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Relationship between Critical Thinking Skills and Creative Thinking Skills with the Biology Learning Outcomes of Grade XI Students at UPT SMAN 1 Wajo

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui hubungan antara kemampuan berpikir kritis dan keterampilan berpikir kreatif dengan hasil belajar biologi siswa kelas XI di UPT SMAN 1 Wajo. Penelitian ini didasarkan pada tuntutan pembelajaran abad ke-21 yang menekankan pada pengembangan kemampuan berpikir tingkat tinggi, seperti berpikir kritis dan kreatif, yang dalam mata pelajaran Biologi. Penelitian ini menggunakan metode deskriptif-kuantitatif. Populasi penelitian terdiri dari siswa kelas XI UPT SMAN 1 Wajo, dan sampel diambil secara *purposive sampling* sebanyak 31 siswa. Hasil penelitian menunjukkan bahwa terdapat hubungan positif dan signifikan antara kemampuan berpikir kritis dan keterampilan berpikir kreatif dengan hasil belajar biologi siswa dengan nilai signifikansi 0,000 < 0,05 dan nilai koefisien korelasi 0,972 dengan kategori korelasi sangat kuat. Penelitian ini, dapat disimpulkan bahwa secara simultan kemampuan berpikir kritis dan keterampilan berpikir kreatif yang lebih tinggi berperan penting dalam meningkatkan hasil belajar biologi siswa.
Kata kunci: Berpikir Kritis; Berpikir Kreatif; Hasil Belajar Biologi.

ABSTRACT

This study aims to determine the relationship between critical thinking skills and creative thinking skills with the biology learning outcomes of grade XI students at UPT SMAN 1 Wajo. This study is based on the demands of 21st century learning, which emphasizes the development of higher-order thinking skills, such as critical and creative thinking, in biology lessons. This study used a descriptive-quantitative method. The research population consisted of 11th grade students at UPT SMAN 1 Wajo, and the sample was taken using purposive sampling of 31 students. The results showed a positive and significant relationship between critical thinking skills and creative thinking skills with students' biology learning outcomes, with a significance value of 0.000 < 0.05 and a correlation coefficient value of 0.972, which is classified as a very strong correlation. This study concluded that simultaneously, higher critical thinking skills and creative thinking skills play an important role in improving students' biology learning outcomes.
***Keywords**: Critical Thinking; Creative Thinking; Biology Learning Outcomes.*

INTRODUCTION

The 21st century is commonly referred to as the age of science and technology, as it demands the mastery of various abilities and competencies. The education

system of the 21st century places emphasis on creativity, critical thinking, collaboration, communication skills, social skills, and character development. As a result, students must possess at least four essential skills required for the workforce (Hafiza et al., 2022). Schools are therefore expected to align their educational patterns with the demands of the professional world. According to Mu'minah (2021), 21st-century learning seeks to prepare individuals who are ready to face the challenges of this era. Syamina et al. (2021) further define 21st-century learning as a process of gaining knowledge through methods intended to enhance cognitive abilities, moral development, and diverse skills such as inquiry, creativity, problem-solving, and the ability to apply learned concepts through educational experiences.

The 21st century demands human resources capable of higher-order thinking skills such as critical and creative thinking. Based on preliminary observations conducted at SMAN 1 Wajo, students' levels of critical and creative thinking were found to be varied—some sufficiently developed, while others require further improvement. According to Ningsih & Rizki (2024), critical thinking is a crucial aspect of education that helps students develop the ability to analyze, evaluate, and synthesize information. As stated by Yulianis & Suryanti (2023), critical thinking is one of the essential competencies needed in the 21st century. Their research emphasizes that critical thinking involves the use of deep reasoning to obtain accurate and accountable information.

In addition, Muis (2021) defines creative thinking as the ability to generate something new—whether in the form of ideas or tangible products—derived either from innate or acquired traits, or a combination of both, that are distinct from previously existing work. It is therefore important for teachers to cultivate students' creativity through methods such as implementing creative thinking patterns during lessons and assigning challenges that stimulate creative problem-solving. Rahman (2021) adds that learning outcomes represent the results achieved by students after undergoing learning activities, which may include knowledge, attitudes, and skills.

