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The Correlation Between Critical Thinking Skills with Student Metacognitive Skills on Ecosystem Material

Hanifah Khairunnisa[1)*], Eka Putri Azrai[1)], Rizhal Hendi Ristanto[1)]
[1]*Study Program of Biologi Education FMIPA Universitas Negeri Jakarta*
**Email: hanikairnia18@gmail.com*

ABSTRACT

Critical thinking skills are the active thinking process by someone by analyzing information, questioning the truth by remembering old memories so that a conclusion is obtained. Critical thinking skills are influenced by student readiness factors in learning including planning, monitoring and evaluation. Therefore, students with low critical thinking skills need to improve thinking skills by planning the systematic learning through empowerment of metacognitive skills. This study aims to determine the correlation between critical thinking skills with the metacognitive skills on ecosystem material. This research was conducted at SMAN 13 Jakarta in year 2021/2022. The method used is a quantitative descriptive method with a correlation study. This research consists of two variables, namely critical thinking skills as independent variables and metacognitive skills as a dependent variable. The sample used was 135 students of class XI MIPA which had obtained the elected ecosystem material through the Simple Random Sampling technique. Data collection is done through survey techniques using critical thinking skills tests and metacognitive skills tests. Based on the results of the study obtained a correlation coefficient of 0, 346 in the correlation of critical thinking skills with student metacognitive skills on ecosystem material. The results of the analysis show that there is a positive correlation between critical thinking skills with student metacognitive skills on ecosystem material.

Keywords: Critical thinking, metacognition, ecosystem

INTRODUCTION

Ecosystem is one of the topics of ecology, namely the study of interactions between organisme by analyzing ecosystem components and interactions between components to study natural phenomena and phenomena that occur by several factors (Yani et al., 2009). The basic competence of ecosystem topics in SMA is to analyze the components of the ecosystem and the interactions between its components. This shows that ecosystem topics are studied through problembased learning / problem solving activities such as the study conducted by Pratiwi et al., (2015) who conducted ecosystem learning through PBL, which can improve critical

thinking skills. Likewise, studies by Gündüz et al., (2016) and Nurdyansyah & Amalia (2015) which prove that learning outcomes of ecosystems with practice and problem solving can improve critical thinking skills. This condition occurs because in the ecosystem material, students study phenomena that occur in society so critical thinking skills are needed.

Critical thinking skills are one of the skills needed in the 21st century (Osman et al., 2013). Critical thinking skills are active thinking processes by analyzing, synthesizing and evaluating results (Astuti et al., 2020; Espey, 2017; Kuhn, 2011; Kurt et al., 2013). However, the questions that arise in learning ecosystem materials tend to be at a low cognitive level, there by lowering the level of students' thinking (Amir & W, 2018; Cooper & Sandi-urena, 2009). Therefore, the teacher can identify certain cognitive factors that can accommodate this. One of the abilities that can improve critical thinking skills is metacognition (Buku et al., 2016; Eriawati, 2013; Malahayati et al., 2015). Metacognitive skills can be used to assist students in planning learning strategies, observing learning activities, evaluating cognitive activities so that thinking skills can be empowered.

Teachers' efforts to increase cognitive levels can foster self-regulation. Self-regulation helps students learn independently, both in learning planning and improvement in learning (Anggraini & Anas, 2019)**.** Self-regulation helps students learn to organize themselves to be oriented towards achieving their academic goals, which in this case is on ecosystem material (Lai, 2011)**.** Self-regulation skills help students to focus on the learning process, because it stimulates interest in learning from their subconscious (Dignath et al., 2008; Kristiyani, 2016; Magno, 2010)**.**

Malahayati et. al. (2015) states that metacognitive skills are skills that help students improve critical thinking skills. Budi M dan Ghofar, (2017) states that metacognitive refers to higher order thinking skills where these skills help cognitive active control of the learning process. Wicaksono and Corebima (2015) states that students who use metacognition in learning can be more organized in planning, monitoring, and reorganizing their learning strategies. This arrangement helps students solve problems in learning so that in the end thinking skills can be empowered.

