# Profile of Self-Efficacy, Metacognitive Skills, Self-Regulated Learning, and Biology Cognitive Learning Outcomes of Public High School Students

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**Abstract:** *This survey research aims to determine the profile of self-efficacy, metacognitive skills, self-regulated learning, and cognitive learning outcomes of Biology students. The study population was the XI science class in Makassar in 2023. Sampling is carried out by cluster sampling technique. The number of research samples was 269 students. The research instruments were self-efficacy questionnaires, metacognitive skills questionnaires, self-regulated learning questionnaires, and Biology cognitive learning outcomes tests. The results showed the self-efficacy profile of students in the medium category, the metacognitive skill profile of students in the medium category, the self-regulated learning profile of students in the medium category, and the Biology cognitive learning outcomes in the low category.*

**Keywords:** self-efficacy, metacognitive skill, self-regulated learning, Biology cognitive learning outcomes

## 1. Introduction

One way of measuring success in learning is through the achievement of student learning outcomes. Learning outcomes consist of three, namely cognitive, affective, and psychomotor. Cognitive learning outcomes are learning outcomes related to changes obtained in the form of knowledge at the end of the learning process [1]. Cognitive learning outcomes include changes in remembering, understanding, applying, analyzing, evaluating, and creating according to Bloom's taxonomic revision[2]

Many factors influence a student's academic success, including Biology's cognitive learning outcomes. These factors can include internal factors and external factors. Internal factors include self-efficacy, metacognitive skills, and self-regulated learning [3], [4]. Educators must understand and recognize these factors in students to encourage students to learn more optimally.

Bandura introduced self-efficacy as a personal assessment of one's ability to regulate and execute some behavior to achieve a defined goal [5] [6]. In Biology learning, Biology self-efficacy is a belief in understanding and using Biological concepts and processes [7]. High self-efficacy encourages or motivates learners to succeed. In addition, self-efficacy helps learners in facing various learning challenges.

Metacognitive skills refer to metacognitive activities that learners use to control their learning and include three important skills: planning, monitoring, and evaluation [8]. Metacognitive skills contribute to learners' cognitive learning outcomes [9]. Learners with high metacognitive skills can control and monitor themselves in their learning [10].

Self-regulated learning is an active and constructive process when learners monitor, regulate, and control cognition, motivation, and behavior [11]. Learners who can self-regulate show an attitude full of self-encouragement or initiative in organizing themselves to learn. The learning process is viewed more as an activity that learners do for themselves proactively than an event that occurs to learners as a reaction to teaching [12].

One of the problems in Biology learning is educators' lack of understanding and focus on internal factors that affect the student learning process, such as self-efficacy problems [13]. Educators need to know and understand self-efficacy, metacognitive skills, and self-regulated learning profiles to know the condition of students. This information can be a reference for teaching evaluation and be considered in lesson planning, including teaching strategies, media selection, and assessment. Likewise, cognitive learning outcomes that describe the success rate of the learning process can be used as an evaluation and encouragement to continue to maximize the learning process.

## 2. Research Methods

The types of research used are descriptive research with survey method. The population of this study was all students of XI Science class of public High School in Makassar in 2023, with cluster sampling technique. The sample was 269 students. This study used self-efficacy questionnaires, metacognitive skills questionnaires, self-regulated learning questionnaires, and Biology cognitive learning outcomes tests. The dimensions of self-efficacy used as a basis for measurement are magnitude/level, generality, and strength. The metacognitive skills questionnaire consisted of statements regarding planning, monitoring, and evaluation indicators. The statement items are adopted from the Metacognitive Awareness Inventory (MAI) [14]. The self-regulated learning questionnaire contained statements regarding motivation, cognition, and behavior indicators.

The statement items were adopted from the self-regulated learning questionnaire [11]. The data obtained in this study were analyzed using descriptive analysis. The results of data analysis from self-efficacy, metacognitive skills, and self-regulated learning questionnaires were interpreted in the percentage categories contained in Table 3.1

**Table 1:** Self-efficacy, Metacognitive Skills, and Self-regulated Learning Categorization Guidelines [15]

| Scores | Category |
|---|---|
| X ≥ M + 1,5 SD | Very High |
| M + 0,50 SD ≤ X < M + 1,5 SD | High |
| M + 0,50 SD ≤ X < M+ 0,5 SD | Medium |
| M – 1,50 SD ≤ X < M + 0,5 SD | Low |
| X < M – 1,5 SD | Very Low |

M = Mean
SD = Standard deviation

Data analysis of cognitive learning outcomes is interpreted in percentage categories contained in Table2.