In the context of biology education, critical thinking enables students to analyze and logically evaluate information, while creative thinking allows them to generate new ideas for understanding complex biological concepts. Learning outcomes are influenced not only by academic factors but also by students' cognitive approaches in addressing learning materials (Maria et al., 2023). Sari (2023) found that students with certain cognitive skills are likely to possess other related skills—for example, students who demonstrate critical thinking often also show creative thinking abilities. Similarly, Kamelia et al. (2023) reported a significant relationship between creative and critical thinking skills and improved biology learning outcomes. Students with creative thinking skills tend to better connect new information with prior knowledge, while those with critical thinking skills can evaluate information objectively and logically. Safitri & Japa (2023) further found a positive and significant correlation between creative thinking ability and biology learning outcomes, with a contribution value of 9.98%.

Although previous studies have shown a positive relationship between critical

and creative thinking skills with learning outcomes, none have examined both skills simultaneously in a more specific context. For instance, Wahyuni (2023), in her study titled “The Relationship Between Critical and Creative Thinking Skills and Problem-Solving Ability,” focused solely on problem-solving, not learning outcomes. Meanwhile, Ramadhani (2018), who investigated “The Relationship Between Study Habits and Biology Learning Outcomes among Grade IX Students at State High Schools in Tampan District,” centered on learning outcomes but did not investigate the role of critical or creative thinking.

Therefore, this study aims to analyze the relationship between critical thinking ability and creative thinking skills with students’ biology learning outcomes simultaneously. The findings are expected to provide deeper insight into the role of these cognitive abilities in improving the quality of education, as reflected in students’ learning achievements. Based on the aforementioned background, this research was conducted to determine the relationship between critical thinking ability and creative thinking skill and biology learning outcomes. The study is titled:“The Relationship Between Critical Thinking Ability and Creative Thinking Skills and Biology Learning Outcomes of Students at UPT SMAN 1 Wajo.”

METHODS

This study employs a survey-based research design with an analytical-descriptive approach. The descriptive method involves sampling from a population in which data are collected through tests and questionnaires. The research sample was determined using a purposive sampling technique, which entails selecting samples based on specific considerations due to the large population size. As stated by Junaidi (2017), if a research population consists of fewer than 100 individuals, the entire population should be used as the sample. However, if the population exceeds 100 individuals, then a minimum of 10–25% of the total population should be selected as the sample.

The variables in this study consist of independent variables (X), namely critical thinking ability (X1), which was assessed using open-ended test questions (essay form). The scoring of each item was based on a rubric developed from the indicators of critical thinking skills, adapted from Ennis (2018). The questions were designed to measure students’ critical thinking ability in relation to biology learning outcomes. In contrast, creative thinking skills were measured using a questionnaire.

A questionnaire is a data collection technique administered by providing respondents with a set of written questions or statements for them to answer (Sugiyono, 2017). The questionnaire in this study was distributed to obtain self-reflection data from students regarding their creative thinking skills and was structured using a Likert scale. Each item on the Likert scale includes responses ranging from strongly positive to strongly negative, categorized as follows: Strongly Agree (SA) = 5, Agree (A) = 4, Neutral (N) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1 (Arikunto, 2010).

The dependent variable (Y) in this study is students' learning outcomes. Data on learning outcomes were collected through documentation, which involved using preexisting data available in the school archives. The values recorded were transformed from students' answers to summative tests administered by the biology subject teacher. The data analysis techniques used in this study include: 1).Descriptive Statistical Analysis, descriptive statistics were employed to determine scores obtained after the completion of the test and questionnaire. The statistical techniques used include frequency distribution, mean, median, mode, variance, standard deviation, range, minimum value, and maximum value, aided by SPSS version 25.0. 2).Analysis of Critical and Creative Thinking Skills Data, scoring for critical thinking ability was conducted using a rubric aligned with the test instrument grid based on the defined indicators, with a score range of 0 to 4. Meanwhile, scores for the creative thinking skill instrument were based on the Likert scale. 3). Analysis of Biology Learning Outcomes Data, students' biology learning outcomes were categorized into five levels: very high, high, medium, low, and very low. 4).Inferential Statistical Analysis, this analysis involved testing the correlation or relationship between variables to examine the research hypotheses.

