



Analysis of the correlation between critical thinking and metacognitive skills of senior high school students in biology Jeneponto Regency, South Sulawesi, Indonesia



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Article Information	ABSTRACT
Submitted: 2023-06-03 Accepted: 2023-11-20 Published: 2023-11-30	<p>There is a need to map the connection between critical thinking and metacognitive skills of high school students so that educators can determine learning steps to help students obtain optimal learning outcomes and 21st-century skills. The research objective is to Examine the relationship between high school biology students' metacognitive abilities and critical thinking education. It is a quantitative-correlational study. The research sample was 230 grade XI students pursuing science specialization obtained by purposive random sampling from Jeneponto Regency, South Sulawesi, Indonesia. The research instrument used is an examination formatted as an essay that has been confirmed by professionals. The research data is the value of critical thinking and metacognitive skills from the results of taking tests in the form of essays. The method of data analysis was used through linear regression analysis using SPSS 23 for Windows. The study's findings indicate a strong correlation between critical thinking and metacognitive abilities of high school students in biology education with a significance value of 0.000 ($p < 0.05$). It can be seen that critical thinking skills contribute 68.6% to students' metacognitive skills. Therefore, this research finds that there is a substantial correlation between high school biology students' metacognitive abilities and critical thinking. Teachers can use the research findings to identify instructional strategies that foster critical thinking in order to help students become more independent and metacognitive.</p> <p>Keywords: Biology, critical thinking; metacognitive</p>
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INTRODUCTION

The expeditious advancement of technology and communication characterizes the 21st century. The advancement of information and communication technology requires students to possess the ability to compete or vie for success by acquiring skills and knowledge. Thinking critically is deemed essential for students in the twenty-first century, as asserted by [Laar et al. \(2020\)](#). Critical thinking pertains to the cognitive ability to take part in thoughtful and evaluative consideration to determine the most appropriate beliefs and actions ([Yusmar et al., 2022](#)). Critical reasoning encompasses an assortment of mental abilities, including but not limited to self-control, interpretation, analysis, appraisal, inference, and explanation ([Alkharusi et al., 2019](#); [Hyytinen et al., 2021](#); [Wale & Bishaw, 2020](#); [Andriana et al., 2019](#)).

Critical thinking comprises six fundamental components: focus, reason, situation, implication, lucidity, and synopsis ([Ennis, 2011](#)). Concentration pertains to the act of directing one's attention toward pre-existing inquiries or concerns to arrive at informed conclusions. Reason is a cognitive process that involves the exploration of justifications for decisions made in light of pertinent situations and factual evidence. Making a logical or persuasive deduction is referred to as Inference. In critical thinking, one understands the circumstances and consistently keeps the scenario in mind to aid in the clarification of the questions and identify key terms and relevant passages as supporting elements. Clarity in critical thinking pertains to the ability to elucidate the intended significance of the terminology employed. Overview involves a comprehensive examination and evaluation of decisions made.

Multiple research endeavors in Indonesia show that the ability to think critically in high school has not been fostered or incentivized. The findings of several studies by [Azrai \(2020\)](#), [Kurniyasari et al. \(2019\)](#), [Mustajab et al. \(2018\)](#), and [Susilawati et al. \(2020\)](#) suggest that a significant proportion of Indonesian pupils in high school exhibit inadequate critical thinking skills across multiple academic disciplines. The level of analytical abilities among Indonesian high school students have been reported to be moderate in the context of learning biology ([Luzyawati, 2017](#); [Perdani et al., 2019](#)) and physics ([Rahayu et al., 2018](#); [Rosdiana et al., 2019](#); [Wijayanti & Siswanto, 2020](#)). Students' deficient critical thinking skills could be attributed to their passive involvement during the process of learning. In addition, educators have been failing to provide effective instruction to strengthen pupils' capacity for critical thought, resulting in students lacking the capacity to analyze and evaluate issues present in their environment ([Sofiyana & Sholiha, 2022](#); [Mislia et al., 2019](#); [Purwanto et al., 2022](#)). Metacognition and critical thinking go hand in hand and are necessary to students' mental capacities ([Amin et al., 2020](#); [Darmawan, 2020](#); [Fauzi & Sa'diyah, 2019](#)). There exists a noteworthy connection between metacognitive factors and analytical reasoning. The growth of metacognitive abilities is associated with the cultivation of advanced cognitive abilities that regulate specific cognitive processes during the learning process ([Kozikoglu, 2019](#); [Kondakçi & Aydin, 2013](#)).

Metacognitive skills are closely related to how one thinks ([Adiansyah et al., 2021](#); [Lukitasari et al., 2019](#)). Metacognitive abilities can help pupils in becoming autonomous and accountable for attaining a goal ([Abdelrahman, 2020](#); [Anthonysamy, 2021](#); [Stanton et al., 2021](#)). Metacognitive abilities are crucial for achieving success in learning because They let pupils take charge of their learning and their cognitive skills and identify their shortcomings, which can be remedied through subsequent cognitive skills ([Tao & Li, 2014](#)). Students' metacognitive skills play a vital part in enhancing their awareness of learning, planning learning, regulating the learning process, and evaluating their learning process ([Hartman, 2001](#); [Rahimi & Katal, 2012](#); [Wibowo et al., 2018](#)).

