SCIENTIFIC ATTITUDE AND CRITICAL THINKING

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Abstract

This study was conducted to determine whether or not there is a relationship between the scientific attitude variable in biology learning and the student's critical thinking ability variable. The research was conducted by distributing research instruments made in questionnaires using google form, the data obtained were validated and reliability determination was then carried out again with correlation and linear regression tests to determine whether or not there was a relationship, significant or not, strong or not, research method it is quantitative. From the research conducted, based on the results of the study, it is known that there is a strong and significant relationship between the two variables.

Keywords: Scientific attitude, critical thinking skills

Abstrak

Penelitian ini dilakukan untuk mengetahui ada atau tidaknya hubungan antara variabel sikap ilmiah dalam pembelajaran biologi dengan variabel kemampuan berpikir kritis mahasiswa. Penelitian dilakukan dengan cara menyebarkan instrumen penelitian yang dibuat dalam bentuk kuesioner dengan menggunakan google form, data yang diperoleh divalidasi dan ditentukan reliabilitasnya kemudian dilakukan lagi dengan uji korelasi dan regresi linier untuk mengetahui ada tidaknya hubungan, signifikan atau tidak, kuat atau tidaknya hubungan, metode penelitiannya adalah kuantitatif. Dari penelitian yang dilakukan, berdasarkan hasil penelitian diketahui adanya hubungan yang kuat dan signifikan antara sikap ilmiah dalam pembelajaran biologi dengan kemampuan berpikir kritis siswa.

Kata kunci: Sikap ilmiah, keterampilan berpikir kritis

Introduction

Biology is natural science that requires proof and experiment and has special characteristic that distinguishes it to other from other sciences, but biology generally has a link to other natural sciences. Science, especially biology, is a study that includes facts and reasons why natural phenomena can occur, of course this is obtained through research that uses a scientific attitude. This is in line with what Ibrahim, et al (2019) states in his writing that science is used to ease some works in counting, engineering, recycling, based on the value of truth, scientific attitudes, curiosity, strong beliefs, diligence and sustainability to learn the secrets of the natural environment. It can be proven by other general sciences by repeated experiments with relevant principles and can be used to explain natural phenomenon or environment. The common principle of science includes the related terms between nature, human, technology, and related experiments at the level of need with time and circumstance.

Biology learning is an interaction that occurs between students and teacher in the class. It is expected to be able to apply the learning structure systematically from the simple step to the complex step, so that the applied learning structure can be evaluated, it is in the line with the research of Setiawan (2019). In embodying structured biology learning, there must be a competent and active teacher. As a biology education student who will become a future biology teacher is expected to apply learning that does not focus only on theory but also be able to make an experiment and evidence. In proving a theory, it needs scientific attitude. Susanto (2014) states that scientific attitude can seek for and develop new knowledge by using the right steps. So that the scientific attitude that a biology teacher possesses can impact on the learning and minimalize misconception between teacher and students.

Based on Permendikbud No. 104 year 2014 on learning, the students is demanded to evolve a potential to be a skill that gradually increases in attitudes (spiritual and social), knowledge, and skills needed for themselves to survive, live in society and nation, as well as contribute to the welfare in mankind in accordance with the demands of the 2013 curriculum, learners must be guided to be able to have a scientific attitude. The students' development must always be monitored even though they have been developing, moreover, those who haven't evolved must be guided more in order to trigger their curiosity and be eager to improve.

According to Susanto (2014), scientific attitude is an attitude that must be possessed by scholars in conducting research and communicating the results of research. It is essential to possess scientific perspective because with this way of thinking, the scholars are able to seek for and evolve new study with the right rules. This attitude must be developed in science learning. It is evolved by students' activity in learning science based on field discussion, trial, simulation and project activity.

According to Mukhopadhyay (2014), scientific attitude has three basic components: trust, feeling, and action. Based on those three components, the scientific method can be applied to foster active attitude, have critical, structured, independent, and logical thinking. For instance, while doing an observation using microscop, through the structural and clear observation steps, the students surely will search for the accurate theory so that the knowledge obtained will be more conceptualized and can be proven. Basically the scientific attitude itself is something that looks positive in scientific work carried out in accordance with actual scientific procedures. In addition, it related to the relationship between the spiritual and social nature of students involving character values that must be generated in biology learning.

