. So, high school graduates are expected to have knowledge that includes factual, conceptual, procedural and metacognitive knowledge.

Metacognitive are used as one of the parameters that must be achieved by students at the high school level. Metacognitive are considered important because metacognitive knowledge can support the success of student learning. Through metacognitive learners learn to develop about their own thinking. Metacognitive are divided into two, namely the knowledge of cognition and the regulation of cognition. Knowledge of cognition includes procedural knowledge, declarative knowledge and conditional knowledge. Meanwhile, cognition arrangements include planning, information regulation strategies, monitoring understanding, strategies for correcting errors and evaluation [2]. Thus, this metacognitive involves knowledge and regulation of the cognition possessed by the learner.

Metacognitive constitute a high level of knowledge. When students have the ability to manage their learning process, the learner can be said to have used metacognitive skills. Metacognitive skills refer to the regulation of one's cognition. According to [3] "Metacognitive skills allow learners to determine suitable learning strategies, monitor the implementation of learning strategies, and evaluate their learning effectiveness". This is in line with the statement of [4] stated "If students have good metacognitive skills, the learning outcomes will be good". The flow that students go through to be able to use metacognitive skills should students need to be aware of the metacognitive they have. Metacognitive awareness allows learners to realize the importance of metacognitive in improving learning outcomes such as being aware of what they already have and do not know about a particular topic.

A person's metacognitive awareness can be measured using a MAI (Metacognitive Awareness Inventory) questionnaire adapted from [2]. Based on the MAI questionnaire that has been given to 100 students of class XI MIA MAN 3 Tasikmalaya which was carried out on Friday, March 29, 2019, total of questions is 52, the results were obtained that overall 71.64% of students had good metacognitive awareness. The results are seen from eight aspects, namely declarative knowledge (knowledge of how a person learns and the factors that influence it), procedural knowledge (knowledge of doing something), conditional knowledge (knowledge of when and why to use declarative and procedural knowledge), planning (plans in learning), information regulation strategies (skills and strategies used to obtain information), monitoring understanding (monitoring the implementation of strategies), strategies in correcting mistakes and evaluation (evaluating the effectiveness of learning).

From the eight aspects, there are three aspects that support metacognitive skills, namely planning, monitoring understanding, and evaluation. Each of the results obtained is that 76% of students have had good learning planning, 73.43% of students have had

good understanding monitoring and 70.33% of students have had awareness of their learning evaluation. This metacognitive awareness allows it to be used as a basis in seeing the metacognitive skills of learners. Therefore, after the dissemination of the metacognitive awareness questionnaire, the author wants to see the metacognitive skills of class XI MIA MAN 3 Tasikmalaya students.

2   Methods of Research

The research method used is the correlational method of surveys. According to [5] "Correlation research is just like comparative research, so it is called association research. In association research, the relationship between two or more variables is studied in the absence of any attempt to influence them". Meanwhile, According to [6] "Correlation research involves collecting data to determine the existence of a relationship and the degree of relationship between two or more variables". So correlation research is one type of research to determine the existence of a relationship and the degree of relationship between two or more variables without any effort to influence it.

3   Results and Discussion

3.1   Results

3.1.1   Statistical Data on Metacognitive Skills of Learner

Based on research that has been carried out in class XI MIA 3 MAN 3 Tasikmalaya on the reproductive system material with 12 items of description, statistical data were obtained as follows.

Based on Table 1, the average value of metacognitive skills obtained is 62.0588. The minimum value of metacognitive skills obtained by learners is 52 while the maximum value of metacognitive skills obtained is 81. The list of frequency distributions of learners' metacognitive skill values can be seen from Table 2.

Table 1. Statistics Of Metacognitive Skills of Learners

Statistics	
Metacognitive Skills	
N Valid	34
Missing	0
Mean	62,0588
Median	61,5000
Mode	58,00
Std. Deviation	6,34341
Variance	40,239
Minimum	52,00
Maximum	81,00
Sum	2110,00

Table 2. Frequency Distribution List Of Metacognitive Skill Values

Interval Class	Frequency	Class Limits
52–56	5	51,5–56,5
57–61	12	56,5–61,5
62–66	11	61,5–66,5
67–71	3	67,5–71,5
72–76	2	71,5–76,5
77–81	1	76,5–81,5
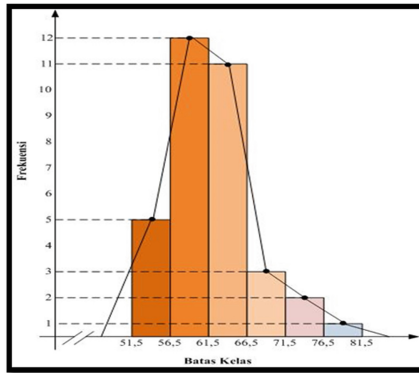
Fig. 1. Histograms and Frequency Polygons

For more details on the frequency distribution of metacognitive skills of learners can be seen in the following histograms and polygons.