**Table 2:** Guidelines for Categorizing Cognitive Learning Outcomes Scores according to Arikunto[16]

| Scores | Category |
|---|---|
| 81-100 | Very High |
| 70-80 | High |
| 60-69 | Medium |
| 46-59 | Low |
| <45 | Very Low |

## 3. Results

Descriptive analysis of self-efficacy, metacognitive skills, and self-regulated learning of public high schools in Makassar is presented in Table 3.

**Table 3**. Data Analysis of Self-Efficacy, Metacognitive Skills, and Self-regulated Learning of Public High Schools in Makassar

| Self-Efficacy | | Metacognitive Skills | | Self-Regulated Learning | |
|---|---|---|---|---|---|
| Interval | Percentage (%) | Interval | Percentage (%) | Interval | Percentage (%) |
| 86-104 | 7 | 68-76 | 12 | 91-102 | 9 |
| 78-85 | 25 | 62-67 | 20 | 83-90 | 21 |
| 70-77 | 43 | 55-61 | 38 | 75-82 | 43 |
| 63-69 | 19 | 49-54 | 27 | 66-74 | 19 |
| 0-62 | 6 | 0-48 | 3 | 0-65 | 8 |

Based on the table above, it is known that all research variables are in the medium category. Self-efficacy, metacognitive skills, and self-regulated learning still need to be improved.

**Table 4:** Analysis of Self-Efficacy, Metacognitive Skills, and Self-regulated Learning Indicators of Public High Schools in Makassar

| Self- Efficacy | | Metacognitive Skills | | Self-Regulated Learning | |
|---|---|---|---|---|---|
| Indicators | Percentage (%) | Indicators | Percentage (%) | Indicators | Percentage (%) |
| Magnitude | 70.56 | Planning | 77.89 | Cognition | 71.07 |
| Generality | 72.55 | Monitoring | 76.06 | Motivation | 77 |
| Strength | 72.28 | Evaluation | 77.32 | Behavior | 72.95 |

On self-efficacy, the generality indicator shows the highest percentage. Meanwhile, the magnitude/level indicator obtained the lowest percentage. On metacognitive skills, planning obtains the highest percentage. Meanwhile, the monitoring indicator obtained the lowest percentage. Self-regulated learning shows that motivational indicators obtain the highest percentage of learners' answers. Meanwhile, cognition indicators obtained the lowest percentage of learners' answers.

**Table 5**. Frequency and Distribution of Biological Cognitive Learning Outcomes of Public High School Students in Makassar

| Interval | Frequency | Percentage (%) | Category |
|---|---|---|---|
| 81-100 | 62 | 23 | Very High |
| 70-80 | 56 | 21 | High |
| 60-69 | 54 | 20 | Medium |
| 46-59 | 66 | 25 | Low |
| 0-45 | 31 | 11 | Very Low |

Biology learning outcomes of public high school students in Makassar are in the low category.

**Table 6:** Analysis of Cognitive Learning Outcome Indicators of Public High School Students in Makassar

| Indicator | Percentage (%) |
|---|---|
| Remember | 69 |
| Understand | 78.95 |
| Applying | 43.74 |
| Analysis | 59.8 |

Table 1.6 shows the understand indicator obtaining the highest percentage of learners' answers. Meanwhile, the applying indicator obtained the lowest percentage of student answers.

## 4. Discussion

### 4.1 Self-Efficacy of Public High School Students

The self-efficacy level of public high school students in Makassar is in the medium category, with a frequency of 116 students with a percentage of 43%. The next highest frequency is in the high category, with a percentage of 25%. The self-efficacy of students in Makassar still needs to be improved.

Analysis of self-efficacy shows that the indicator with the lowest score is magnitude, with insignificant differences

from other indicators. This is also in line with other research, which shows that magnitude/level is an indicator with the lowest scores compared to other indicators [17]. This indicates low learner confidence in facing varying difficulty levels compared to the breadth of confidence and confidence in facing learning challenges.

On the magnitude indicator, the statement "No matter how the Biology question is twisted, I can answer it" and "I am challenged to do difficult Biology tasks and problems" showed the lowest scores. This illustrates the low confidence of students to succeed in facing tasks or questions with a high level of difficulty. Low-magnitude indicators indicate low self-confidence in achieving a goal in various difficulties [17]. These results show that students lack confidence in facing learning difficulties and have low confidence in being able to master learning material.