According to Ulfah (2018), scientific attitude is an attitude where a person is able to accept other people's opinions, take action in solving problems with systematic scientific steps, not discouraged, and also consistent and transparent. Scientific attitudes contain two notions, namely attitudes about science and about scientific attitudes. The first setting relates to the attitude towards science and the other attitude relates to the innate attitude after learning science.

Scientific attitude aims to avoid the occurrence of negative attitudes among learners and their various responsibilities. In addition, scientific attitudes should outline how learners behave, react to problems, solve challenges and develop more while learning. Therefore, scientific attitudes have a strong positive influence on learners' learning outcomes. Scientific attitudes that must be developed in learning are not only that, curiosity but always prioritizing data/facts, critical thinking, an enthusiasm for discovering and creativity as well as cosmopolitanism and cooperation are also part of the scientific attitudes that must be developed in learning.

Kurniawan et al (2019) stated in their research that students' attitudes towards learning science are good, but indicators of students' attitudes towards science are still lacking because students still distance themselves from science. Kurniawan further suggested that the process of learning is creatively designed and adapted to the circumstances or characteristics. Toma, et al (2019) suggested increasing the positive attitude of students from the beginning of natural science in elementary school, researchers want to see an overview of the attitude of elementary school students' science knowledge.

Toharuddin, et al (2011) stated that scientific attitudes can be developed in learning science, such as curiosity, honesty, transparency, tolerance, caution, optimism, courage, and willingness to work cooperatively. So that in the research facilities, scientific attitude has indicators in the form of curiosity, discipline, responsibility, accuracy, cooperation, honesty, and care.

Thinking skills are indispensable skills to face the challenges of life that change every year. These acquisitions include critical thinking skills, creative thinking, and problem solving skills (Kalelioglu & Gulbahar, 2014). As an educator, teachers must be able to design competent learning to train learners' critical skills to find learning information independently and create an active structure of students' cognitive abilities (Patonah, 2014). Forming optimal critical thinking skills of students requires an effort to have an interactive class, students are seen as thinkers and not as teachers, and teachers act as facilitators, facilitators and motivators who help students learn not teach. The purpose of this research is to analyze learners' thinking. It is important to provide this to teachers, especially to biology education students who will become biology teachers in the future so that they can plan appropriate learning and improve students' critical thinking.

Poor critical thinking skills can be detrimental to continuing education. Therefore, critical thinking must be practiced. This is in accordance with the statement of Yuliati (2013) that critical thinking can be taught and requires practice. It is considered a very basic skill that is important to manage. According to Simbolon et al. (2017), critical thinking is the process of finding, analyzing, synthesizing, and conceptualizing information to develop thinking, improve and enhance creativity. Low critical thinking skills are caused by several factors such as: students memorize materials and formulas rather than understand concepts. According to the research conducted by Siantur et al (2018), it has been clarified that students' lack of responsibility and tendency to memorize concepts rather than understand concepts weaken learners' critical thinking. Most learners do not play an active role in the learning process which is indicated by the small number of learners who actively ask questions and to engage in debates. This shows that learners only focus on the teacher without analyzing, criticizing or evaluating what the teacher teaches. Critical thinking skill is essential to be taught to students because it allows students to analyze their thinking when making decisions and drawing intelligent conclusions.

Critical thinking has a purpose, which is to build the strength of learners' minds in order to have a trait or personality that remains inherent in their lives, learners can solve all their life problems. It is crucial for learners, as this skill allows students to act rationally and choose the best option for themselves. Students with critical thinking skills are always needed for every problem to make the best choice for them. Likewise, if students whose critical thinking skills are reflected in their character and personality are implemented in all areas of life. It means that empowering students' critical thinking is very urgent to be integrated with learning methods that are proven to empower students' critical thinking (Juhji et al., 2018).

According to Suriasumantri in Juhji, et al (2018), there are six levels of thinking, namely: 1) Knowing is a thinking process based on retention (storage) and retrieval of any

information heard or read; 2) Understanding is a more complex thinking process and has a deep quality of translating, interpreting, extrapolating, and combining; 3) Applying is the ability to apply knowledge, fact and theory to draw conclusions, evaluate or solve problems; 4) Analyzing or thinking in different ways, namely the ability to describe a concept or principle in its parts or components; 5) Synthesis is the ability to generalize or abstraction of various facts, information, phenomena, etc.; 6) Appraisal or thinking in a different way; 6) Assessment or also called intellectual judgment, which is broad knowledge and understanding and the ability to know things thoroughly, analyze and synthesize to make judgments or evaluations.