Before conducting inferential statistical tests, a prerequisite analysis was performed to determine whether parametric or non-parametric tests should be used. a) Prerequisite Analysis Test. This test aims to determine the type of statistical analysis to be used. Parametric analysis can be applied if the data meet the necessary assumptions, namely normality and linearity. b) Normality Test. The normality of the data was tested using the Shapiro-Wilk test, as it is appropriate when the sample size is fewer than 50. c) Linearity Test. This test was conducted to determine whether the relationship between two variables is linearly significant. Linearity is indicated by the Sig. value of the deviation from linearity at a 5% significance level. d) Hypothesis Testing. Hypothesis testing was performed to determine whether there was a significant relationship between the independent variables—critical thinking ability (X1) and creative thinking skill (X2)—and the dependent variable, biology learning outcomes (Y). The correlation analysis used was the Pearson Product-Moment correlation test. The interpretation guideline for the correlation coefficient (r) values is presented in Table 1.

Table 1. Determination of Correlation Level

Coefficient Interval	Coefficient Interval
0,00 – 0,199	Very Weak
0,20 – 0,399	Weak
0,40 – 0,599	Moderate
0,60 – 0,799	Strong
0,80 - 1,000	Very Strong

Source: Jainuddin *(2016)*

To determine the simultaneous relationship among the three variables, multiple linear regression analysis was employed. Multiple regression is used to measure the strength and contribution of two independent variables (X1 and X2) on the dependent variable (Y) collectively. To assess the magnitude of the relationships among these variables, the multiple correlation test in SPSS version 25 was utilized to facilitate the

analysis process. The significance of the multiple regression model can be determined by comparing the calculated F-value (F_{hitung}) with the critical F-value (F_{tabel}), or by comparing the significance value (Sig.) with the predetermined alpha level (α). In this study, the researcher opted to compare the Sig. value to an alpha level of 0.05 to determine the significance of the regression model. The criteria for determining the significance of the regression model based on the SPSS output are as follows: If the Sig. FChange value is greater than or equal to α = 0.05 (0.05 ≤ Sig. FChange), the regression model is not significant. If the Sig. FChange value is less than or equal to α = 0.05 (0.05 ≥ Sig. FChange), the regression model is significant.

RESULT AND DISCUSSION

Result

1. Descriptive Analysis

a. Descriptive Analysis of Students' Critical Thinking Ability

The descriptive statistical analysis yielded the following measures for students' critical thinking ability: a mean score of 52.00, a standard deviation of 2.103, a median of 52.00, a mode of 52.00, a minimum score of 46.00, and a maximum score of 55.00.

Tabel 2. Frequency Distribution of Critical Thinking Ability

Score Interval	Score Interval	Score Interval	Score Interval
53 – 55	15	48,4%	Very High
51 – 52	10	32,3%	High
49 – 50	4	12,9%	Moderate
47 – 48	1	3,2%	Low
≤46	1	3,2%	Very Low
Jumlah Total	31	100%	

Source: Results of Critical Thinking Ability Test

From Table 2, it can be observed that: (1). 15 students (48.4%) demonstrated very high critical thinking ability, (2).10 students (32.3%) showed high ability, (3). 4 students (12.9%) displayed moderate ability, (4). 1 student (3.2%) showed low ability, and (5). 1 student (3.2%) demonstrated very low critical thinking ability.

Therefore, it can be concluded that the overall critical thinking ability of Grade XI students at UPT SMA Negeri 1 Wajo falls within the "High" category. The frequency histogram of critical thinking ability is shown in Figure 1.

