Journal of Natural Science and Integration
P-ISSN: 2620-4967 | E-ISSN: 2620-5092
Vol. 8, No. 1, April 2025, pp 47-56

Available online at:
http://ejournal.uin-suska.ac.id/index.php/JNSI
DOI: 10.24014/jnsi.v8i1.36222

Metacognition and Self-System Among Biology Education Undergraduates at Islamic University of Riau

Tengku Idris[1], Adi Rahmat[2]*, Topik Hidayat[3], Riandi[1]

[1] *Department of Science Education, Universitas Pendidikan Indonesia, Indonesia*
[2] *Department of Biology Education, Universitas Pendidikan Indonesia, Indonesia*
[3] *Department of Biology, Universitas Pendidikan Indonesia, Indonesia*

**Correspondence Author: adirahmat@upi.edu*

ABSTRACT

Metacognition and the self-system are critical components influencing an individual's learning success. The ability to reflect on and regulate one's learning processes must be accurately identified and assessed to support instructional planning that enhances these skills. This descriptive study aims to examine the metacognitive abilities and self-system of fifth-semester students enrolled in the Biology Education Study Program at the Islamic University of Riau. Utilizing a survey method, data were collected from a sample of 30 students, consisting of 6 males and 24 females. The instrument, a questionnaire based on Marzano's Taxonomy and comprising three indicators per variable, was validated through expert review. Data were analyzed using percentage-based categorization and further examined through a Pearson product-moment correlation test via SPSS 22. Results indicated that all metacognitive indicators fell into the high category, with clarity monitoring achieving the highest score (80.27%) and process monitoring the lowest (77.87%). For the self-system, examining importance and emotional response were categorized as high, while efficacy was rated moderate. A significant positive correlation was found between metacognition and the self-system ($r = 0.536$), with the regression equation $Y = 36.662 + 0.478X$. These findings suggest that students exhibit high levels of both metacognitive and self-system abilities, which are significantly interrelated.

Keywords: *biology education, metacognitive, self-system, undergraduate*

INTRODUCTION

Metacognition refers to an individual's ability to regulate their cognitive processes—often described as "thinking about thinking." The term was first introduced in the 1970s by John Flavell, an American developmental psychologist. According to Flavell (1979), metacognition comprises two components: metacognitive knowledge and metacognitive regulation. In educational contexts, metacognition has become a central topic of research, as learning success is significantly influenced by one's capacity to learn independently—through awareness of learning styles, effective strategies, and the ability to plan, monitor, and evaluate learning activities (Jayaprom, 2023; Kassem, 2022).

In addition to Flavell, other scholars such as Marzano (1997), Schraw and Dennison (1994), and Zimmerman (2002) have explored metacognition. Marzano integrated metacognition into his Taxonomy of Learning, placing it at the fifth level. His taxonomy distinguishes between two domains: the level of processing—comprising retrieval, comprehension, analysis, knowledge utilization, metacognition, and self-system—and the knowledge domain, which includes

information, mental procedures, and psychomotor procedures. Indicators of metacognitive ability include goal specification, process monitoring, clarity monitoring, and accuracy monitoring (Marzano & Kendall, 2008). Metacognitive knowledge can further be classified into declarative (knowing "what"), procedural (knowing "how"), and conditional knowledge (knowing "when" and "why" to apply strategies).

In the 21st century, metacognition has become an essential skill for students. Rapid advancements in science and technology demand that students adapt and engage in independent learning (Sinaga et al., 2023). In higher education, learning environments are increasingly student-centered, with lecturers functioning as facilitators. Students with strong metacognitive skills are typically better at setting goals, completing tasks on time, and evaluating their learning processes (Febrina, 2019). Research has shown a strong correlation between metacognition and academic achievement (Riyanti et al., 2019).

