

## CORRELATION IN BIOLOGICAL LITERACY AND CRITICAL THINKING SKILLS OF SCIENCE STUDENTS THROUGH PROBLEM-BASED LEARNING MODEL INTEGRATED BY MACROMEDIA FLASH

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**Abstract:** Biological literacy and critical thinking skills are two abilities students studying biology must possess. This study aimed to determine the correlation between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through the Problem-Based Learning model integrated by Macromedia Flash. The research method is correlational research. The sample in this research were students of class XI Science 1 and XI Science 3 at Senior High School I Aikmel. The data analysis used in this study is a simple linear regression analysis. The results showed a relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through the Problem-Based Learning model integrated by Macromedia Flash. The value of the correlation coefficient ( $r$ ) of biological literacy with critical thinking skills is 0.712 (high). The direct relationship between biological literacy and critical thinking skills is positive. The coefficient of determination ( $r^2$ ) is 50.8%. The regression line equation for the relationship between biological literacy and students' critical thinking skills in learning using the Problem-Based Learning model with Macromedia Flash is  $Y = 43.847 + 0.568X$ .

**Keywords:** *Biological Literacy, Critical Thinking, Problem-Based Learning, Macromedia Flash.*

### INTRODUCTION

Biology is the scientific field that studies life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy. Modern biology discusses knowledge that is very broad, eclectic and consists of various branches and sub-disciplines. Biology is a fundamental and applied discipline, which is developing rapidly and playing an important role in our understanding of life at every level [1].

Biology is a fundamental and applied scientific discipline that is developing rapidly and playing an important role in our understanding of life [2]. Therefore, in studying biology, students are expected to have various supporting abilities, including good biological literacy skills. Biological literacy is part of scientific literacy, conceptualized as a series that develops throughout life. As part of scientific literacy, biological literacy focuses primarily on the biological context.

Characteristics in biological literacy are used to strengthen the level of scientific literacy. The similarities between biological literacy and scientific literacy are the importance of thinking creatively, formulating questions about nature, reasoning logically and critically, evaluating information, using technology for appropriate application of biological sciences, making personal and ethical decisions related to issues related to biology, and apply biological knowledge to solve problems [1].

The dimension of biological literacy is seen as the same as scientific literacy (knowing and understanding the characteristics of scientific knowledge), the values of science, and the methods

and processes of scientific investigation, the nature of science. But in this regard, it is important to identify more specific aspects related to the identification of a biologically literate person, namely understanding of biological principles and key concepts of biology, human impact on the biosphere, the historical development of biological concepts, personal values about biological investigations, biodiversity and culture, the impact of biology and biotechnology on society, and the importance of biology to individuals [1]. In addition to good biological literacy skills, someone who studies biology must also have good critical thinking skills. Empowerment of critical thinking skills is one of the goals to be achieved by 21st-century education [3]. Critical thinking as part of higher-order thinking skills has been considered a planned educational achievement in 2050 [4].

Critical thinking is a mental discipline activity that evaluates arguments and makes judgments as part of giving the confidence to take certain actions [5]. Being critical doesn't just mean finding fault or expressing distaste for something. It means giving a fair and impartial opinion about something [6]. Critical thinking is "purposeful self-regulatory assessment, which results in interpretation, analysis, evaluation, and conclusions" [7].

Critical thinking is a thinking process that involves higher cognitive processes in information processing to produce new thoughts [8-9] through asking questions, reasoning, decision-making, and problem-solving [9-10]. The ability to think critically refers to a form of reflective thinking directed at analyzing and evaluating existing communications, information, and arguments, especially through logic

and reason [11]. Critical judgments must have some basis, which usually requires measuring the knowledge or expertise of the person making the assessment. There must be a basis for judgment before we can call it critical [6].

Critical thinking is a higher-order thinking skill with traits such as analyzing, evaluating, understanding, and thinking deeply, enabling individuals to make judgments about the world [12]. Critical and critical thinking are not the same thing. If critical thinking only means judging, anyone can do it just by giving an opinion. No special training or practice is required to provide a judgment. But serious critical judgment is much more than a statement of preference or taste [6].

Many studies have been conducted to examine the empowerment of biological literacy and critical thinking [9,13-14]. Empowerment of biological literacy and students' critical thinking skills in learning only sometimes appear in a short time. These skills can be raised through the application of learning models that have certain characteristics, one of which is constructivism. One of these learning models is problem-based learning. In this research, the problem-based learning model is carried out by integrating Macromedia Flash media in its syntax. So based on this description, this study aimed to determine the relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through a Problem-Based Learning model integrated by Macromedia Flash.