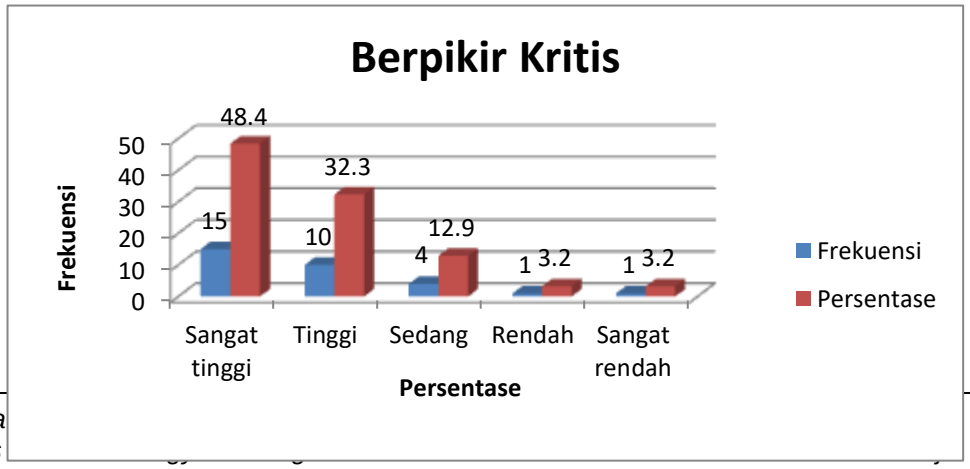

Figure 1. Histogram of Critical Thinking Ability

b. Descriptive Analysis of Students' Creative Thinking Skills

The descriptive statistical analysis for creative thinking skills yielded the following measures: a mean score of 114.451, a standard deviation of 3.364, a median of 114.00, a mode of 112.00, a minimum score of 109.00, and a maximum score of 122.00. The frequency distribution is presented in Table 3.

Table 3. Frequency Distribution of Creative Thinking Skills

Score Interval	Score Interval	Score Interval	Score Interval
119 – 122	4	12,9%	Very High
115 – 118	11	35,5%	High
115 – 114	13	41,9%	Moderate
112 – 114	2	6,5%	Low
≤ 109	2	6,5%	Very Low
Jumlah Total	31	100%	

Based on Table 3, it is evident that: (1). 4 students (12.9%) had very high creative thinking skills, (2). 11 students (35.5%) had high skills, (3). 13 students (41.9%) demonstrated moderate skills, (4). 2 students (6.5%) showed low skills, and (5). 2 students (6.5%) displayed very low skills.Thus, the overall creative thinking skills of Grade XI students at UPT SMA Negeri 1 Wajo can be categorized as "Moderate." The frequency histogram of creative thinking skills is presented in Figure 2.