Based on Fig. 1 explains the value of learners' metacognitive skills in the form of histograms and polygons. The figure shows that the highest scoring frequency lies in the class limit between 56.5 and 61.5 with a frequency of 12. While the lowest frequency is located at the class limit between 76.5 to 81.5 with a frequency of 1.

3.1.2 Statistical Data on Students Learning Outcomes

Based on research that has been carried out in class XI MIA 3 MAN 3 Tasikmalaya on the reproductive system material with 12 items of description questions, statistical data on learning outcomes were obtained as follows.

Based on Table 3, the average learning outcome of students obtained is 80.5. The minimum score of learning outcomes is 71 while the maximum score of learning outcomes is 94. The list of distrubution of the frequency of student learning outcomes can be seen from Table 4.

For more details on the frequency distribution of student learning outcomes, please see the following histograms and polygons.

Table 3. Statistics of Learner Learning Outcomes

Statistics	
Learning Outcomes	
N Valid	34
Missing	0
Mean	80,5000
Median	80,0000
Mode	75,00
Std. Deviation	6,04152
Variance	36,500
Minimum	71,00
Maximum	94,00
Sum	2737,00

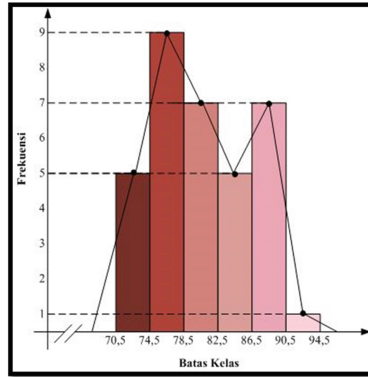**Table 4.** Frequency Distribution List Of Learner Learning Outcomes Values

Interval Class	Frequency	Class Limits
71–74	5	70.5–74.5
75–78	9	74.5–78.5
79–82	7	78.5–82.5
83–86	5	82.5–86.5
87–90	7	86.5–90.5
91–94	1	90.5–94.5

Based on Fig. 2, it explains the value of student learning outcomes in the form of histograms and polygons. The figure shows that the highest scoring frequency lies in the class boundary between 74.5 and 78.5 with a frequency of 9. While the lowest frequency is located at the class limit between 90.5 to 94.5 with a frequency of 1.

3.2   Discussion

3.2.1   The Relationship Between Metacognitive Skills and Learner Learning Outcomes

Based on the results of the correlation regression analysis,a calculated F value of 13.675 with a significance value of $0.001 < 0.05$, meaning that there is a relationship between metacognitive skills and student learning outcomes. Based on the results of the regression test, the regression line equation was obtained, namely $\hat{Y} = 48.159 + 0.521x$. The constant of 48,159, means that the consistent value of the learning outcomes variable is 48.159. While the regression coefficient x of 0.521 states that every addition of 1% of the value of metacognitive skills, the value of learning outcomes increases by 0.521. The

Fig. 2. Histograms and Frequency Polygons

Table 5. Frequency Distribution List Of Learner Learning Outcomes Values

Coefficient Intervals	Criterion
0,80 – 1,00	Very powerful
0,60 – 0,799	Strong
0,40 – 0,599	Strong enough
0,20 – 0,399	Low
0,00 – 0,199	Very low
0,80 – 1,00	Very powerful

Source:[7]

regression coefficient is positive, so it can be said that the direction of the relationship of the variable X to Y is positive. According to Edi Hernawan (2018: 162) "Bila price positive regression coefficient, then variable Y will increase or increase. Conversely, if the regression coefficient is negative, the variable Y will decrease".

In addition, from the results of linear regression analysis, it is known that the value of the correlation coefficient/relationship is 0.547. This R value is used to determine the strength of the relationship between metacognitive skills and learner learning outcomes. To see the strong relationship between the two variables can be seen in Table 5.

Based on Table 5, a correlation coefficient (R) value of 0.547 is obtained, indicating that metacognitive skills and learning outcomes of learners have a fairly strong relationship strength. However, when compared to research conducted by [8] and [9] has a higher correlation value, namely the value of the correlation coefficient (R) of 0.866 means that the strength of the relationship is very strong and 0.727 means that the strength of the relationship is strong. The difference in strength is due to the research of [8] and [9] the strength of the relationship is influenced by the empowerment of the use of strategies and learning models used.