**RESEARCH METHODS**

This research uses correlational research methods. Correlational research is research that is used to describe the relationships that exist between variables [15-16]. The relationship between the variables examined in this study is a real illustration of the relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through the Problem-Based Learning model integrated by Macromedia Flash. The sample in this study were students of class XI Science 1 and XI Science 3 at Senior High School I Aikmel. Biological literacy was measured using an essay writing test and a biology literacy assessment rubric. Critical thinking skills are measured using

descriptive questions and assessed using a critical thinking skills assessment rubric. The data analysis used in this study is a simple linear regression analysis. Regression analysis is a statistical technique for investigating and modeling the relationships between variables [17]. Before being analyzed using regression analysis, the data were first analyzed with normal distribution and the linearity relationship pattern of the data as a classic assumption test for simple regression analysis. The normality test of data distribution was analyzed using the One-sample Kolmogorov-Smirnov analysis. The normality test uses the One-sample Kolmogorov-Smirnov test to determine how well the distribution of research data matches the normal curve if the number of samples is 50 or more [than 18], and a linearity test was carried out to determine the relationship pattern between biological literacy and critical thinking skills. One of the linearity tests that can be used is the One Way Anova Test [19].

**RESULT AND DISCUSSION**

The research results are explained in detail, starting from the results of the classic assumption test of research data, namely the normality and linearity of the data. The results of the data normality test can be seen in Table 1.

Table 1. Summary of Data Normality Test Results

Variable	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Biological literacy	.108	66	.055
Critical thinking	.069	66	.200*

Table 1 shows that the students' biological literacy data are normally distributed with a significance value of 0.055, greater than the predetermined significance level of 0.05. Data on students' critical thinking skills are normally distributed with a significance value of 0.200, greater than the predetermined significance level of 0.05. In addition to the normality test, a linearity test was also carried out on the research data. The results of the linearity test can be seen in Table 2.

Table 2. Summary of Data Linearity Test Results

			Sum of Squares	df	Mean Square	F	Sig.
Critical thinking * Biological literacy	Between Groups	(Combined)	3209.399	21	152.829	4.358	.000
		Linearity	2412.379	1	2412.379	68.789	.000
		Deviation from Linearity	797.020	20	39.851	1.136	.351
	Within Groups	1543.040	44	35.069			
	Total	4752.439	65				

Based on the results of the linearity test, it is known that the significance value of the linearity of the biological literacy data with the ability to think critically is  $0.00 < 0.05$ , so it can be concluded that the relationship pattern of biological literacy and critical thinking skills has a linear relationship. The pattern of linear relationships can also be seen from the significance value of Deviation from Linearity. If the significance value of the Deviation of Linearity  $>$  the level of significance, then the relationship pattern of the two variables is said to be linear. Based on the results of the analysis, it is known that the significance value of Deviation from Linearity is  $0.351 > 0.05$ , so it can be concluded that the relationship pattern of biological literacy and critical thinking skills has a linear relationship.

The next results explain the value of the regression coefficient, which can be seen in Table 3. Based on the results of the analysis in Table 3, it can be seen that the regression significance value is  $0.00 < 0.05$ , so  $H_0$  states that there is no relationship between biological literacy and critical thinking skills of class XI Science students in Senior High School I Aikmel Through Problem-based Learning model Integrated by Macromedia Flash was rejected and  $H_a$  who stated that there was a relationship between biological literacy and critical thinking skills of class XI Science at Senior High School I Aikmel in learning using the Problem-based Learning model with the help of Macromedia Flash, was accepted.

Table 3. Regression Coefficient Analysis Results.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	2412.38	1	2412.379	65.978	.000 <sup>b</sup>
Residual	2340.06	64	36.563		
Total	4752.44	65			

The significance value of this regression is also used to determine whether the regression line equation can be used for prediction, so based on the analysis results, it can also be concluded that the regression line equation can be used for prediction. The value of the correlation coefficient ( $r$ ), which explains the close relationship between biological literacy variables and critical thinking skills, and the coefficient of determination ( $r^2$ ), which explains the effect of the predictor variable on the response variable, can be seen in Table 4.