Various studies have demonstrated that metacognition can be enhanced through specific teaching models and strategies, such as Problem-Based Learning (PBL) (Aisyah & Ridlo, 2015), inquiry-based learning (Antika et al., 2022), discovery learning (Windasari et al., 2017a), the 5E instructional model (Purwaningsih & Mubarok, 2021), and science-environment-society (JAS) approaches (Budiman & Marianti, 2020a; Septina et al., 2018). In Indonesia, research on metacognition in biology education remains in development. A variety of methods—surveys, experiments, and correlational studies—have been employed to examine how biology content such as the circulatory system (Putri et al., 2014), musculoskeletal system (Az-Zahra et al., 2021), reproductive system (Rahayu et al., 2020; Windasari et al., 2017b), immune system (Septiyana et al., 2013), ecosystems (Eriawati, 2015; Khairunnisa et al., 2022), animalia (Budiman & Marianti, 2020b), and environmental pollution (Lestari et al., 2017) can be used to foster metacognitive skills.

In addition to metacognition, the self-system—conceptualized by Marzano as the highest tier in his taxonomy—plays a pivotal role in learning. It refers to an individual's capacity to evaluate and control their learning environment. While Marzano refers to this construct as the "self-system," other scholars commonly use the term "self-regulation." According to Zimmerman and Pons (1986), self-regulation involves the active and sustained management of cognition, behavior, and motivation toward achieving learning goals. Characteristics of students with a strong self-system include the ability to select relevant information, identify effective strategies, respond appropriately to new information, and maintain high levels of motivation. Marzano (2008) emphasized the reciprocal relationship between the self-system and knowledge mastery—students with a well-developed self-system tend to achieve higher academic success and vice versa.

Numerous studies have confirmed the strong association between self-regulation and learning outcomes (Dewika et al., 2021; Kusuma & Baskara, 2023). Students with a well-developed self-system are more adaptable to diverse teaching styles, course demands, and learning challenges—qualities that are essential for academic success and future career readiness (Aziz & Aisyah Putri Siswanto, 2018; Lutfi, 2019). Self-regulation evolves throughout life but typically matures during adolescence and early adulthood (ages 15–25), a period when individuals develop skills in time management, goal setting, progress monitoring, and emotional regulation (Tabelak et al., 2024).

Given this theoretical and empirical background, the present study aims to conduct a preliminary survey to examine the metacognitive and self-system abilities of students in the Biology Education Study Program at the Islamic University of Riau.

METHODOLOGY

This study employed a survey method to assess the metacognitive abilities and self-system of students enrolled in the Biology Education Study Program. The population consisted of all active students within the program, while the research sample comprised sixth-semester students who had completed the majority of the core curriculum. A total of 30 students participated in the study, including 6 male and 24 female students. Data collection was carried out using a questionnaire that had undergone both construct and empirical validation. The instrument was developed based on indicators derived from Marzano's Taxonomy, encompassing key aspects of both metacognition and the self-system. The instrument blueprint outlining the indicators for each construct is presented as follows:

Tabel 1. Metacognitive Indicators and Item Count

No	Indicator	Item	
		Positive	Negative
1.	Specifiying goal	1,2,3,	4
2.	Process monitoring	5,6,7,8	9
3.	Monitoring clarity	10,11,12	13,14

Tabel 2. Self-System Indicators and Item Count

No	Indicator	Item	
		Positive	Negative
1.	Examining importance	1,2,3,	4,5
2.	Examining efficacy	6,7,8	9,10
3.	Examining emosional response	11, 12, 13, 15	14

The questionnaire was administered to students via Google Forms, utilizing a Likert scale with five response options: Strongly Agree, Agree, Less Agree, Disagree, and Strongly Disagree. The collected data were analyzed using percentage calculations and descriptive statistics to provide an overview of students' metacognitive and self-system abilities. The percentage scores were then interpreted using predefined categorical classifications to determine the levels of each variable.

$$P = \frac{f}{n} x100\%$$

The results of the percentage calculations are then categorized as in the table below.