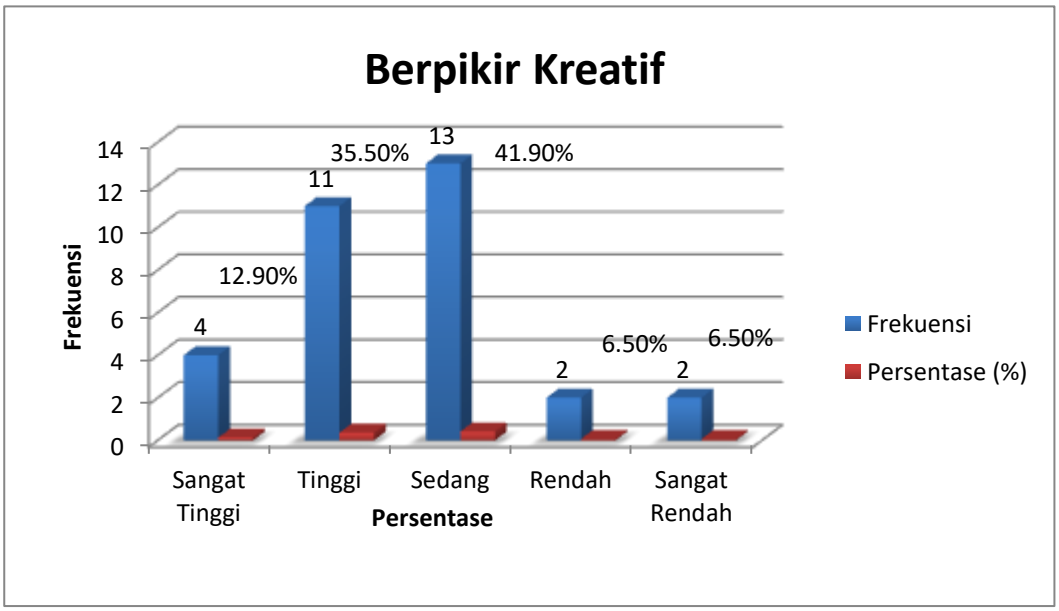

Figure 2. Histogram of Creative Thinking Skills

c. Descriptive Analysis of Biology Learning Outcomes

The descriptive statistical analysis for students' biology learning outcomes revealed the following: a mean score of 91.645, a standard deviation of 5.462, a

median of 93.00, a mode of 95.00, a minimum score of 77.00, and a maximum score of 98.00. The frequency distribution is shown in Table 4..

Tabel 4. Frequency Distribution of Biology Learning Outcomes (Grade XI, SMA Negeri 1 Wajo)

Score Range	Score Range	Score Range	Score Range
96 – 98	8	25.8%	Very High
93 – 95	8	25.8%	High
90 – 92	7	22.6%	Moderate
84 – 89	5	16.1%	Low
≤83	3	9.7%	Very Low
Jumlah Total	31	100%	

Source: Biology Learning Outcomes of Students at SMA Negeri 1 Wajo

Based on Table 4, most students achieved biology learning outcomes in the "High" and "Very High" categories, each with a percentage of 25.8% (8 students). Additionally, 22.6% of students showed "Moderate" outcomes (7 students), 16.1% were in the "Low" category (5 students), and 9.7% (3 students) fell in the "Very Low" category. This indicates that the majority of Grade XI students at UPT SMA Negeri 1 Wajo achieved high-level learning outcomes in biology. The frequency distribution histogram for biology learning outcomes is shown in Figure 3.

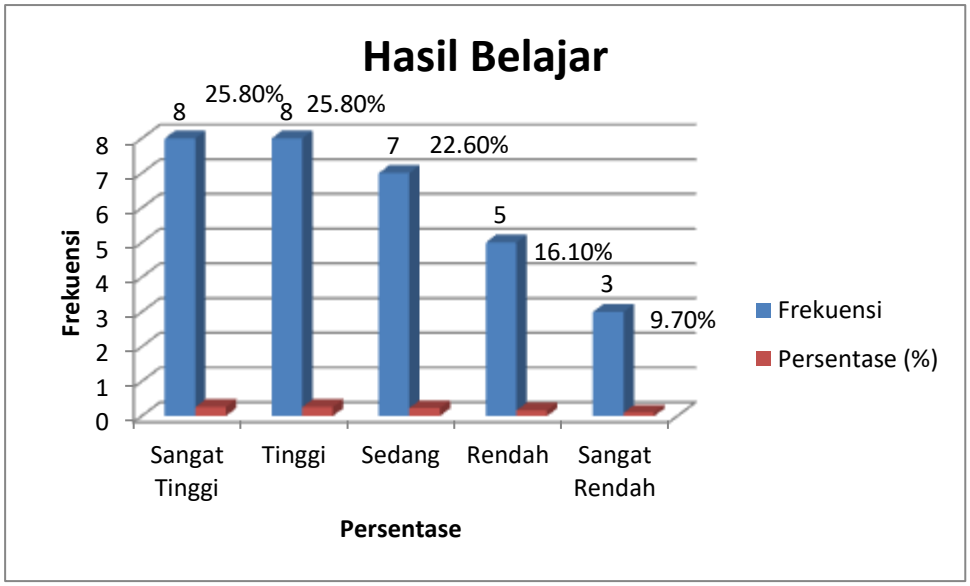

Figure 3. Histogram of Biology Learning Outcomes

2. Inferential Analysis

a. Normality test

(1) Normality Test for Critical Thinking Ability and Biology Learning Outcomes

Based on the significance value in Table 5, it can be concluded that the residual values are normally distributed, as indicated by a probability value of Sig. = 0.685, which is greater than 0.05. Therefore, the data meet the normality assumption.