Lestari et al., (2019) states that one way to develop students' thinking skills is by using an essay in the form of an instrument. These instruments help students think more deeply so

that their thinking skills can develop and help them hone their creativity in answering questions (Cooper & Sandi-urena, 2009). However, the essay instrument has the disadvantage that it takes a lot of time to analyze their results (Lestari et al., 2019; Zubaidah & Corebima, 2015). As a result, it may not be able to cover some critical thinking indicators. For this reason, it can be integrated with understanding metacognitive skills.

Efficiency in metacognitive skills can help students improve critical thinking skills, improving learning outcomes (Arifin et al., 2012; Ratri & Sugiarto, 2016). Thus in accordance with the objectives of learning Biology which refer to the National Education Standards Agency (BSNP) by developing analytical, inductive, and deductive thinking skills according to the principles and concepts of biology. (Harahap et al., 2020).

Learners who have high critical thinking skills allow them to have confidence in solving problems, open-minded, (Paul & Elder, 2006; Tofade et al., 2013) active, creative, precise in time management and have analytical thinking and synthesis in communicating (KarakoÇ, 2016; Ristanto et al., 2020). active that it can help students compete in the era of globalization (Trilling & Fadel, 2009) and help students in the competitive world of work (Permana & Chamisijatin, 2019). Based on this, this research needs to be carried out to determine the relationship between critical thinking skills and metacognitive skills on ecosystem materials.

METHOD

Research Design

The method used in this study is a quantitative descriptive method with a correlation study. This study consists of two variables, the independent variable (X) critical thinking skills and the dependent variable (Y) metacognitive skills. The design of this study is presented in Figure 1.

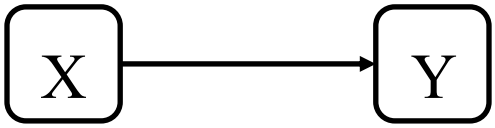

Figure 1. Research Design (X dan Y Variable)

Description:

X variable: Critical Thinking Skills

Y variable: Metacognitive Skills

Population and Samples

The population in this study were all students of SMA Negeri 13 Jakarta. Through purposive sampling technique selected class XI MIPA as respondents. Then, from a total of 200 students of class XI MIPA as respondents, 135 students were selected as samples with simple random sampling technique.

Instrument

The research instrument used in this study was a test of Finken and Ennis's critical thinking skills (1993). the test instrument for critical thinking skills and and the metacognitive instrument of Zulfiani et al, (2018). The test instrument were tested for validity using the Pearson Product Moment at = 0.05 with Cronbach's Alpha reliability test at = 0.05. The results of the validity test of the critical thinking skills test instrument showed that there were 9 valid statements. The results of the validity test of the metacognitive skills test instrument showed that there were 16 valid questions. The results of the reliability test showed that both research instruments were declared reliable with the reliability coefficient of the critical thinking skills test instrument of 0.743, and the reliability coefficient of the metacognitive skills test instrument of 0.555.

Procedure

The research instrument used in this study was a test of Finken and Ennis's critical thinking skills (1993) measured using the assessment rubric of Zubaidah and Corebima's critical thinking assessment (2015) and the metacognitive instrument of Zulfiani et al, (2018) in the form of an essay consisting of planning, monitoring and evaluation indicators. Evaluation. Aims to stimulate students' metacognitive skills, which are measured by scores using a Likert scale and using the metacognitive skills rubric of Corebima (2009).

Data Analysis Techniques

The data analysis techniques used in this study include prerequisite tests for data analysis and hypothesis testing. The prerequisite test for data analysis was in the form of a normality test using the Kolmogorov-Smirnov test ($\alpha = 0,05$) and a homogeneity test using the Levene test ($\alpha = 0,05$). Hypothesis testing in the form of regression and correlation tests. Regression test using simple regression test and correlation test using Pearson Product Moment ($\alpha = 0,05$).