Tabel 3. Categori of Metacognite

Category	Score Range (1–5 Scale per Item)	Interpretation
Very High	81% - 100% (4.21 – 5.00)	Highly capable of understanding and regulating learning processes.
High	61% - 80% (3.41 – 4.20)	Capable of recognizing and effectively managing learning strategies.
Moderate	41% - 60% (2.61 – 3.40)	Moderately able to manage learning strategies, but needs improvement.
Low	21% - 40% (1.81 – 2.60)	Less capable of monitoring and regulating learning processes.
Very Low	0% - 20% (1.00 – 1.80)	Lacks sufficient awareness and metacognitive strategies.

Tabel 4. Category of Self System

Category	Score Range (1–5 Scale per Item)	Interpretation
Highly Positive	81% - 100% (4.21 – 5.00)	Highly motivated with strong confidence in learning.
Positive	61% - 80% (3.41 – 4.20)	Well-motivated with a positive attitude toward learning.

Category	Score Range (1–5 Scale per Item)	Interpretation
Moderate	41% - 60% (2.61 – 3.40)	Moderately motivated but requires additional encouragement.
Low	21% - 40% (1.81 – 2.60)	Lacks motivation and tends to be passive in learning.
Very Low	0% - 20% (1.00 – 1.80)	Not motivated and lacks self-confidence in learning.

In addition, the researcher examined the relationship between the two variables by conducting a Pearson product-moment correlation analysis using SPSS version 22. A simple linear regression analysis was also performed to further explore the predictive relationship between metacognitive ability and the self-system.

RESULT AND DISCUSSION

The research data were collected through a Google Form comprising 14 items measuring metacognitive ability and 15 items assessing the self-system. Based on the quantitative analysis conducted, the following results were obtained:

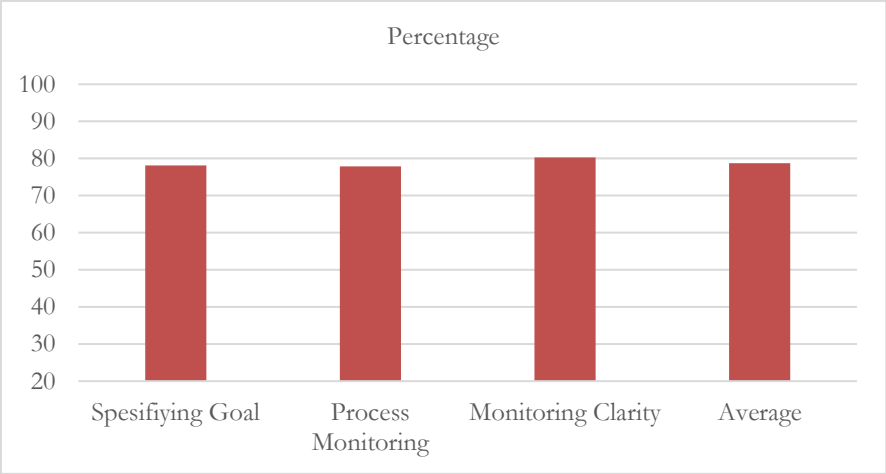

Figure 1. Percentage of Metacognitive Biology Education Students

Based on Figure 1, it can be observed that the metacognitive awareness of students in the Biology Education Study Program falls within the high category, with an average score of 78.77%. When analyzed by individual indicators, all components of metacognition also fall into the high category. The highest indicator was monitoring clarity, with a percentage of 80.27%, while the lowest was process monitoring, at 77.87%. Metacognition is broadly defined as the awareness and regulation of one's own thinking processes—essentially, "thinking about thinking." It involves the ability to reflect on, organize, and evaluate cognitive activities. Although various scholars have proposed differing frameworks and indicators of metacognition, there is a shared consensus on its critical role in both the learning process and learning outcomes. Students with strong metacognitive skills are typically able to plan, monitor, evaluate, and adjust their learning strategies effectively. According to Marzano's taxonomy, metacognition is composed of several key indicators: (1) specifying goals—the ability to set learning objectives, (2) process monitoring—tracking the progress of learning activities, (3) monitoring clarity—ensuring the clarity of received or processed information, and (4) monitoring accuracy—assessing the reliability and precision of the acquired knowledge (Marzano et al., 1993).