Tabel 5. Normality Test for Critical Thinking Ability and biology Learning Outcomes

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig	Statistic	Df	Sig
KRITIS	.098	31	.200*	.976	31	.685
HASIL	.140	31	.126	.962	31	.336

(2) Normality Test for Creative Thinking Skills and Biology Learning Outcomes

Tabel 6. Normality Test for Creative Thinking Skills and Biology Learning Outcomes

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig	Statistic	Df	Sig
KREATIF	.108	31	.200*	.946	31	.124
HASIL	.140	31	.126	.962	31	.336

From Table 6, the significance value of 0.124 is greater than 0.05, indicating that the data are normally distributed.

b. Linearity Test

(1) Linearity Test between Critical Thinking Ability and Biology Learning Outcommes

Tabel 7. Linearity Test between Critical Thinking Ability and Biology Learning Outcomes

			Sum of Squares	df	Mean Square	F	Sig.
Hasil Belajar * Kritis	Between Groups	(Combined)	250.121	8	31.265	1.066	421
		Linearity	28.905	1	28.905	986	332
		Deviation from Linearity	221.215	7	31.602	1.078	410
		Within Groups	644.976	22	29.317		
		Total	895.097	30			

Based on Table 7, the Deviation from Linearity value is 0.410, which is greater than 0.05. Therefore, it can be concluded that there is a significant linear relationship between critical thinking ability and biology learning outcomes.

(2) Linearity Test between Creative Thinking Skills and Biology Learning Outcomes

As shown in Table 8, the Deviation from Linearity value is 0.708, which is

greater than 0.05. Thus, it can be concluded that there is a significant linear relationship between creative thinking skills and biology learning outcomes.

Tabel 8. Linearity Test between Creative Thinking Skills and Biology Learning Outcomes

			Sum of Squares	df	Mean Square	F	Sig.
Hasil Belajar * Kreatif	Between Groups	(Combined)	274.466	12	22.872	663	763
		Linearity	2.151	1	2.151	62	806
		Deviation from Linearity	272.315	11	24.756	718	. .708
		Within Groups	620.631	18	34.479		
		Total	895.097	30			

c. Hypothesis Testing

(1) Relationship between Critical Thinking Ability and Biology Learning Outcomes of Grade XI Students at SMA Negeri 1 Wajo

Tabel 9. Correlation between Critical Thinking Ability and Learning Outcomes

Correlations

		Critical Thinking	Learning Outcomes
Critical Thinking Critical Thinking	Pearson Correlation	1	972**
	Sig. (2-tailed)		0
	N	31	31
Learning Outcomes	Pearson Correlation	.972**	1
	Sig. (2-tailed)	0	
N		31	31

**. Correlation is significant at the 0.01 level (2-tailed).

As shown in Table 9, the significance value is 0.000, which is less than 0.05. This indicates a significant and strong correlation between critical thinking ability and biology learning outcomes of students at SMA Negeri 1 Wajo.

(2) Relationship between Creative Thinking Skills and Biology Learning Outcomes among Grade XI Students of SMA Negeri 1 Wajo

Tabel 10. Correlation between Creative Thinking Skills and Learning Outcomes

Correlations

		Creative Thinking	Learning Outcomes
Creative Thinking	Pearson Correlation	1	.716**
	Sig. (2-tailed)		0
	N	31	31

Learning Outcomes	Pearson Correlation	.716**	1
	Sig. (2-tailed)	0	
N		31	31

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10 shows a significance value of 0.000, which is less than 0.05. Thus, there is a significant relationship between creative thinking skills and biology learning outcomes among students at UPT SMA Negeri 1 Wajo, with a strong degree of correlation.