RESULT AND DISCUSSION

Based on the results of the study, obtained descriptive statistical calculations including; the lowest value, highest value, average value, and standard deviation which can be seen in Table 1

Table 1. Description Data of Critical thinking Skills dan Metacognitive Skills

Deskription	Critical thinking Skills	Metacognitive Skills
N	135	135
Highest Score	84	81
Lowest Score	26	26
Average	64,6	63,3
Standard Deviation	10,27	9,67

Table 1 shows that the average critical thinking skill test is greater than the metacognitive skill test. The highest score was obtained by students from the critical thinking skills test while the lowest score for each skill was the same. There are four indicators in the Ecosystem material, Components, Ecological Pyramids, Food Chains and Webs, and Energy Cycles and Flows. The difference in the average value of critical thinking skills with metacognitive skills based on Ecosystem material indicators is in Table 2.

Table 2. Different Score Average on Ecosystem

Material	Critical Thinking		Metacognitive	
	Average	Standard Deviation	Average	Standard Deviation
Ecosystem Component	70,7	13,6	74,7	21,1
Food Chains and Webs	67,7	17,4	66,9	16,3
Ekological Pyramids	82,8	32,4	0*****	0*****
Energy Cycles and Flows	72,6	21,2	69,3	16,8

*(Metacognitive skills have not question of the ecological pyramid)

Based on Table 2, the highest average value of critical thinking skills is obtained by the ecological pyramid indicator. Meanwhile, in metacognitive skills, the highest value was obtained in the material of ecosystem components. Critical thinking skills were measured using an instrument developed by Ennis and Finken (1993)and measured using the critical thinking assessment rubric developed by Zubaidah and Corebima (2015). Meanwhile, metacognitive skills were measured using an instrument developed by Zulfiani (2018) and an assessment rubric developed by Corebima (2009). There are three indicators of cognitive domain in critical thinking skills and metacognitive skills, while in this study two indicators were used, namely C4 and C5. The difference in the average value of critical thinking skills and metacognitive skills on Ecosystem material based on indicators of the cognitive domain is in Table 3.

Table 3. Differences in Values by Cognitive Level

Cognitive Level	Critical Thinking		Metacognitive	
	Average	Standard Deviation	Average	Standard Deviation
C4	73,2	13,3	74,4	16,8
C5	68,9	15,7	63,1	17,2

Based on Table 3, the highest average value of critical thinking skills and metacognitive skills was obtained by the C4 domain indicator (analyzing). The difference in the value of students' critical thinking skills and metacognitive skills is due to students are being better able to solve problems related to the C4 (analyzing) a domain than the C5 (evaluating) domain. There are five categories of critical thinking skills, namely: very high criteria totaling 4 students; the high criteria are 28 students; medium criteria as many as 56 students; low criteria of 42 students; very low criteria of 5 students which can be seen in Table 4.

Table 4. Percentage of Critical Thinking Skills Score

Interval Nilai	Kategori	N	Persentase (%)
$0 < X \leq 43,75$	Very Low	5	3,7
$43,75 < X \leq 62,50$	Low	42	31,1
$62,50 < X \leq 71,50$	Medium	56	41,5
$71,50 < X \leq 81,25$	High	28	20,7
$81,25 < X \leq 100$	Very High	4	3
Jumlah		135	100

Source: Ermayanti & Sulisworo, 2016

Based on the category of critical thinking skills according to Ermayanti & Sulisworo, (2016) which is shown in Table 4 above, the value of critical thinking skills of students at SMAN 13 Jakarta is mostly at the moderate level. This shows that students have used critical thinking skills in the learning process. The difference in the value of metacognitive skills based on the metacognitive skill scale can be seen in Table 5 below.

Table 5. Percentage of Metacognitive Skills Score

Score	**Scala**	N	Percentage (%)
85 – 100	*Super*	0	0
68 – 84	*Ok*	1	0,7
51 – 67	*Developing*	13	9,6

34 – 50	*Cannot Really*	74	54,8
17 – 33	*At Risk*	47	34,8
0 – 16	*Not Yet*	0	0
Total		135	100

Source: Green, 2002

Based on Green (2002), the metacognitive skill scale is shown in Table 5 above, there are four metacognitive skill value scales from 135 students of SMAN 13 Jakarta, including: the At Risk scale of 1 student; the scale cannot really be 13 students; Developing a scale of many as 74 students and Ok many as 47 students which shows that the value of metacognitive skills of students at SMAN 13 Jakarta is mostly on the Developing scale. This shows that students have used metacognitive skills in the learning process.