The relationship between metacognitive skills and learning outcomes lies in the cognitive of the learners. Learning outcomes are obtained from the results of using cognitive. The high cognitive low of the learner depends on how the learner uses it. It is this regulation of cognitive processes that is called metacognitive skills. So, indirectly metacognitive skills can affect learners' learning outcomes.

Based on the results of the study, the relative contribution given by metacognitive skills to learning outcomes was 29.9%. The author assumes that the donation shows that not entirely the learning outcomes of students of class XI MIA 3 are influenced by metacognitive skills. There are other factors outside the research variables that contribute to supporting their learning success. In line with [10] opinion's, which states that learning outcomes are influenced by two factors, namely internal factors and external factors. Internal factors, namely factors that exist in individuals include physical factors such as health; psychological factors such as interests, talents, intelligence, attention and motivation; and the fatigue factor. Meanwhile, external factors are factors that exist outside the individual including family factors, school factors and community factors. So, metacognitive skills are one of the internal factors that can support the learning success of students.

Metacognitive skills help individuals in better managing cognitive. According to [11] between cognitive and metacognitive are interrelated with each other. Cognitive is used to assist individuals in achieving goals while metacognitives are used to ensure those goals can be achieved. In addition, by using metacognitive skills we can reflect on ourselves to find out the weaknesses in learning. Introducing metacognitive skills to learners begins with building their metacognitive awareness. In line with [12] and [13] "Learners who have an awareness of their own thinking and know cognition in general, when they act on this consciousness tend to learn better". The next step teaches learners about when to use the right strategies in learning. Flexible strategies can be used to make prudent decisions that allow those learners to plan, monitor and evaluate their learning. These goals can be met through various teaching practices in schools.

To build and develop metacognitive abilities, learners can apply the following gradually, namely:

a. Identifying "what I know" and "what I don't know". At this stage, the learner first consciously understands his level of knowledge. This can be initiated by writing "I have understood about…" and I want to understand the chapter…".
b. Expressing the thought process orally can be done by discussion in pairs or discussions in groups.
c. Write a learning log. A learning diary can help reflect on learners' thought processes. This learning diary contains a record of the learner's learning plan, his own learning progress, how the learner faces difficulties in learning. The teacher can provide constructive input and criticism of what the learner has written in his or her study diary.
d. Conducting self-planning and regulation. Learners can create their own details of their learning planning, such as the amount of time needed, the organization of the material to be studied and the study schedule. Meanwhile, learning evaluation can be prepared with the help of evaluation criteria from teachers. Evaluation activities can

be carried out by providing tests to students to measure the extent to which students master the material.

3.2.2 Description of Metacognitive Skills

Based on the results of research that has been carried out in class XI MIA MAN 3 Tasikmalaya, an average of 62.0588 was obtained with a minimum value of 52 and a maximum value of 81. The metacognitive skills of students are measured using integrated metacognitive skills instruments of learning outcomes as many as 12 items of description questions which are divided into three indicators, namely indicator 1, namely planning (planning) totaling 4 questions, in that question students are asked to provide solutions to a problem, explain differences, and make abstractions from a text. According to Pintrich (2002) "Planning deals with setting goals that guide cognition in general and monitoring specifically". Meanwhile, [3] mentions planning indicators including how much time is used to work on tasks, which strategies are used, how to start something, the sources that need to be collected, focusing on something. So, this planning indicator is not defined narrowly, namely planning, but can be widely implemented in various things that are still within the scope of planning.

Furthermore, indicator 2, namely monitoring (monitoring) amounts to 5 questions, in this question students are asked to explain the reproductive organs, sequence a process, link the relationship between the two processes and provide examples. [3] suggests monitoring as a way for a person to do something and have a correct understanding of something. Meanwhile, according to [12] "Monitoring activities include assessing learning and performance in action". So, monitoring is defined as a person's way of understanding and assessing something.

Furthermore, indicator 3, namely evaluating (evaluation) amounts to 3 questions, in that question students are asked to consider answers about the menstrual process, analyze a problem, criticize about a problem. [3] posits evaluating as an assessment of the processes and results of thinking. So, evaluating is defined as the process that a person carries out to determine the value of a thing.

The three indicators that have been discussed have a maximum and minimum score, respectively. The maximum score of each indicator is 7 while the minimum score is 0. For more details on the average score of the perindicator obtained by the learners can be seen in the following figure.