The present findings reaffirm that the metacognitive abilities of biology education students are well-developed. These skills can be enhanced through various instructional strategies, such as collaborative learning, inquiry-based learning, and project-based learning (Idris et al., 2024). Students with strong metacognitive abilities tend to achieve greater academic success due to their

capacity to recognize effective learning strategies and manage learning challenges independently. Abedini (2022) emphasized that metacognition enables learners to make more informed decisions and become autonomous in managing their education. Moreover, metacognitive ability is shaped by several influencing factors, including age, gender, education level, and prior learning experiences. Research by Ellis and Hudson (2011) and Johnson and Whisman (2013) has shown that gender may influence metacognitive skills, with certain indicators being more dominant in males, and others more prevalent in females. Likewise, studies have revealed that metacognitive development is positively correlated with age and educational experience (McWilliams et al., 2023; Palmer et al., 2014; Siegel & Castel, 2019), as older and more experienced students demonstrate a higher capacity for cognitive regulation.

The Biology Education Study Program at the Islamic University of Riau adopts a student-centered approach, primarily utilizing Project-Based Learning (PBL) to enhance student engagement. This approach encourages students to take an active role in the learning process through assignments, material presentations, and collaborative projects. Instructional methods that incorporate feedback—such as those used in PBL—support students in recognizing their cognitive strengths and weaknesses, thereby fostering metacognitive growth (Molin et al., 2020; Shekh-Abed, 2024). Constructive feedback from lecturers plays a vital role in this development by prompting students to reflect on their errors and adjust their learning strategies accordingly.

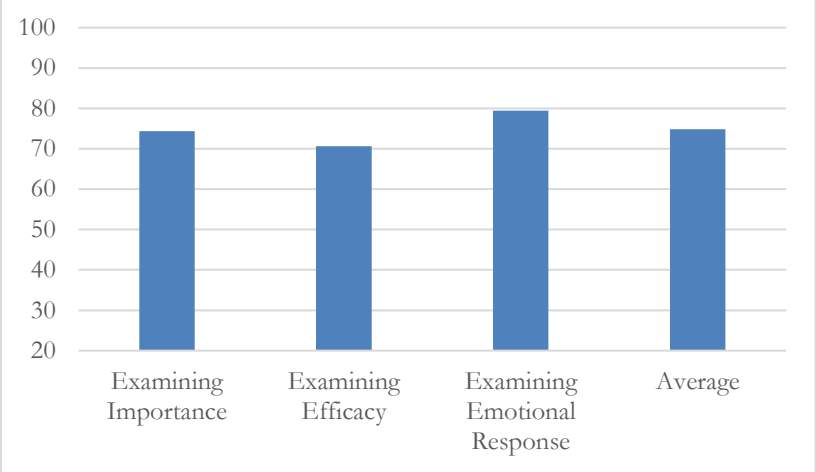

Figure 2. Percentage of Self System Biology Education Students

Based on Figure 2, the average self-system ability of students in the Biology Education Study Program is 74.80%, which falls within the high category. A closer examination of the individual indicators reveals that both examining importance and examining emotional response are categorized as high, while examining efficacy is classified as medium or sufficient, with a percentage of 70.62%.

The self-system plays a crucial role in determining learning success (Marnola et al., 2024). Students with a well-developed self-system are generally capable of managing their own learning processes, possess strong self-confidence, can identify what is essential to learn, and effectively regulate their emotional responses (Brenner, 2022). In student-centered learning environments, such self-regulatory abilities are particularly vital, as learning independence and self-awareness of learning styles significantly contribute to academic achievement.