Precondition Test and Data Analays

Based on the results of the normality test, a significance value (p) = 0.071 was obtained. This shows that the significance value (p) > 0.05 is 0.071 > 0.05, which means that H_0 is accepted at = 0.05. It can be concluded that the data on critical thinking skills and metacognitive skills are normally distributed.

Based on the results of the homogeneity test, a significance value (p) = 0.971 was obtained. This shows that the significance value (p) < 0.05 is 0.971 > 0.05, which means that H_0 is accepted at = 0.05. It can be concluded that the data on critical thinking skills and metacognitive skills have homogeneous variances.

Statistical Hypothesis Test

In this study, hypothesis testing was carried out using the SPSS 25 program at a significance level (α) = 0.05, namely:

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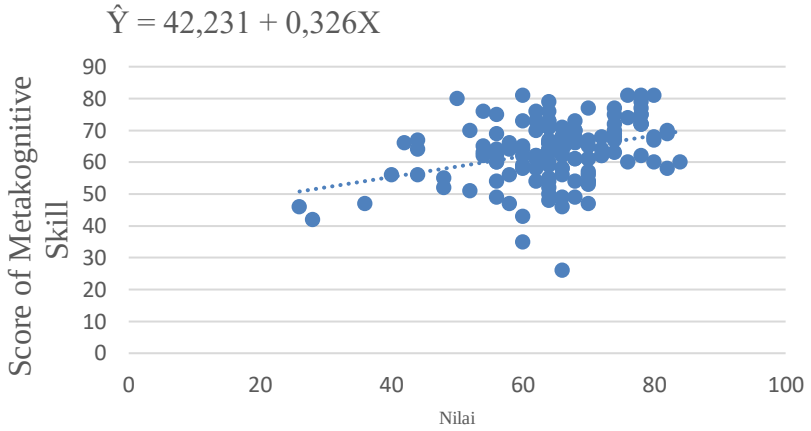
Based on the test results of the simple linear regression model, a significance value (p) of 0.000 was obtained. This shows that the significance value (p) < is 0.000 < 0.05, which means rejecting H0 at 0.05. It can be concluded that the simple linear regression model is significant. The calculation of a simple linear regression model produces an equation model = 42.231 + 0.326X for critical thinking skills (X) and metacognitive skills (Y). The results of the linearity test show a significance value (p) of 0.124. This shows that the value of p > , which

is 0.124 > 0.05, so accept H0 at 0.05. It can be concluded that there is a linear relationship between the variables of critical thinking skills and metacognitive skills. The relationship between Critical Thinking Skills and Metacognitive Skills in Ecosystem Materials is illustrated in the following graph:



Picture 2. Simple Regression Linier Model Correlation of Critical thinking and Metacognitive Skills

Based on the results of the correlation coefficient test, the correlation coefficient value of Critical Thinking Skills with Metacognitive Skills in Ecosystem Materials is 0.346. The value of the correlation coefficient indicates the level of relationship on the low criteria. In the calculation of the coefficient of determination, the value of is 0.12. These results indicate that environmental knowledge is able to influence students' environmental care attitudes by 12%, while 88% is related to other factors.

Discussion

The purpose of this study was to determine the relationship between critical thinking skills and students' metacognitive skills on ecosystem material. The Pearson Product Moment correlation test results in a positive relationship between critical thinking skills and students' metacognitive skills on ecosystem materials at low criteria. This means increasing critical thinking skills can improve metacognitive skills even though it is quite low. The result of the coefficient of determination is 0.12 which indicates that critical thinking skills can affect

metacognitive skills by 12%. This shows that most of the metacognitive skills (88%) are influenced by other factors.