Based on Fig. 3, it can be seen that from the three indicators of metacognitive skills, the highest average indicator is 4.54, the average lowest indicator is the planning indicator of 4.1, while the average evaluating indicator is 4.35.

The author assumes that monitoring indicators are higher because students are better able to monitor the extent to which they understand a material. In understanding a material, this monitoring activity can be done by reading repeatedly or often filling in the questions. In line with [13] mentioned that monitoring ability will improve by conducting exercises periodically. In addition [12] mentions "The accuracy of answers relates to the monitoring ability of learners". When faced with a question, there are two attitudes carried out by the student, namely if the student knows and masters the question then he will fill in the question correctly and if the student does not master the question then he will not answer the question correctly. Whether or not it is correct in answering

Metacognitive Skills
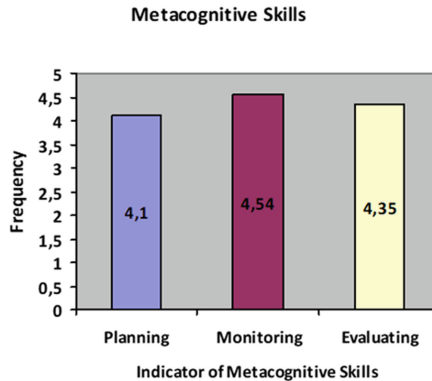
Fig. 3. Data Processing Results for Indicator of Metacognitive Skills

questions depends on the mastery of the material owned by the students. Furthermore, the monitoring activities that are usually carried out by students are by re-examining the correctness of the answers in filling out the questions before they are collected to the teacher.

While the lowest indicator is the planning indicator. The author assumes that these students already know the learning objectives to be achieved, but some students have difficulty in implementing suitable strategies in solving these problems. Based on research conducted by [14] which states that the planning stage has not been carried out by students optimally because some students when doing the questions do not read the instructions for working on the questions correctly. In addition, students have also not been able to sort out important information that is in accordance with the learning material. The average evaluating score obtained by students was 4.35. This evaluating is useful for learners to assess each activity carried out. In learning, this evaluation activity needs to be carried out continuously to see whether the learning process is achieved. In line with [15] mentions "Evaluating deals with assessing one's product and learning efficiency by revisiting one's goals and conclusions".

Often we are not aware that we are using metacognitive skills in everyday life including in learning. This is in line with [16] opinion that metacognitives are not used all the time. Some actions become a habit such as planning, monitoring, and evaluating are activities that we use automatically without realizing it.

There are several kinds of metacognitive skill processes including having good knowledge in solving problems, focusing attention on something, understanding what is read, designing a plan, using certain strategies in memorization, improving the plan being carried out, learning enough to face an exam, arranging the cognitive strength possessed to achieve a goal [3]. The metacognitive skills possessed by learners vary depending on how the learner controls their cognitive processes.

3.2.3   Description of Learner Learning Outcomes

Based on the results of research that has been carried out in class XI MIA MAN 3 Tasikmalaya, the average learning outcomes of participants were obtained at 80.5 with a
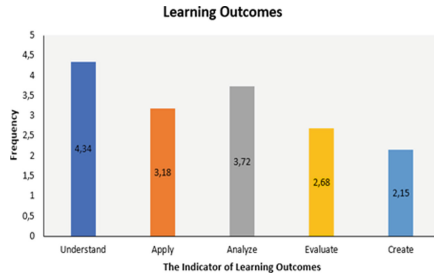
Fig. 4. Data Processing Results for Indicator of Learning Outcomes

minimum score of learning outcomes of 71 and a maximum score of learning outcomes of 94. Learning outcomes are measured using a learning outcomes test instrument in the form of 12 items of description questions which are divided into five dimensions of cognitive process knowledge, namely 4 items about aspects of understanding (C2), 3 items of questions about aspects of applying (C3), 2 items of aspects of analyzing (C4), 2 items of evaluating aspects (C5) and 1 item of making aspects (C6). For more details on the average achievement score of each level of the cognitive process dimension can be seen in Fig. 4.

Based on Fig. 4, the highest average score of learning outcomes is found in the aspect of understanding, namely 4.34 and the aspect of analyzing, which is 3.72. While the lowest average score in the aspect of making is 2.15. The difference in average scores on each cognitive dimension is due to different criteria and weights of the questions.

According to [17], Bloom suggests that skills are divided into two parts, namely low-level skills (Lower Order Thinking Skill) and high-level skills (High Order Thinking Skill). Low-level skills are important in learning, namely remembering, understanding, and applying while high-level skills that are important in learning are analysing, evaluating and creating.