At the Islamic University of Riau, the Biology Education Study Program implements Project-Based Learning (PjBL) and Team-Based Project Learning—both of which are adaptations of the broader Problem-Based Learning (PBL) model. These pedagogical approaches are mandated across higher education institutions in Indonesia (Pratiwi, 2020) and have been shown to positively influence the development of students' self-systems. Through these models, students are encouraged to engage in authentic problem-solving experiences derived from real-world contexts

and to present their findings in academic settings. Empirical evidence has consistently demonstrated that PBL not only enhances cognitive skills but also significantly improves students' self-regulation and self-system abilities across various educational levels.

Table 5. Categories of Metacognitive Abilities and Self-System of Students

Category	Metacognitve		Self-System	
	F	Persentage	F	Persentage
Very High	5	16.67	3	10.34
High	24	80.00	22	75.86
Moderate	1	3.33	4	13.79
Low	0	0.00	0	0
Very Low	0	0.00	0	0

Based on the table above, it can be observed that the majority of Biology Education students at FKIP UIR exhibit metacognitive abilities within the high category, accounting for 80% of the sample (24 students). Additionally, 5 students (16.7%) fall into the very high category, while only 1 student (3.3%) demonstrates metacognitive ability at the moderate or sufficient level. A similar trend is evident in the distribution of self-system abilities. While 4 students (13.3%) are categorized as having sufficient self-system abilities, the majority, or 22 students (73.3%), fall within the moderate category, and 3 students (10%) are classified in the very high category. To further examine the relationship and predictive influence between the two variables—metacognitive ability and self-system ability—a correlation analysis and regression test were conducted using SPSS version 22. The results of these inferential statistical tests are presented as follows.

Table 6. Results of Correlation and Regression Tests between Metacognition and Self System

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.536[a]	.288	.262	5.95377

a. Predictors: (Constant), Metacognitive

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	400.700	1	400.700	11.304	.002[b]
	Residual	992.528	28	35.447		
	Total	1393.227	29			

a. Dependent Variable: Self_System

b. Predictors: (Constant), Metacognitive

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	36.662	11.250		3.259	.003
	Metacognitive	.478	.142	.536	3.362	.002

a. Dependent Variable: Self_System

Table 5 presents the results of the correlation and regression analysis between metacognitive ability and self-system among Biology Education students. The summary output indicates a correlation coefficient (r) of 0.535, suggesting a moderate positive relationship between the two variables. Furthermore, the regression model reveals that metacognition accounts for approximately 28.8% of the variance in students' self-system abilities. From the coefficients table,

the calculated t-value (t_o = 3.362) exceeds the critical t-table value (t_t = 1.70113), confirming a statistically significant effect of metacognition on self-system at the 5% significance level. The derived linear regression equation is Y = 36.662 + 0.478X, indicating that for every unit increase in metacognitive score, the self-system score is expected to increase by 0.478 units, starting from a baseline value of 36.662.

In educational research, the relationship between metacognition and the self-system (often conceptualized as self-regulation) has been well-documented. According to Marzano's Taxonomy (1993), metacognition occupies level five, while the self-system resides at level six—suggesting that the development of a robust self-system is predicated on the mastery of metacognitive processes. Similarly, Zimmerman (1995) posits that metacognition constitutes a central component of self-regulation, underscoring its integral role in learning autonomy and goal-directed behavior. While terminological differences exist, both perspectives converge on the notion that cognitive regulation is essential for fostering an effective self-system. The findings of this study corroborate prior research (Dewika et al., 2021; Kusuma & Baskara, 2023), which also reported a significant and positive correlation between metacognition and self-system, affirming that students with higher metacognitive awareness tend to exhibit stronger self-regulatory capabilities, and vice versa.