The ecosystem is a material that studies the interactions between organisms and their environment. The goals that can be achieved by students learning biology are to develop analytical, inductive, and deductive thinking skills according to the principles and concepts of biology (Harahap et al., 2020). An environment that is vulnerable to change requires students to develop thinking skills. 21st-century education is learning that emphasizes improving thinking skills, one of which is critical and metacognitive thinking skills.

Critical thinking skills are active thinking skills by analyzing arguments, interpreting, and making conclusions (Zakiyah & Lestari, 2019). While metacognitive skills are skills to control self-cognition intentionally through the process of preparation, monitoring, and evaluation (Risnanosanti, 2008). Based on Table 1, the average critical thinking and metacognitive skills are quite low, this shows that students are less able to develop their thinking skills. The low results of critical thinking and metacognitive skills tests are caused by the lack of interest in reading by students, students being unable to understand the meaning of the questions, students answering carelessly, and technical obstacles such as breaking the internet network to access the google form. This statement is in accordance with the research of Irwan et. al. (2019) which states that critical thinking indicators in ecosystem materials are still not used in learning so the value of students' critical thinking skills is low. Meanwhile, the low level of metacognition is caused by the readiness of students in learning including planning, monitoring, and evaluation.

Another study that is by this research is Fauzi (2019) which states that learning biology can be understood by students if students can think critically in learning. According to Ichsan et. al., (2020) students answer questions only based on textbooks and do not completely build their arguments. There are still many students who do not understand answering the given ecosystem questions. This can be understood by the existence of online learning during the Covid-19 pandemic, students need greater motivation and determination to plan to learn at home. The participation of parents is very much needed in coordination with students and teachers (Cahyati & Kusumah, 2020). In addition, the researchers constantly reminded them to take tests in between free online learning hours from school.

Several studies that show a positive relationship between critical thinking skills and metacognitive skills include research by Budi M and Ghofar (2017); Magno (2010); Irawan (2017); and Malahayati et. al. (2015) which states that critical thinking skills show a positive relationship with metacognitive skills. The increase in critical thinking skills is followed by an increase in metacognitive skills. This is because students who think critically involve metacognitive skills. Students who think critically think in analysis, synthesis, and evaluation to help students to choose learning strategies that can be used in understanding material. A high understanding of a concept, especially an ecosystem material, helps students solve problems so that the value of thinking skills can increase.

The difference in the value of critical thinking and metacognitive skills that students get is because thinking skills are influenced by various factors such as material understanding, students' techniques in analyzing questions, self-readiness in answering questions and other psychological factors (Buku et al., 2016; Dwyer et al., 2014). In addition, the readiness factor of students which include planning, monitoring and evaluation is an important factor to regulate the rhythm of learning so that students did not only answer questions but can also understand the meaning and thought processes. Therefore, students with low critical thinking and metacognitive skills need to improve their thinking skills by planning their systematic learning.

Thus, it is hoped that the thinking skills of students can be empowered. Students with low thinking skills will find it difficult to understand lessons, especially in 21st century learning which emphasizes improving skills. According to Proulx (2004), critical thinking can be created if students can understand the shortcomings and weaknesses of arguments so that students can reason. These thinking skills can be built if students can judge and decide on the opinions of others who are more inclined to scientific truth (Zubaidah & Corebima, 2015).

In line with that, metacognitive skills are high-level thinking processes so that to achieve them students are required to make better self-regulation so that learning achievement can be achieved (Risnanosanti, 2008). Basith (2009) states that students who have not been able to appreciate the questions given are most likely due to the fact that students have not thought coherently and have not been able to understand themselves.

The results of this study indicate that critical thinking skills have a low relationship with metacognitive skills. In this study, it is known that critical thinking skills in different categories because the scale of metacognitive skills possessed by students is also different. Collaboration between critical thinking skills and metacognitive skills is expected to improve analytical thinking skills so as to help students create learning ecosystem materials that are communicative, critical and insightful (Buku et al., 2016; Malahayati et al., 2015).

