Available online at: http://ijer.ftk.uinjambi.ac.id/index.php/ijer
IJER (Special Edition)
The 3rd International Conference on Education (Icon 2023)
Vol.8 No.3 (119-125)

Profile Analysis of Students' Critical Thinking Skills in Integrated Biology Learning

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Abstract

Critical thinking is the ability to think reasonedly and reflectively. It emphasizes making decisions about what to believe or do. So, students must have the ability to be able to compete in the industrial revolution 5.0 era. This research aims to describe students' critical thinking skills in integrated biology learning on biodiversity material. This research is exploratory research with a qualitative and quantitative descriptive approach. The objects in this research were 109 students of class X MAS Raudlatul Ulum for the academic year 2023/2024. Data collection was carried out using test methods (multiple choice and essay), observation, and interviews. The test questions are arranged according to indicators of critical thinking skills namely; interpretation, analysis, evaluation, and inference. The result shows that students' critical thinking skills are not good category. The results of observations and interviews show that students are not yet able to analyze questions independently, process and conclude the various information they obtain, and they do not yet have the confidence to express the opinions or thoughts they have. The varied abilities of students also influence the research findings, because the research subjects are new students from various junior high schools who have diverse educational backgrounds and educational systems. Based on the result, teachers should train and familiarize students with being able to think critically through various effective and efficient learning processes.

Keywords*: Analysis, Critical Thinking Skill, Biology Learning*

1. Introduction

World developments require youth to be able to think critically about various existing changes. It is because not all changes that occur will have a positive impact on life. For example, in the current industrial revolution 5.0 era. It is a concept related to the latest technological developments to support the creation of digitalization and automation systems carried out by human resources. In response, 21st-century skills are something that students must have. These skills include: (1) critical thinking and problem-solving skills, (2) communication skills, (3) creativity and innovation, and (4) collaboration (Kamal et al., 2020).

Education is an effort that aims to form educated people who are independent and can think effectively. Students should be educated and motivated to be sensitive and understand various things critically (Atabaki et al., 2015). However, the facts show that teachers in Indonesia tend to focus on transferring information by giving a limited portion to developing critical thinking skills. It is proven by the results of the 2018 Program for International Student Assessment (PISA) for Indonesia which showed that Indonesia was ranked 72nd out of 78 participating countries (Rahardhian, 2022).

The fact shows that critical thinking in biology learning is low and needs to be increased. Students' low levels of critical thinking are caused by the fact that the learning process is still dominated by rote memorization. It has an impact on learning outcomes (Hamdani et al., 2019). Low learning outcomes indicate that students' critical thinking abilities are still low (Kurniahtunnisa et al., 2016). The results of research conducted by Sudarmini et al. (2015) shows that at senior high school, the learning activities only emphasized cognitive aspects in the form of rote memorization. Hayes & Devitt (2008) also say that critical thinking is not developed or widely practiced during the educational process.

According to Ennis (1993), critical thinking is thinking that makes sense and focused reflection to decide what should be believed or done. Critical thinking skill is a person's ability to jump out of ordinary thinking patterns (Smetanová et al., 2015). According to

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Wakhidah (2018), critical thinking skills are the initial foundation for encouraging high-level thinking abilities and must be possessed by every student (Rustam et al., 2017 and Herliandry et al., 2018).

The concept of critical thinking is complex and includes complex mental and complex activities. The critical thinking process is a process that is not easy to describe (Vacek, 2009). Even though critical thinking is something complex, that doesn't mean it can't be developed. Critical thinking can be developed through its application in learning (Kealey, Holland, & Watson, 2005). Lipman (2003) argues that critical thinking is related to cognitive growth and intellectual responsibility. And the significant part of critical thinking is evaluation skills. Rahardhian (2022) said that interest and trend factors have an important role in critical thinking.

There are various indicators of critical thinking skills that have been explained by experts. Ennis (1993)states that the characteristics of critical thinking abilities consist of; 1) judge the credibility of sources; 2) identify conclusions, reasons, & assumptions; 3) judge the quality of argument; 4) develop & defend a position on an issue; 5) ask appropriate clarifying questions; 6) plan experiments and judge experimental designs; 7) define terms in a way appropriate for the context; 8) be open-minded; 9) try to be well informed; and 10) draw conclusions. According to Silaban et al. (2022), indicators of critical thinking ability include: analyzing problems, focusing on problems, searching for information, communicating or presenting problems, giving opinions, respecting different opinions, providing alternative solutions, and choosing the right solution. Meanwhile, Fitriyah (2020) concluded that there are four indicators of critical thinking abilities, namely interpretation, analysis, evaluation and inference.