Metacognitive skills play a significant role in diverse cognitive processes, including but not limited to memory, understanding, attention, communication, and problem-solving ([Jia et al., 2019](#); [Kusaka,](#)

2022). Students require metacognitive skills to engage in reflective thinking about the requirements of learning tasks. According to [Medina et al. \(2017\)](#) and [Shannon \(2008\)](#), metacognitive abilities are beneficial for pupils since they allow them to select and utilize learning techniques that promote academic achievement. The development of metacognitive skills can enhance students' cognitive abilities because metacognitive skills foster students' awareness of the learning process, enabling them to strategize their learning, regulate their learning activities, assess their learning outcomes, and appraise their aptitudes and limitations in learning ([Ramadhanti et al., 2019](#); [Saricoban, 2015](#)).

Numerous prior investigations have made an effort to establish a the connection between critical thinking abilities and metacognition. Some previous research was limited to studying single relationships between variables, for example, the link among metacognitive abilities and analytical reasoning abilities. Research conducted by [Malahayati et al. \(2014\)](#) and [Wicaksono & Corebima, \(2015\)](#) discovered a substantial relationship between metacognitive and critical thinking abilities.. Research conducted by [Arslan \(2012\)](#) reported that the ability to think critically is linked to metacognitive skills. The study carried out by [Amin et al. \(2020\)](#) stated that a favorable association existed between critical thinking skills and metacognitive abilities in implementing learning strategies. Certain scholars posit that acquiring and utilizing metacognitive skills can cultivate critical thinking. The study carried out by [Magno \(2010\)](#), and [Rivas et al. \(2022\)](#) pertains to university students as their subjects. A scholarly inquiry has been carried out regarding the correlation between critical thinking and metacognitive skills in genetic courses, as evidenced by ([Miharja et al., 2019](#)). The study by [Sudirman and Yusnaeni \(2020\)](#) investigated the critical and metacognitive thinking abilities of secondary school pupils in the context of Thermochemistry education. Regrettably, the investigation solely focused on evaluating the degree of metacognitive and critical thinking skills among students without delving into the correlation between the two constructs. Another study focused on the relationship between senior Students' critical thinking in high school and metacognitive skills in the field of biology. This study, however, was carried out within the framework of students' process skills, focusing on high school students residing on the island of Java ([Naimnule & Aloysius, 2018](#)). It can be asserted that there exists Insufficient research concerning this. The connection between mental abilities and critical thinking in biology education for senior pupils in high school hailing from regions beyond Java, particularly in the province of South Sulawesi.

The current investigation relationship between critical thinking as well as senior high school students and metacognitive abilities and the extent to which students' critical thinking influences metacognitive skills in biology education. The current study's findings offer researchers in the field an insight into the necessity of cultivating students' metacognitive abilities and critical thinking, which will later favorably impact student learning objectives. The findings of this research can potentially function as directives for augmenting the instructor's function as a facilitator, motivator, and mediator in improving pupils' critical thinking and metacognitive skills in biology. Thus, the study objective is to analyze The relationship between critical reasoning and metacognitive skills of students in high school in biology education.

RESEARCH METHODS

It is a quantitative-correlational study, which intends to ascertain the connection between metacognitive abilities and critical thinking of pupils while in high school in biology education. Critical thinking acts as a predictor, while metacognitive skills act as a criterion. The research was carried out in South Sulawesi, Indonesia's Jeneponto Regency. This research sample involved 230 eleventh-grade

students from Jeneponto Regency, South Sulawesi, Indonesia who were chosen utilizing a purposeful random sampling methodology.

The research instrument used to measure participants' critical critical reasoning and metacognitive abilities was an essay-based test. The test has been confirmed by professionals with a valid and reliable value of 0.857 so It's a tool for measuring Metacognitive abilities and critical thinking. The test was also created using indicators of critical thinking such as (1) focus, (2) explanations and evidence for them, (3) structure, (4) norms, and (5) integration by Zubaidah et al. (2018) and based on indicators of metacognitive skills such as (1) answers are original, (2) answers are arranged coherently, systematically and logically, (3) answers are written in appropriate language and grammar, (4) answers are supported by rationales (analysis, assessment, and creation), and (5) correct/incomplete/not written answers by Corebima (2008). The study's data is presented as of critical thinking and metacognitive skills scores obtained from the outcomes of essay tests containing indicators of Metacognitive abilities and critical thinking. Research data was examined using linear analysis of regression with a importance level of 5% using SPSS 23 for Windows. Before examination, the information was first examination for normality and uniformity.

FINDING AND DISCUSSION

The correlation between critical thinking and the metacognitive skills of biology pupils in high school can be measured and determined by employing regression analysis in linear form. The result of the regression analysis examining the relationship between metacognitive abilities and critical thinking of biology students in senior high school is shown in Table 1. The result of the Anova on the association between critical thinking and metacognitive skills of senior biology students in high school is shown in Table 2 The analysis conclusion of the regression equation coefficient appears in Table 3.