CONCLUSION

Metacognitive skills are skills that help students improve critical thinking skills. Data collection through survey techniques using critical thinking skills tests and metacognitive skills tests. Based on the results of the study obtained a correlation coefficient of 0, 346 in the correlation of critical thinking skills with student metacognitive skills on ecosystem material. The results of the analysis show that there is a positive correlation between critical thinking skills with student metacognitive skills on ecosystem material. Students with low thinking skills will find it difficult to understand lessons, especially in 21st century learning which emphasizes improving skills.

REFERENCES

Amir, M. F., & W, M. D. K. (2018). Pengembangan Perangkat Pembelajaran Berbasis Masalah Kontekstual Untuk Meningkatkan Kemampuan Metakognisi Siswa Sekolah Dasar. *Journal of Medives*, *2*(1), 117–128. http://e-journal.ikip veteran.ac.id/index.php/matematika/article/view/538

Anggraini, L. G., & Anas, N. (2019). Analisis Kemampuan Metakognisi Siswa Terhadap Materi Bangun Ruang Di SD. *SEJ (School Education Journal*, *9*(3), 281–289.

Arifin, M. S., Zubaidah, S., & Mahanal, S. (2012). Hubungan Antara Keterampilan Metakognitif Terhadap Hasil Belajar Biologi Dan Retensi Siswa Kelas X Dengan Strategi Reciprocal Teaching Di SMA Negeri 1 Lawang. *Jurnal Pendidikan Biologi Indonesia*, *0*(0), 1–9.

Astuti, L., Wihardi, Y., & Rochintaniawati, D. (2020). The Development of Web-Based Learning using Interactive Media for Science Learning on Levers in Human Body Topic. *Journal of Science Learning*, *3*(2), 89–98. https://doi.org/10.17509/jsl.v3i2.19366

Basith, A. (2009). Potensi Strategi Reciprocal Teaching Untuk Memberdayakan Keterampilan

Metakognitif Siswa Sekolah Menengah Berkemampuan Akademik Rendah Pada Pembelajaran Biologi. *Biologi, Sains, Lingkungan, Dan Pembelajarannya Dalam Upaya Peningkatan Daya Saing Bangsa*, *1999*, 84–89.

Budi M, I., & Ghofar, A. (2017). Analisis keterampilan berpikir kritis dan metakognitif mahasiswa program studi pendidikan biologi. *Bioma*, *6*(1), 11.

Buku, M. N. I., Aloysius, D. C., & Rohman, F. (2016). The correlation between metacognitive skills and the critical thinking skills of the senior high school students in biology learning through the implementation of problem based learnin (PBL) in Malang, Indonesia. *International Journal of Academic Research and Development*, *1*(5), 58–63.

Cahyati, N., & Kusumah, R. (2020). Peran Orang Tua Dalam Menerapkan Pembelajaran Di Rumah Saat Pandemi Covid 19. *Jurnal Golden Age*, *04*(1), 4–6.

Cooper, M. M., & Sandi-urena, S. (2009). Design and Validation of an Instrument To Assess Metacognitive Skillfulness in Chemistry Problem Solving. *Journal Of Chemical Education*, *86*(2), 240–241.

Corebima, A. D. (2009). Metacognitive skill measurement integrated in achievement test. *Third International Conference on Science and Mathematics Education (CoSMEd)*, *5*, 1–9.

Dignath, C., Buettner, G., & Langfeldt, H. (2008). How can primary school students learn self-regulated learning strategies most effectively ? A meta-analysis on self-regulation training programmes. *Educational Research Review Journal*, *3*, 101–129. https://doi.org/10.1016/j.edurev.2008.02.003

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2014). An integrated critical thinking framework for the 21st century. *Thinking Skills and Creativity*, *12*, 43–52. https://doi.org/10.1016/j.tsc.2013.12.004

Eriawati. (2013). Aplikasi Keterampilan Metakognitif Dalam Pembelajaran Ekosistem Di MAN Rukoh. *Jurnal Biotik*, *1*(1), 60–66.

Ermayanti, & Sulisworo, D. (2016). Tingkat Kemampuan Berpikir Kritis Peserta Didik setelah Penerapan Model Pembelajaran Student Team Achievement Divisions (STAD) pada Siswa Sekolah Menengah Atas (SMA). *Prosiding Seminar Nasional Quantum*, 175–181.