CONCLUSION

The findings of this study indicate that the metacognitive abilities of students in the Biology Education Study Program at the Islamic University of Riau are categorized as high, with a mean score of 78.77%. Similarly, the self-system of these students also falls within the high category, with an average score of 74.80%. Furthermore, a moderate yet significant relationship was observed between the two variables, suggesting that students with higher metacognitive abilities tend to exhibit stronger self-regulatory capacities. However, this study is limited by its small sample size, which restricts the generalizability of the findings. Future research should aim to include a larger and more diverse sample to enhance the validity and applicability of the results. Additionally, further investigation is recommended to explore effective teaching models that can foster the development of both metacognitive abilities and self-regulation in prospective teacher candidates, thus contributing to more effective and independent learning strategies.

REFERENCES

Abedini, Y. (2022). Metacognition as A Core Skill For Wise Decision-Making in Higher Education: Investigating Gender Differences. *Journal of Applied Research in Higher Education*, *14*(2), 886–900. https://doi.org/10.1108/JARHE-11-2020-0400

Aisyah, S., & Ridlo, S. (2015). Pengaruh Strategi Pembelajaran Jigsaw dan Problem Based Learning Terhadap Skor Keterampilan Metakognisi Siswa pada Mata Peajaran Biologi. *Unnes Journal of Biology Education*, *4*(1), 50229. http://journal.unnes.ac.id/sju/index.php/ujbe

Antika, L. T., Sukron, S., Haikal, M., & Farthir, A. (2022). *Metacognitive and Creative Thinking Skills: A post-covid-19 correlational study*. *7*(2), 264–275.

Aziz, A., & Siswanto, K. A. P. (2018). Hubungan antara self regulated learning dengan kematangan karir pada siswa SMA. *Analitika: Jurnal Magister Psikologi UMA*, *10*(1), 7-13.

Az-Zahra, R., Rusdi, R., & Ristanto, R. H. (2021). Metacognitive, Critical Thinking, and Concept Understanding of Motion Systems: A Correlational Study. *Bioedukasi: Jurnal Pendidikan Biologi*, *14*(2), 156. https://doi.org/10.20961/bioedukasi-uns.v14i2.52972

Budiman, W. N., & Marianti, A. (2020a). The Effectiveness of The Group Investigation Model with a Jelajah Alam Sekitar Approach to The Metacognitive Skills of High School Students in Animalia Material. *Journal of Biology Education*, *9*(3), 306–314.

Budiman, W. N., & Marianti, A. (2020b). The Effectiveness of The Group Investigation Model with a Jelajah Alam Sekitar Approach to The Metacognitive Skills of High School Students in Animalia Material. *Journal of Biology Education*, *9*(3), 306–314.

Dewika, A., Rahmi, F., & Maputra, Y. (2021). Metakognisi dan Kaitannya dengan Self Efficacy Siswa. *Jurnal Pendidikan Dasar dan Menengah (Dikdasmen)*, *1*(2), 48–55. https://doi.org/10.31960/dikdasmen-v1i2-1394

Ellis, D. M., & Hudson, J. L. (2011). Test of the Metacognitive Model of Generalized Anxiety Disorder in Anxiety-Disordered Adolescents. *Journal of Experimental Psychopathology*, *2*(1), 28–43. https://doi.org/10.5127/jep.011910

Eriawati, E. (2015). Aplikasi Keterampilan Metakognitif dalam Pembelajaran Ekosistem di MAN Rukoh. *BIOTIK: Jurnal Ilmiah Biologi Teknologi dan Kependidikan*, *1*(1), 60. https://doi.org/10.22373/biotik.v1i1.214

Febrina, E. (2019). Metakognisi sebagai Keterampilan Berfikir Tingkat Tinggi pada Pembelajaran Abad 21. *Jurnal Ilmu Pendidikan Dan Pengajaran*, *6*(1).