Table 4 shows that the value of the correlation coefficient ( $r$ ) of biological literacy with students' critical thinking skills in learning using the Problem-Based Learning model with Macromedia Flash is 0.712 (high) [38]. The direct relationship between biological literacy and critical

thinking skills is positive. The coefficient of determination ( $r^2$ ) is 0.508, so it can be explained that the variability of students' critical thinking skills is determined at 50.8% of students' biological literacy. The relationship pattern of biological literacy with students' critical thinking skills based on scatterplot analysis can be seen in Figure 1.

Table 4. Correlation Coefficient and Determination Coefficient Between Biological Literacy and Critical Thinking Skills

	R	R Squared	Eta	Eta Squared
Critical thinking * Biological literacy	.712	.508	.822	.675

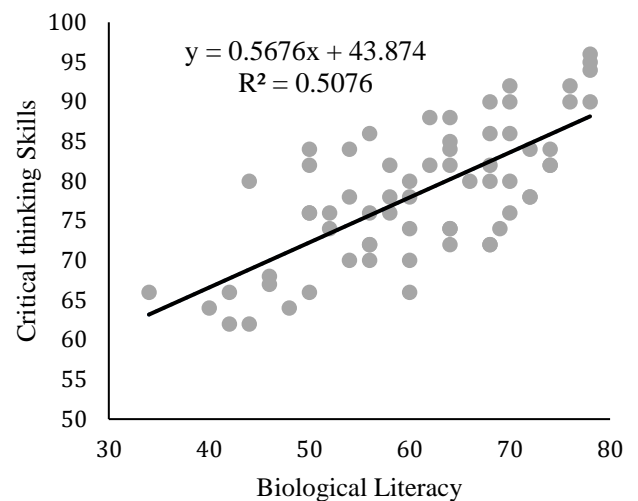


Figure 1. Relationship Between Biological Literacy and Critical Thinking Skills

Figure 1 shows that biological literacy and students' critical thinking skills form a positive, linear relationship. An overview of the regression line equation for the relationship between biological literacy and students' critical thinking skills can be seen in Table 5.

Table 5 indicates that the intersection of the regression line equation is 43.874. The slope value (slope of the line) is 0.568. This slope value means that every 1 increase in the biological literacy variable will increase the value of the critical thinking skills variable by 0.568. The regression line equation for the relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through Problem-Based Learning model integrated by Macromedia Flash is  $\hat{Y} = 43.847 + 0.568X$ .

Table 5. An overview of the regression line equation for the relationship between biological literacy and critical thinking skills.

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	43.874	4.324		10.147	.000
	Biological_literacy	.568	.070	.712	8.123	.000

Based on the results of data analysis, it is known that there is a significant relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through the Problem-Based Learning model integrated by Macromedia Flash with a correlation coefficient is 0.712 which means that the relationship between biological literacy and critical thinking skills is high.

Biological literacy skills are considered slow to form students' critical thinking skills because there is a stimulus to actively read and study biological phenomena to answer problems related to the phenomena encountered, so there is an increase in cognitive abilities and critical thinking skills.

Biological literacy is part of scientific literacy [1]. Scientific literacy itself has four indicators, namely nominal literacy, functional literacy, conceptual literacy, and multidimensional literacy [20]. Scientific literacy describes students' competencies to understand scientific knowledge, theories, and phenomena that aim to link science learning, in this case learning biology, with everyday life, including identifying various academic problems, explaining academic phenomena, and applying scientific evidence [21].

If it is related to students, then biological science literacy has meaning as the capacity of a student's ability to apply scientific knowledge, describe, illustrate, explain, identify, make decisions based on existing truths, predict biological phenomena that occur, and connect them to life that is real in social life [22]. Students gain knowledge to relate the material learned in class to the context of their lives. Students can also connect science and technology with practical and valuable school learning in life. One dimension of learning science is that learning science is intended to build a relationship between science and technology, and society [23].

The characteristics of people who understand science include: (1) having the ability to make more informed choices, (2) realizing that science and technology are often sources of solutions and sources of risk, (3) creating new problems that require science and technology to solve them, (4) consider the implications of applying scientific knowledge and issues for oneself or society in general, (5) explain phenomena scientifically, (6) evaluate and design

scientific investigations, and (7) interpret data and evidence scientifically [24-26]

Aspects of scientific literacy that are then adapted to biological literacy are 1) the role of biological science literacy, which includes identifying questions that can be answered through scientific investigations, understanding the nature of scientific activities, and understanding science concepts. The next aspect is thinking and doing, which includes explaining natural phenomena, recognizing patterns, identifying research variables, asking critical questions about research designs, and evaluating conclusions based on evidence. In science and society, there are several indicators, namely implementing scientific decisions in everyday life, understanding the role of biology in decision-making, developing questions to assess the validity of scientific reports, asking for sources of scientific reports, and identifying sources of scientific reports. Scientific reports, science content, especially biology, which underlies policy selection. The next aspect is mathematics in natural science which has indicators, namely the use of mathematics in science and understanding the application of mathematics in natural sciences. The last aspect is science motivation and scientific beliefs, which indicate certain scientific knowledge sources [27].