Espey, M. (2017). Enhancing critical thinking using team-based learning. *Higher Education Research & Development*, *0*(0), 1–15. https://doi.org/10.1080/07294360.2017.1344196

Fauzi, A. (2019). Profile of Junior High School Students ' Critical Thinking Skills in Answering Questions Related to Biological Concepts. *Scientiae Educatia: Jurnal Pendidikan Sains*, *8*(1), 51–63.

http://www.syekhnurjati.ac.id/jurnal/index.php/sceducatia/article/view/4081

Finken, M., & Ennis, R. H. (1993). *Illinois Critical Thinking Essay Test* (pp. 1–7).

Green, R. (2002). *Better Thinking Learning and Introduction to Cognitive Education*. online.

Gündüz, A. Y., Alemdağ, E., Yaşar, S., & Erdem, M. (2016). Design of a Problem-Based Online Learning Environment and Evaluation of its Effectiveness. *TOJET: The Turkish Online Journal of Educational Technology*, *15*(3), 49–57.

Harahap, L. J., Ristanto, R. H., & Komala, R. (2020). Getting critical thinking about ecosystem : How impact and responses of students about the CirGi learning model ? *Biosfer: Jurnal Pendidikan Biologi*, *13*(1), 86–100. https://doi.org/10.21009/biosferjpb.v13n1.86-100

Ichsan, I. Z., Rahmayanti, H., Purwanto, A., Sigit, D. V., Miarsyah, M., & Gomes, P. W. P. (2020). HOTS-AEP-COVID-19 and ILMIZI learning model: The 21st-century environmental learning in senior high school. *Jurnal Pendidikan Biologi Indonesia*, *6*(2), 265–272. https://doi.org/10.22219/jpbi.v6i2.12161

Irawan, L. I. (2017). *Hubungan Metakognitif Dan Berpikir Kritis Dengan Hasil Belajar Kognitif Materi Sistem Koordinasi Manusia Siswa SMA[Skripsi]*. Jakarta : Pendidikan Biologi, FMIPA. Universitas Negeri Jakarta.

Irwan, Maridi, & Dwiastuti, S. (2019). Developing guided inquiry-based ecosystem module to improve students ' critical thinking skills. *Jurnal Pendidikan Biologi Indonesia*, *5*(1), 51–60. https://doi.org/10.22219/jpbi.v5i1.7287

KarakoÇ, M. (2016). The Significance of Critical Thinking Ability in terms of Education. *International Journal of Humanities and Social Science*, *6*(7), 81–84.

Kristiyani, T. (2016). *SELF-REGULATED LEARNING* (Y. Y. Taum (ed.); 1st ed.). Yogyakarta : Sanata Dharma University Press.

Kuhn, D. (2011). A Developmental Model of Critical Thinking. *American Educational Research Association*, *28*(2), 16–25.

Kurt, H., Ekİcİ, G., Aksu, Ö., & Aktaş, M. (2013). The most important concept of transport and circulatory systems : Turkish biology student teachers ' cognitive structure. *Educational Research Reviews*, *8*(17), 1574–1593. https://doi.org/10.5897/ERR2013.1566

Lai, E. R. (2011). Metacognition : A Literature Review Research Report. *Metacognition Learning*, *0*(April), 3–40.

Lestari, P., Ristanto, R. H., & Miarsyah, M. (2019). Metacognitive and Conceptual Understanding of Pteridophytes : Development and Validity Testing of an integrated Assessment Tool. *Indonesian Journal of Biology and Education*, *2*(1), 15–24.

Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning*, *5*(2), 137–156. https://doi.org/10.1007/s11409-010-9054-4

Malahayati, E. N., Corebima, A. D., & Zubaidah, S. (2015). Hubungan Keterampilan Metakognitif dan Kemampuan Berpikir Kritis dengan Hasil Belajar Biologi Siswa SMA dalam Pembelajaran Problem Based Learning (PBL). *Jurnal Pendidikan Sains*, *3*(4), 178–185.