Idris, T., Rahmat, A., & Hidayat, T. (2024). The Trend of Metacognition Research Trend in Learning Biology in Indonesia. *KnE Social Sciences*. https://doi.org/10.18502/kss.v9i13.15911

Johnson, D. P., & Whisman, M. A. (2013). Gender differences in rumination: A meta-analysis. *Personality and Individual Differences*, *55*(4), 367–374. https://doi.org/10.1016/j.paid.2013.03.019

Khairunnisa, H., Azrai, E. P., & Ristanto, R. H. (2022). The Correlation Between Critical Thinking Skills with Student Metacognitive Skills in Ecosystem Material. *Journal Of Biology Education*, *5*(2), 130. https://doi.org/10.21043/jobe.v5i2.12336

Kusuma, A. S., & Baskara, Z. W. (2023). Hubungan Self-Regulation dengan Metacognitive Awareness Mahasiswa Pada Pembelajaran Berbasis Portofolio. *Jurnal Ilmiah Profesi Pendidikan*, *8*(1b), 987–994. https://doi.org/10.29303/jipp.v8i1b.1307

Lestari, H. N., Suganda, O., & Widiantie, R. (2017). Hubungan antara Pengetahuan Metakognitif Dengan Kemampuan Pemecahan Masalah Melalui Model Problem Based Learning (Pbl) Pada Konsep Pencemaran Lingkungan Di Kelas X. *Quagga : Jurnal Pendidikan Dan Biologi*, *9*(02), 27. https://doi.org/10.25134/quagga.v9i02.745

Lutfi, A. (2019). Pengaruh Efikasi Diri Terhadap Kematangan Karir Siswa dikelas XII Di SMK N 6 Yogyakarta. *Jurnal Riset Mahasiswa Bimbingan Dan Konseling*, *5*(5).

Marnola, I., Degeng, I. N. S., Ulfa, S., & Praherdhiono, H. (2024). Project Based Learning in Online Discussion Forums and Self-Regulated Learning. *Al-Hayat: Journal of Islamic Education*, *8*(2), 724. https://doi.org/10.35723/ajie.v8i2.607

Marzano, R. J., & Kendall, J. S. (2008). Designing & Assessing Educational Objectives: Applying the New Taxonomy. In *Corwin Press*.

Marzano, Robert. J., Pickering, D., & Mctighe, J. (1993). *Assessing Student Outccomes: Performance Assessment Using the Dimension of Learning Model*. Mid-Continent Regional Education Lab. Aurora, Co.

McWilliams, A., Bibby, H., Steinbeis, N., David, A. S., & Fleming, S. M. (2023). Age-related Decreases in Global Metacognition Are Independent Of Local Metacognition And Task Performance. *Cognition*, *235*. https://doi.org/10.1016/j.cognition.2023.105389

Molin, F., Haelermans, C., Cabus, S., & Groot, W. (2020). The Effect of Feedback on Metacognition - A Randomized Experiment Using Polling Technology. *Computers and Education*, *152*. https://doi.org/10.1016/j.compedu.2020.103885

Palmer, E. C., David, A. S., & Fleming, S. M. (2014). Effects of age on metacognitive efficiency. *Consciousness and Cognition*, *28*(1), 151–160. https://doi.org/10.1016/j.concog.2014.06.007

Pratiwi, S. E. (2020). *Manajemen Percepatan Pembelajaran Peserta didik (Studi Kasus di MAN 2 Ponorogo)*. etheses.iainponorogo.ac.id. http://etheses.iainponorogo.ac.id/id/eprint/10031

Purwaningsih, S. D. A., & Mubarok, I. (2021). Jurnal of Biology Education Biological Science Curriculum Study 5E Model Based on Multiple Representations in Ecosystem Materials on Problem Solving and Metacognitive Abilities. *Journal of Biology Education*, *10*(1), 63–69. http://journal.unnes.ac.id/sju/index.php/ujbe%0AThe

Putri, windha A., Prasetyo, A. P. B., & Supriyanto. (2014). Unnes Journal of Biology Education. *Journal Og Biology Education*, *3*(3), 319–329.