From those statements, it can be concluded that critical thinking involves in deepening awareness and intelligence to compare several problems so that there will be conclusion and opinion to solve problems. Every person has different ways of thinking. However, when they know how to think critically, those problems will be more simple and easier to solve. Therefore, people are given mind and the notion to keep thinking of how they can fix and live their life. Considering that scientific attitude and critical thinking are necessary, so this reseach aims to know the relationship between scientific attitude and critical thinking that are significant to students of biology education that soon will be biology teachers.

Research Method

This research applied quantitative research aiming to explain and examine the relationship between students' scientific attitude and critical thinking. This study involved all biology education students from the even semester of 2022/2023, the sample consisted of 100 biology education students of UINSU. The sampling technique used in this research was purposive sampling which is a sampling technique that is not based on levels (strata), random sampling or areas, but sampling techniques based on specific objectives, the focus of this research is biology learning, students as prospective biology teachers, scientific attitudes and critical thinking. Data analysis began with the validity and reliability of scientific attitudes and critical thinking questionnaires which were then continued with correlation tests and linear regression tests. Data presentation was analyzed using Microsoft Excel 2010, with data obtained through questionnaire results distributed using google form.

Result and Discussion

Result

The result of the first questionnaire contained the scientific attitude in biology learning and the second questionnaire was about students' critical thinkin skill in which before the questionnaire was made using google form and every research instrument was tested for validity and reability thus the coefficient r (0.60) was obtained, so it can be seen that the two questionnaires are valid and reliable presented in tabular and descriptive form. Bellow is the questionnaire of validity and reability test in table 1.

Table 1. Questionnaire Validity and Reability Test Results

Drawing Conclusion		Conclusion
Cronbach Alpha	**Coefficient r**	
1,394623493	0,60	**Reliable**

From the results of the table listed above, it can be seen that the reliability value of the first and second questionnaires (research instruments) is equally reliable because of the requirements, which if the alpha coefficient > rtabel with a significance level of 5%, then the research instrument or research data becomes reliable. After knowing the validity and reliability of the questionnaire, then proceed to look for the results of the correlation test between scientific attitudes and critical thinking of students can be seen in table 2, where it is known that the independent variable (scientific attitude) affects the critical thinking ability of students (variable Y).

Table 2. Correlation Test Result

a = scientific attitude	**53,27863**	
b = critical thinking	**-0,02231**	**Y = 53,278+(-0,02231)X**

From table 2, the results of the correlation test between the two questionnaires (a) amounted to 53.27863 and questionnaire (b) amounted to -0.02231, from the correlation value between questionnaire (a) and questionnaire (b), it is easier to determine the relationship between scientific attitudes and critical thinking by summing the values of questionnaire (a) and questionnaire (b) so that the results of the correlation test between scientific attitudes and critical thinking are obtained so that the regression equation Y = 53.278 + (-0.02231)X. After conducting a correlation test, followed by a linear regression test which aims to determine the relationship between scientific attitudes and critical thinking of students in table 3.

Table 3. Linear Regression Test Result

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,676112
R Square	0,457127
Adjusted R Square	0,415367
Standard Error	5,952204
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	387,8264	387,8264	10,94666	0,005653687
Residual	13	460,5736	35,42874		
Total	14	848,4			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	12,6922	11,14081	1,139252	0,275156	-11,3760675	36,8	-11,4	36,76
X	0,591379	0,178741	3,308574	0,005654	0,205231818	0,98	0,21	0,9775

From the table of statistical regression test above, it can be seen that the value of rcount is greater than rtable so that H0 is rejected and H1 is accepted. Based on the linear regression test, the correlation value can be analyzed which can be seen based on the multiple R value, with a value of 0.676112, so it can be known that the correlation value

between scientific attitudes and students' critical thinking skills is 0.676112. In this case, the resulting value is included in the strong category in accordance with the correlation coefficient interval. So it can be concluded that between scientific attitudes in learning biology there is a very strong relationship with students' critical thinking skills.

The coefficient of determination is obtained in the Adjusted R Squere, so that the coefficient of determination is 0.415 or if converted into percent form it becomes 41.5%, so that the level of relationship between scientific attitudes and students' critical thinking skills is 41.5%. Based on Anova output, it shows a significance value of 0.005, compared to the 5% significance level (0.05), it can be seen that there is a significant relationship between scientific attitudes and students' critical thinking skills.