(3) Significance of the Relationship between Critical Thinking Ability and Creative Thinking Skills and Biology Learning Outcomes among Grade XI Students of SMA Negeri 1 Wajo

Tabel 11. F-Test Table

Model		Squares	Df	Mean Square	F	Sig.
1	Regression	414.856	2	207.428	17.327	.000b
	Residual	335.206	28	11.972		
	Total	750.062	30			

a. Dependent Variable: Y
b. Predictors: (Constant), X.2, X.1

Tabel 12. Relationship between Critical Thinking Ability, Creative Thinking Skills, and Learning Outcomes

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	Constant)	972.019	15.657		7.921	0
	X.1	782	191	838	4.097	0
	X.2	184	300	125	612	546

a. Dependent Variable: Y

The two tables above show a significance value of 0.000, which is less than 0.05, and indicate that the calculated F-value (17.327) is greater than the F-table value (7.921). Thus, there is a significant combined relationship between critical thinking ability and creative thinking skills and biology learning outcomes at UPT SMA Negeri 1 Wajo, with a strong degree of correlation.

Discussion

The results of this study show that there is a positive and significant correlation between critical thinking ability and creative thinking skills with biology learning outcomes among grade XI students at UPT SMA Negeri 1 Wajo. The relationship

between critical thinking ability and learning outcomes (r = 0.972) is stronger than the relationship between creative thinking skills and learning outcomes (r = 0.716).

This difference in correlation strength can be explained through constructivist learning theory, which emphasizes that learning occurs when learners actively construct knowledge through experience and reflection. In biology learning, critical thinking plays a vital role in analyzing concepts, identifying misconceptions, and drawing conclusions based on scientific evidence. This aligns with the cognitive domain of Bloom's Taxonomy, where critical thinking encompasses skills such as analysis, evaluation, and synthesis, which significantly influence students' cognitive learning outcomes.

Meanwhile, creative thinking skills are more associated with generating new ideas and innovative solutions to problems. However, their contribution to biology learning outcomes may be lower than that of critical thinking, partly due to the assessment system in schools that still prioritizes analytical and conceptual skills over innovation. These findings are consistent with studies by Safitri & Japa (2023) and Wahyuni (2023), which found that critical thinking has a stronger association with biology learning outcomes compared to creative thinking.

This study is limited by its small sample size (31 students) and research context confined to a single school. Hence, the findings cannot be generalized widely. Future research is recommended to expand the sample size and employ experimental approaches or apply teaching models based on Higher Order Thinking Skills (HOTS) to further understand the role of critical and creative thinking in improving biology learning outcomes.

In conclusion, there is a significant simultaneous relationship between critical thinking ability and creative thinking skills and biology learning outcomes among grade XI students at UPT SMA Negeri 1 Wajo.

CONCLUSION AND RECOMMENDATIONS

This study shows that both critical thinking ability and creative thinking skills have a significant and positive relationship with the biology learning outcomes of grade XI students at UPT SMA Negeri 1 Wajo. Critical thinking makes a stronger contribution to learning outcomes than creative thinking because it directly involves analytical, evaluative, and logical application of biological concepts. Therefore, enhancing both critical and creative thinking skills is essential for improving biology education quality in schools. Based on the findings, the following recommendations are proposed: 1). For Biology Teachers: The results can serve as a basis for developing HOTS-based instructional strategies that encourage students to practice critical and creative thinking through biological problem analysis or real-world problem-solving tasks. 2). For Schools: Support is needed in the form of training and facilities to implement active learning environments that focus on developing higher-order thinking skills. 3). For Future Researchers: It is recommended to extend the scope of this study to larger populations, employ experimental approaches, or

incorporate other variables such as learning motivation or thinking styles to gain deeper insights into the factors influencing biology learning outcomes.

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