Rahayu, I. P., Sukaesih, S., & B, F. P. M. H. (2020). The Effectiveness of Metacognition Strategy by Snowball Throwing on Student' s Metacognition Ability and Learning Outcomes on Reproduction System Material. *Journal of Biology Education*, *9*(2), 86–91.

Riyanti, A. I., Ngadiman, N., & Hamidi, N. (2019). Pengaruh Kesadaran Metakognisi dan Motivasi Belajar Terhadap Hasil Belajar Siswa. *Jurnal Tata Arta*, *1*.

Septina, E. P., Marianti, A., & Widiatningrum, T. (2018). The Use of Science Reflective Journal Writing by JAS Approach to Train Students Metacognitive Ability. *Journal of Biology Education*, *7*(3), 244–252. https://doi.org/10.15294/jbe.v7i3.24260

Septiyana, K., Prasetyo, A. P., & Chrisjanti, W. (2013). Jurnal belajar sebagai strategi berpikir metakognitif pada pembelajaran sistem imunitas. *Unnes Journal of Biology Education*, *2*(1), 1–9.

Shekh-Abed, A. (2024). Metacognitive self-knowledge and cognitive skills in project-based learning of high school electronics students. *European Journal of Engineering Education*. https://doi.org/10.1080/03043797.2024.2374479

Siegel, A. L. M., & Castel, A. D. (2019). Age-related Differences in Metacognition for Memory Capacity and Selectivity. *Memory*, *27*(9), 1236–1249. https://doi.org/10.1080/09658211.2019.1645859

Sinaga, N., Octavianty Prasetiyo, H., Psikologi, F., & Pelita Harapan, U. (2023). Learning During The Pandemic: The Role of Metacognition In The Relationship Between Student Autonomy And Student Engagement Of First-Year Students. *Jurnal Psibemetika*, *16*(2), 105–111. https://doi.org/10.30813/psibernetika.v16i2.4655

Tabelak, V., Damayanti, Y., & Mage, M. Y. C. (2024). Hubungan Antara Regulasi Diri dalam Belajar dengan Kematangan Karier Pada Peserta Didik Kelas XI-XII SMAKr Pandhega Jaya Kupang. *Wacana Psikokultural*, *2*(1), 49–58. https://doi.org/10.24246/jwp.v2i1.12547

Windasari, C., Hasanuddin, H., & Hasanuddin, H. (2017a). Pengaruh Model Guided Discovery Terhadap Kesadaran Metakognitif dan Hasil Belajar Kognitif Peserta Didik pada Materi Sistem Reproduksi Manusia di MAS Babun Najah Banda Aceh. *BIOTIK: Jurnal Ilmiah Biologi Teknologi Dan Kependidikan*, *4*(1), 66. https://doi.org/10.22373/biotik.v4i1.1072

Windasari, C., Hasanuddin, H., & Hasanuddin, H. (2017b). Pengaruh Model Guided Discovery Terhadap Kesadaran Metakognitif dan Hasil Belajar Kognitif Peserta Didik pada Materi Sistem Reproduksi Manusia di MAS Babun Najah Banda Aceh. *BIOTIK: Jurnal Ilmiah Biologi Teknologi Dan Kependidikan*, *4*(1), 66. https://doi.org/10.22373/biotik.v4i1.1072

Zimmerman, B. J. (1995). Self-Regulation Involves More Than Metacognition: A Social Cognitive Perspective. *Educational Psychologist*, *30*(4), 217–221. https://doi.org/10.1207/s15326985ep3004_8

Zimmerman, B. J., & Pons, M. M. (1986). Development of a Structured Interview for Assessing Student Use of Self-Regulated Learning Strategies. *American Educational Research Journal*, *23*(4), 614–628. https://doi.org/10.3102/00028312023004614