On the generality indicator, the statements "I believe I can design a Biology experiment" and "I believe I can master basic laboratory skills" showed the lowest scores. Learners demonstrate low self-efficacy in practicum activities and mastery of basic laboratory skills. A lack of practicum activities can cause this. Students' self-efficacy must also be extended to practicum activities and laboratory mastery. Therefore, teachers need to plan more practicum activities.

On the strength indicator, the statement "I believe I can overcome obstacles in doing the Biology task" and "I believe I will receive excellent grades in learning Biology" shows the lowest score. Uncertainty in the face of obstacles can cause students to be unsure of being able to do an assignment and not sure they can get excellent results. Low efficacy of students in this dimension can lead to low effort and resistance to face challenges in learning Biology. In contrast, individuals with strong efficacy and stability in their abilities will continue to persist in their efforts despite many difficulties and challenges [18]. This aspect must be continuously empowered to form high self-efficacy and unyielding character.

## 4.2 Metacognitive Skills of Public High School Students

Students' metacognitive skills are in the medium category, with as many as 103 students with a percentage of 38%. The next highest frequency is in the low category, with a percentage of 27%. The low category has the lowest frequency, or 3%. The metacognitive skills of students in Makassar still need to be improved.

Analysis of metacognitive skills showed that planning indicators obtained the highest scores. The next highest score is from the evaluation indicator, and the lowest is obtained from the monitoring indicator. This shows that learners have better planning skills than monitoring and evaluation. Another research also showed that the planning aspect has the highest percentage compared to monitoring and evaluation [19], [20]. It can be concluded that learning planning is easier than monitoring and evaluating it.

Analysis of planning indicators showed that some statements had the lowest scores. The statement "My study plan is specific, includingthe deadline for submitting assignments"

shows the lowest score. These results show the absence of task targets according to the set time limit. Learners need to be trained on targeting goals and planning steps to achieve goals.

The statement monitoring indicator, "I change learning strategies when I cannot understand the learning material," had the lowest score. Learners do not replace learning strategies when struggling with one strategy. This can be due to the low examination of the strategies' benefits. In addition, it can also be caused by a lack of knowledge about the various kinds of learning strategies that can be used. As a result, students keep using certain strategies constantly regardless of the effectiveness of those strategies. Another research also concluded that learners had not monitored or chosen the right learning improvement strategy when the initial strategy did not work optimally [20]. Therefore, learners must be taught various learning strategies and trained to monitor their learning.

On the evaluation indicator, "I check my progress in learning Biology" has the lowest score. Students do not yet have an awareness of conducting self-evaluation. Learners follow the learning and move on to the next material without evaluation. This can cause students to lack recognition of weaknesses and advantages, weaknesses and advantages of the strategies used, and not make future improvements. Learning that rarely reflects on the learning process causes students to have not been trained to assess their shortcomings in understanding the material that has been learned [21]. Therefore, students need to be trained in the evaluation process, for example, by reflecting on learning. A good evaluation can be done if goals are to be achieved at the planning stage. Thus, evaluation can be carried out to answer the achievement or failure of the targeted goals and evaluate the steps taken.

## 4.3 Self-regulated Learning of Public High School Students in Makassar

The level of self-regulated learning of students is medium which is as many as 115 students with a percentage of 43%. The next highest frequency is in the high category, with a percentage of 21%. Self-regulated learning in the very low category had the lowest frequency of students, or 6%. Students' self-regulated learning in the city of Makassar still needs to be improved.

Analysis of self-regulated learning shows that motivational indicators obtain the highest scores. The next highest score is a behavioral indicator; the lowest value is obtained from the cognition indicator. This illustrates that the regulation of learner motivation is better than the regulation of behavior and cognition.

On the motivation indicators, the statement "I set a goal for how much I need to learn and promise myself a reward if I reach that goal" and "I challenge myself to get the job done and learn as much as possible" showed the lowest scores. This analysis shows that in the aspect of motivation, students still lack giving self-reward for themselves and have a low desire to master learning material. Self-reward is important to increase self-motivation to succeed.

Giving self-rewards and some self-consequences after achievement or failure will significantly influence students' internal motivation, self-determination, and mentality [22]. Meanwhile, mastery of the material is not only for short-term performance impact but also long-lasting learning outcomes that benefit students' future lives. A lack of desire to master learning material can minimize learning outcomes and the maximum benefits of mastery of learning that can be obtained.