Based on the results of research, the aspect of understanding is more prominent than other aspects, the author assumes that this aspect of understanding is closely related to the indicator of metacognitive skills, namely monitoring. Monitoring indicators focus on monitoring the understanding of learners. According to [18] and [19] "Understanding is constructing meaning or understanding based on the initial knowledge possessed, or integrating new knowledge into existing schemes in their thinking". Based on the research of [20] which mentions deep understanding arises when curiosity and motivation in learners to find their own understanding through the collection of data they carry out".

Furthermore, when viewed from the classification of skills, this aspect of understanding is included in the (Lower Order Thinking Skill). The author assumes that the basis of this level of cognitive dimension starts from the aspects of remembering (C1) and understanding (C2), so it is impossible for a learner to be able to answer questions C3-C6 when he does not have the ability to understand the problem.

While the lowest average score is found in the aspect of making (C6), the author assumes that students are not familiar with C6 questions. This is because students are used to doing questions from the C1 to C5 levels. The C6 question is included in the

highest level of taxonomy, therefore it is normal for students to lack mastery of this type of question.

4   Conclusion

Based on the research results, data processing and hypothesis testing, the authors conclude that there is a correlation between metacognitive skills and student learning outcomes in the reproductive system material for class XI MAN 3 Tasikmalaya. The amount of contribution given by metacognitive skills is 29.9%. The correlation coefficient is quite strong (0,547).

References

1. The Minister of Education, Regulation of The Minister Education Number 20. Indonesia: The Minister of Education, 2016.
2. G. Schraw and D. R. Sperling, Assessing Metacognitive Awareness, Contemp. Educ. Psychol, 19(04) (1994) 460–475.
3. A. Woofolk, Educational Psychology, 13th ed. Ohio, USA: Pearson, 2016.
4. S. A. Coutinho, The relationship between goals, metacognition, and academic success, *Educate*, 7(1) (2007), 39–47.
5. J. R. Fraenkel and Norman E. Wallen, How to Design and Evaluate Research in Education. Jossey-Bass Publishers, 2009.
6. L. R. Gay, G. E. Mills, and P. W. Airasian, Educational research: Compentencies for analysis and application, Pearson Education, 2012.
7. Akdon and Riduwan, Rumus dan data dalam aplikasi statistika, Alfabeta, 2006.
8. E. N. Malahayati, A. D. Corebima, and S. Zubaidah, Hubungan Keterampilan Metakognitif dan Kemampuan Berpikir Kritis Dengan Hasil Belajar Biologi Siswa SMA Dalam Pembelajaran Problem Based Learning (PBL), J. Pendidik. Sains, 3(4) (2015), 178–185.
9. A. Ardila, Development of Metacognitive and Emotional Executive Functions in Children, Appl. Neuropsychol. Child, 2(2) (2013), 82–87.
10. Slameto, Belajar dan faktor-faktor yang Mempengaruhinya, Rineka Cipta, 2010.
11. J. H. Flavell, Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry, Am. Psychol. Assoc, 34 (10) (1979) 906–911.
12. P. R. Pintrich, The Role of Metacognitive Knowledge in Learning, Teaching, and Assessing. Theory Pract., 41(4) (2002), 219–225.
13. V. R. Delclos and C. Harrington, Effects of strategy monitoring and proactive instruction on children's problem-solving performance, Am. Psychol. Assoc., 83(1) (1991), 35–42.
14. M. Sholihah, S. Zubaidah, and S. Mahanal, Keterampilan metakognitif Siswa SMA Negeri Kota Batu pada Matapelajaran Biologi, in Seminar Nasional dan Workshop Nasional Biologi dan Pembelajarannya ke-2, 2015.
15. G. Schraw, Promoting general metacognitive awareness, Instr. Sci., 6 (1998), 113–125.
16. J. Perner, B. Lang, and D. Kloo, Theory of mind and self-control: More than a common problem of inhibition, Am. Psychol. Assoc., 73(3) (2002) 752–767.
17. N. H. Zamroni and M. H. M. Ramli, Prevalence of Academic Stress Among Medical and Pharmaceutical Students, Eur. J. Educ. Stud., 4(10) (2018), 256–267.
18. L. W. Anderson *et al.*, *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy,* Longman Publishing, 2001.
19. A. Widodo, Taksonomi dan Tujuan Pembelajaran, Didaktis, 4(2) (2015), 61–69.
20. A. Oğuz and N. Ataseven, The Relationship Between Metacognitive Skills and Motivation of University Students, Educ. Process Int. J., 5(1) 2016) 54–64.