Nurdyansyah, N., & Amalia, F. (2015). Model Pembelajaran Berbasis Masalah Pada Pelajaran IPA Materi Ekosistem. *Jurnal Pengajaran MIPA (JPMIPA)*, *1*(0), 1–8.

Osman, K., Hiong, L. C., & Vebrianto, R. (2013). 21 st Century Biology : An Interdisciplinary Approach of Biology , Technology , Engineering and Mathematics Education. *Procedia - Social and Behavioral Sciences*, *102*(Ifee 2012), 188–194. https://doi.org/10.1016/j.sbspro.2013.10.732

Paul, R., & Elder, L. (2006). *The Miniature Guide to Critical Thinking: Concepts & Tools* (1st ed.). The Foundation For Critical Thinking.

Permana, F. H., & Chamisijatin, L. (2019). Project-based learning through edmodo: improving critical thinking and histology concepts. *Biosfer*, *12*(1), 58–69. https://doi.org/10.21009/biosferjpb.v12n1.58-69

Pratiwi, H. E., Suwono, H., & Susilo, H. (2015). Pengaruh Model Pembelajaran Socio-Biological Case Based Learning Terhadap Keterampilan Berpikir Kritis Mahasiswa Biologi FMIPA Universittas Negeri Malang. *Jurnal Pendidikan Biologi*, *7*(1), 22–30.

Proulx, G. (2004). Integrating Scientific Method & Critical Thinking in Classroom Debates on Environmental Issues. *The American Biology Teacher*, *66*(1), 26–33. https://doi.org/http://dx.doi.org/10.1662/0002-7685(2004)066[0026:ISMCTI]2.0.CO;2

Ratri, V. T. C., & Sugiarto, B. (2016). Hubungan Antara Keterampilan Metakognisi Siswa Dengan Hasil Belajar Siswa Menggunakan Model Pembelajaran Langsung (Direct Instruction) Pada Materi Hidrolisis Garam Kelas XI. *Unesa Journal of Chemical Education*, *5*(2), 104–110.

Risnanosanti. (2008). Kemampuan Metakognitif Siswa Dalam Pembelajaran Matematika. *Pythagoras*, *4*(1), 86–98.

Ristanto, R. H., Djamahar, R., Heryanti, E., & Ichsan, I. Z. (2020). Enhancing Students ' Biology-Critical Thinking Skill through CIRC-Based Scientific Approach (Cirsa).

Universal Journal of Educational Research, *8*(4A), 1–8. https://doi.org/10.13189/ujer.2020.081801

Tofade, T., Elsner, J., & Haines, S. T. (2013). Best Practice Strategies for Effective Use of Questions as a Teaching Tool. *American Journal Of Pharmaceutical Education*, *77*(7), 1–9.

Trilling, B., & Fadel, C. (2009). *21 century skills: Learning For Life In Our Times* (1st ed.). Jossey- Bass., San Fransisco.

Wicaksono, A. G. C., & Corebima, A. D. (2015). Hubungan antara keterampilan metakognitif dan retensi siswa dalam strategi pembelajaran reciprocal teaching dipadu jigsaw dikelas x sman 7 malang. *Bioma*, *4*(X), 58–68.

Yani, R., Musarofah, Atikah, T., & Purwianingsih, W. (2009). *Biologi 1* (P. Latifah (ed.); vi th). Pusat Perbukuan, Departemen Pendidikan Nasional., Jakarta.

Zakiyah, L., & Lestari, I. (2019). *Berpikir Kritis dalam Konteks Pembelajaran* (Erminawati (ed.); 1st ed., Issue August). Erzatama Karya Abadi., Jakarta.

Zubaidah, S., & Corebima, A. D. (2015). Asesmen Berpikir Kritis Terintegrasi Tes Essay. *Symbion*, *0*(April), 200–213.

Zulfiani, Z., Herlanti, Y., Rosydatun, E. S., Hasiani, S., Rohmatulloh, G., & Zuqistya, N. (2018). Developing Metacognitive Skill Instrument on Fungus Concept. *Edusains*, *10*(2), 243–253. https://doi.org/10.15408/es.v10i2.7919