On behavior indicators, the statement "I often feel so lazy or bored when I study for this class that I quit before I finish what I planned" and the statement "Even if I have difficulty learning the material in this class, I try to work on it myself, without anyone's help" show the lowest scores. This analysis shows suboptimal effort regulation and the reluctance of students to seek help if they experience difficulties. Low effort regulation is characterized by laziness, boredom, and giving up easily. This is also exacerbated by the reluctance to ask for help, so it tends to do it alone even though it is not optimal. Effort regulation and help-seeking behavior need to be grown to improve the regulation of student behavior.

On the cognition indicator, the statements "When studying Biology, I make a list of important terms and memorize the list" and "When reading Biology material, I makeup questions to help focus my reading" statements show the lowest scores. This analysis illustrates the lack of use of rehearsal and metacognitive strategies. Rehearsal strategies include attempts to memorize material by repeating it repeatedly [23]. Meanwhile, metacognitive strategies include asking yourself, checking answers, rereading something you do not understand and correcting answer errors. Thus, these two strategies are important and need to be used by learners in understanding Biology material with material characteristics with many important terms and complex concepts.

Motivation, cognition, and behavior regulation still need to be empowered in learners. Thus, the manifestation of motivation becomes directed by selecting appropriate actions to direct cognition and behavior. Motivation regulation needs to be cultivated so students have a strong desire to succeed because of encouragement from within or outside. Behavioral regulation includes awareness of whether a person has used time effectively or exerted sufficient effort, including asking others for help [24]. Meanwhile, cognition regulation is concerned with diverse cognitive strategies and finding ways to improve understanding. Therefore, the role of teachers is important in helping learners cultivate motivational regulation and model behavior regulation. Regarding cognition, teachers need to model the use of various cognitive strategies. Thus, learners understand aspects of self-regulated learning and can apply them.

### 4.4 Biology Cognitive Learning Outcomes of Public High School Students

The cognitive learning outcomes of Biology students are in a low category, with a frequency of 66 students with a percentage of 25%. The next highest frequency is in the very high category, which is as many as 62 students with a percentage of 23%. The low cognitive learning outcomes category had the lowest frequency of 31 learners, or 11%. These results show that the results of learning Biology have not been maximized and urgently need to be improved.

Analysis of students' cognitive learning outcomes showed that the lowest scores were obtained from questions at applying and analyzing. Applying is the ability of students to use concepts in new practices or situations [25].Analysis is the ability of students to separate concepts into several components to gain an understanding and relationship of components to the concept [2].

In applying cognitive level, students still find it difficult to determine abnormalities/diseases in the excretory system based on laboratory test results and the cause of abnormalities/diseases in the excretory system based on the diagnosis. Students must be trained to apply concepts to certain situations or cases, such as laboratory tests and disease diagnoses. In addition, practicum activities can also strengthen students' understanding. Meanwhile, for the analysis of cognitive level, students still find it difficult to diagnose dysfunction in the excretory system based on laboratory examination data and analyze life patterns and their relationship with organ work in the process of urine formation. This also aligns with other research, showing low analysis cognitive level[19]. Learners must be taught the components and functions of the body's organs and their relationship with abnormalities/diseases in urine formation.

High scores are obtained from questions at the remembering and understanding cognitive levels. This shows that the higher the cognitive level, the more difficult the problem and the lower the student's score. The stages of remembering, understanding, and applying are categorized as Low Order Thinking Skills (LOTS), at the stages of analyzing, evaluating, and creating are categorized as High Order Thinking Skills (HOTS) skills [26]. Students still struggle with HOTS questions. Therefore, educators must empower critical thinking skills and practice more HOTS questions.

Analysis of indicators shows that scores of learning outcomes are not only determined by cognitive levels. However, learning outcomes are also determined by mastery of material on certain subtopics. In subtopics that students master more, the question in the high cognitive level is more correctly answered than the lower cognitive level in the subtopic that is less mastered. This is because teachers tend to put more emphasis on certain subtopics than others. In this study, the subtopic of determining disease abnormalities based on laboratory tests and disease diagnosis is less mastered by students than the components and works of excretory organs.

## 5. Conclusion

Students' self-efficacy, metacognitive skills, and self-regulated learning still need to be empowered by teachers by paying attention to the factors that influence them. The learning process must also be maximized to improve students' cognitive learning outcomes. Educators must observe students' learning process and reflect on their teaching to know student needs. Educators must plan to

teach specifically and intentionally to empower students' self-efficacy, metacognitive skills, self-regulated learning, and cognitive learning outcomes.

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