Discussion

Biology education students are future biology teachers, as prospective biology teachers must be able to apply learning that does not focus on theory alone but needs to do experiment and proof. In proving a theory, a scientific attitude is needed. Susanto (2014) states that a scientific attitude can seek and develop new knowledge using the right stages. So that the scientific attitude of a biology teacher has an impact on learning and can minimize misconceptions between teachers and students. In general, scientific attitude itself is something that looks positive in scientific work carried out in accordance with actual scientific procedures. In addition, scientific attitudes are related to the relationship between the spiritual and social nature of students involving character values that must be generated in biology learning.

According to Patonah (2014), as an educator, teachers must be able to design learning that is competent in training students' critical skills to find learning information independently and create an active structure of students' cognitive abilities. Critical thinking is a process of finding, analyzing, synthesizing, and conceptualizing information to develop thinking, improve and enhance creativity. Low critical thinking skills are caused by several factors such as: students memorizing materials and formulas rather than understanding concepts. Establishing optimal critical thinking skills of students requires an interactive classroom effort, students are seen as thinkers and not as teachers, and teachers act as facilitators and motivators who help students learn not teach, this needs to be understood by teachers, especially biology education students who will become biology teachers in the future so that they can plan appropriate learning and improve students' critical thinking. Based on the importance of scientific attitudes and critical thinking in studying biology, this study was conducted to determine how strong the relationship between scientific attitudes and critical thinking skills in biology pre-service students.

The validity and reliability of the instrument are not solely determined by the instrument itself. According to Sugiyono (2014), the factors that affect the validity and reliability of a measuring instrument are the user of the measuring instrument who takes the measurement and the subject being measured. Although an instrument has been standardized and reliable, it does not immediately make the instrument usable anywhere, anytime, to any subject. Therefore, the instrument needs to be retested before it is used. According to Yusup, P (2018), the validity of the instrument can be proven by several evidences. These evidences include content, also known as content validity or content validity, construct, also known as construct validity, and criterion, also known as criterion validity.

Based on the results of data analysis, in the validity and reliability test of the scientific attitude questionnaire and critical thinking of students, it is known that the reliability value of the first and second questionnaires (research instruments) is equally reliable because of the fulfillment of the requirements, which if the alpha coefficient> rtabel

with a significance level of 5%, then the research instrument or research data becomes reliable. Through these results, each statement is used as a benchmark for further research. Then the research instrument in the form of a questionnaire that has passed the validation and reliability stages will be discarded with a maximum of 7 invalid instruments which will then proceed to the correlation and linear regression stages. The purpose of the correlation test is to determine whether or not there is a relationship between the first variable and the second variable. By doing the correlation test, the regression coefficient Y = 53.278 + (-0.02231) X is obtained from the sum of the values of the x variable and the y variable. After the correlation test, the research continued with linear regression testing, so that the rcount value was greater than the rtable so that H0 was rejected and H1 was accepted, because the regression test obtained a multiple R value (correlation value) of 0.676112, which when adjusted to the correlation coefficient interval table indicates a strong relationship. So based on the linear regression test, it is known that between scientific attitudes and students' critical thinking skills have a strong relationship.

The coefficient of determination is obtained through linear regression, which is found in the Adjusted R Squere. From the Adjusted R Squere table, the coefficient of determination is 0.415. Through the anova output, it can be seen that the significance value is obtained at 0.005653687, which if converted into percent form becomes 0.05%, which when adjusted to the 5% significance level, it is known that the anova value is smaller than the significance level, so it is known that the relationship between scientific attitudes and students' critical thinking skills has a significant relationship.

Conclusion

Based on the result and discussion about the relationship between the students' scientific attitude and critical thinking, it can be concluded that there is a strong relationship between scientific attitudes and critical thinking of students obtained from linear regression tests with a multiple R value of 0.676112 with a significance level of 5% (0.5) obtained through anova test so that the result is 0.05% after being converted, then from the anova value it is known that the relationship between scientific attitudes and critical thinking skills of students is significant. From these results, as biology department students who will become prospective teachers in the future must be able to develop scientific attitudes and critical thinking skills, thus there will be interactive and active environtment between students.

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