Table 1. The Result of The Regression Analysis regarding The Relationship Between Critical Thinking and Metacognitive Skills of Biology Students in Senior High School

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.828 ^a	.686	.684	5.92954

Table 2. The Result of the Anova on The Correlation between Critical Thinking and Metacognitive Skills of Senior High School Students in Biology

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17487.945	1	17487.945	497.390	.000 ^b
	Residual	8016.345	228	35.159		
	Total	25504.291	229			

Table 3. The Result of The Analysis of The Regression Equation Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.466	1.463		3.737	.000
	Critical Thinking Skills	.728	.033	.828	22.302	.000

Data analysis in the Tables above showed an R-value of 0.828 (Table 1) and an F-value of 497.390 (Table 2), along with a significance level of 0.000 ($p < 0.05$). These findings pointed to a correlation between critical thinking and metacognitive skills of biology students in senior high school. According to the regression model with an equation of $y = 0.728x + 5.466$ (Table 3) and an R Square-value of 0.686

(Table 1), it can be inferred that a significant proportion of students' metacognitive skills, specifically 68.6%, were influenced by their critical thinking skills. The remaining 31.4% of the variance in metacognitive skills was attributed to factors beyond critical thinking.

The linear regression analysis revealed a correlation between Students in senior high school critical thinking and metacognitive skills in biology, with a significance level (0.000) smaller than 0.05. The current study's findings are consistent with prior scholarly inquiry, which suggests a strong association between critical thinking and metacognitive skills (Amin et al., 2020; Naimnule & Aloysius, 2018). The literature also suggests a significant correlation between students' critical thinking abilities and metacognitive skills (Buku et al., 2016; Lukitasari et al., 2019). Research has indicated a direct relationship between the capacity for important thought and the possession of metacognitive skills in the execution of learning strategies (Fitriani et al., 2018).

Critical thinking abilities are required to refine students' metacognitive abilities (Fauzi & Sa'diyah, 2019; Tuysuzoglu & Greene, 2014). The increase in metacognitive skills parallels the growth of analytical reasoning skills (Bryce et al., 2015). The findings outcomes from his research show that critical thinking contributes 68.6% to students' metacognitive abilities. This significant percentage demonstrates that critical thinking is an essential ability that is required to be fostered throughout the learning process (Magno, 2010). When students incorporate critical thinking into the learning process, metacognitive skills are also involved (Fauzi & Sa'diyah, 2019). Critical thinking and metacognitive abilities can be enhanced by implementing suitable learning tactics. Meaningful knowledge involves students' active participation in conceptual construction, leading to the formation of new knowledge (Dang et al., 2018).

The enhancement of metacognitive abilities in students is contingent upon their possession of critical thinking skills. Through the application of critical thinking, students can engage in metacognitive processes, whereby they can assess the efficacy of their cognitive operations concerning predetermined objectives, thereby fostering a sense of self-confidence in the completion of academic tasks (Rivas et al., 2022; Wibowo et al., 2018). According to Magno (2010), the implementation of metacognitive skills in the classroom can aid in raising pupils' critical thinking skills. Individuals with high critical thinking skills are more likely to address practical issues effectively (Hakim et al., 2018). Critical thinking skills refer to intellectual rigor involving the dynamic conceptualization utilization, analysis, evaluation, and communication of information derived from various sources, including experience, observation, reflection, and reasoning (Herlina & Syahfitri, 2022).

The elements of self-controlled education encompass critical thinking skills and metacognitive skills, which pertain to the capacity to comprehend and manage the learning environment (Lajoie, 2008; Phan, 2010; Uppal & Kumar, 2020). Individuals with high critical thinking skills will likely exhibit effective metacognitive processes, particularly in devising and assessing strategies. The utilization of metacognitive skills has the potential to mitigate challenges encountered during the learning process. Additionally, critical thinking can offer thoughtful criticism as a component of the learning cycle, thereby enhancing students' capacity to resolve problems, identify influential factors, assess diverse possibilities, and arrive at informed decisions (Herlina & Syahfitri, 2022).

The optimal and continuous development of critical thinking skills in learning must occur at all educational levels. Developing critical thinking will affect students' metacognitive skills and independence in learning. Students need critical thinking and metacognitive skills to be competitive and motivated to confront the difficulties of the rapid era of digital development. Teachers should therefore provide students with learning activities that strengthen their critical thinking and metacognitive skills. The learning process

should be able to encourage students to develop problem-solving skills, make mature decisions, and become independent thinkers.

CONCLUSION

The outcomes and discussion of this study indicate a noteworthy partnership between metacognitive abilities and critical thinking. Students' metacognitive abilities are significantly enhanced by Critical thinking skills. The findings of this study are suggestive to educators to determine learning steps that can train critical thinking skills so that students' metacognitive abilities and independence increase. It is recommended for further research that wants to further explore these skills and their implications in order to cultivate 21st-century competencies. Additional investigation can be conducted by adding additional factors, especially gender.

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