Scientific literacy, in this case, biological literacy, can directly affect students' cognitive abilities [28]. Cognitive ability is a construction of thinking processes, including remembering, solving problems, and making decisions [29]. Scientific literacy, in this case, biology, can influence students' cognitive abilities, including remembering, understanding, applying, analyzing, evaluating, and creating.

Critical thinking skills show the development of very important cognitive abilities [30] and must be developed because they are integrated with everyday life. Critical thinking skills are defined as a person's ability to describe and evaluate to improve everyday life problems and make the right decisions.

Aspects of students' critical thinking skills that are measured have seven indicators, namely answering questions, using predetermined procedures, identifying or formulating criteria to decide on possible answers, looking for similarities and differences, concluding and considering deduction results: interpreting statements, analyzing opinions,

looking for similarities and differences, identify opinions or assumptions [31].

As a supporter, literacy skills, in this case, biological literacy, are closely related to critical thinking skills. [32] argue that critical thinking skills are an important component of information literacy. Critical thinking skills and dispositions must guide every element of information literacy (finding, evaluating, and using information). Information literacy is a concrete skill, and critical thinking is abstract. Information literacy is content that requires students to think critically [5].

Scientific literacy emphasizes the importance of the ability to think [9] and act by involving mastery of thinking by recognizing and addressing several issues that are developing in society. Scientific literacy can develop in line with the development of reasoning abilities and academic thinking in social life so that mastery of basic biology concepts can be felt. Scientific literacy can develop in line with reasoning abilities and academic thinking in social life [33].

Critical thinking involves using focused self-regulatory assessment to help identify issues and associated assumptions: clarify and focus issues; analyze, understand, and make conclusions; inductive and deductive logic; and assess the validity and reliability of assumptions and available data [34].

Students' abilities in giving meaning, interpreting, translating, and expressing basic biology concepts are influenced by scientific literacy variables and critical thinking skills variables. Critical thinking includes skills in conceptualizing, applying, analyzing, synthesizing, and evaluating information collected from, or generated by observation, experience, reflection, reasoning, or communication as a guide for beliefs and actions, evaluating information to reach an answer or conclusion [34-35].

Critical reading activities are expected so students can find as much information about a material or concept being studied. Activities carried out in critical reading are understanding works by recognizing facts and interpreting what has been read, meaning: understanding main ideas, knowing important and detailed facts, being able to make conclusions and interpret ideas, distinguishing material presented as opinions or facts, comparing learning resources each other, as well as provide conclusions and reasons. The process facilitates students' development of critical thinking skills. Reading topics from various sources can improve thinking skills because it requires reasoning and evaluation in choosing the right information [36].

Someone who is trained to understand and be able to properly analyze certain news or read indirectly trains himself to think critically. When students can give reasons, look for similarities and differences, determine main ideas, and draw conclusions from a text, this can improve critical thinking skills [37].

Some aspects and indicators of critical thinking skills are 1) Interpretation which has indicators of understanding and expressing various kinds of experiences, situations, and so on, as well as indicators of recognizing actual and expected inference relationships. 2) Analysis with indicators recognizes and obtains the elements needed to conclude. 3) Conclusion. 4) Evaluation that has indicators assessing the credibility of a statement or other representation. 5) Explain which indicators have presented considerations in the form of solid opinions. 6) Self-regulation, which has indicators to monitor its knowledge [36].

## CONCLUSION

The results showed a relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through the Problem-Based Learning model integrated by Macromedia Flash. The value of the correlation coefficient ( $r$ ) of biological literacy with critical thinking skills is 0.712 (high). The direct relationship between biological literacy and thinking skills is positive. The coefficient of determination ( $r^2$ ) is 50.8%. The regression line equation for the relationship between biological literacy skills and critical thinking skills of class XI Science at Senior High School 1 Aikmel Through Problem-Based Learning model integrated by Macromedia Flash is  $\hat{Y} = 43.847 + 0.568X$ .

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