There are many research has been carried out in developing critical thinking skills in students (Chukwuyenum, 2011). Critical thinking skills can help students think independently and solve problems at school, society, and also environment (Jacob, 2012). One effort that can be made to improve students' critical thinking skills is by carrying out learning activities that encourage students to learn actively both mentally, physically and socially (Pujiasih, 2018). Dahana (2018) explains that developing students' critical thinking skills starts from interactions in the learning process. It is because the teacher must provide opportunities for students to enter into the interaction of the learning process. The interactions that occur in the teaching and learning process make it an important point in teaching and learning activities because not only students get the benefits, but also teachers get feedback on whether the material presented is well received or vice versa. It allows teachers to see the extent of students' abilities in absorbing the material that has been given during the teaching and learning process.

The impression of "rote learning" is one of the challenges faced by teachers in implementing the biology learning process in the classroom. It can cause low student motivation to learn and increase student boredom in participating in classroom learning. So teachers must be creative in designing and presenting effective learning materials so that the objectives of implementing learning can be realized optimally, both in terms of increasing student knowledge and student skills. According to Damayanti et al. (2020), the emergence of student boredom can be caused by several things, including: inappropriate learning methods, less interesting learning media, imaging learning material as memorized objects, and so on. Akruifu (2018) explains that a biology teacher needs to motivate his students to enjoy studying biology, provide reinforcement and show that good biology learning is not done by rote memorization.

Integrated learning approaches have been developed to improve the quality of learning implementation, for example: STS (Science, Technology, and Society), SETS (Science, Environment, Technology, and Society), STEM (Science, Technology, Engineering, and Mathematics), STEAM (Science, Technology, Engineering, Art, and Mathematics), and so on. According to Yulistiana (2015), implementing SETS can improve learning outcomes, increase process skills and activeness in the learning process. Apart from that, the SETS approach also has a positive impact on students' written communication skills (Fatchan & Soekamto, 2018), students' scientific literacy (Trihastuti et al., 2017), students' curiosity and interest in learning process (Resni, 2013).

Integrated learning can help create a cognitive structure that can bridge the initial knowledge of students with related learning experiences so that students' understanding becomes organized and deep, and can make it easier for students to understand the relationship of material from one context to another (Depdiknas, 2007). Through integrated learning, students can gain real learning experiences (Herwina & Madjid, 2018).

According to Kasi (2022), in the active participation learning, students are invited to think critically and analyze information. They are stimulated to formulate arguments, solve problems, and make good decisions. It helps develop critical thinking skills that are important for students' daily lives and future. Active participation engages students in group work, discussions, and social

interactions. It allows them to learn to work together, respect other people's opinions, build effective communication, and develop social skills that are important in society. In learning that involves active participation, students are encouraged to take responsibility for their own learning. They are given opportunities to solve problems, find resources, and manage their time. It helps foster independence and problem-solving skills that are essential in students' lives (Surayya, et al., 2014).

Based on the description above, it is hoped that the implementation of an integrated biology learning design can be an effective solution for determining students' critical thinking skills and describing its profile. It was done as an effort to identify and analyze indicators of critical thinking skills so that in the future they can design an appropriate and effective learning method to improve students' critical thinking skills.

2. Method

This research is exploratory research with a quantitative and qualitative descriptive approach. The objects in this research were 109 students of three classes X MAS Raudlatul Ulum for the academic year 2023/2024. Data collection was carried out using test methods (multiple choice and essay), observation, and interviews. The test questions are arranged according to indicators of critical thinking skills namely; interpretation, analysis, evaluation, and inference. The test method is carried out at the beginning and end of the biology learning process (pre-test and post-test). It was done to determine the level of students' thinking skills in the integrated biology learning process (Science, Religion, Environment, Technology, and Society/ SRETS). Data analysis is based on indicators of critical thinking skills using the formula:

$$\text{Score} = \frac{\text{Total score obtained}}{\text{maximum scores}} \times 100$$

The resulting scores are converted into categories according to the Table 1.

Table 1. Critical Thinking Skills Categories

Score	Category
81-100	Very good
61-80	Good
41-60	Good enough
21-40	Not good
0-20	Not very good

(Arikunto, 2013)

Analysis of pre-test and post-test scores also was carried out using N-Gain.

$$\text{N-Gain Formula} = \frac{\text{posttest scores} - \text{pretest scores}}{\text{maximum scores} - \text{pretest scores}}$$

Then N-Gain value is described qualitatively based on the following criteria.

Table 2. N-Gain Interpretation Categories

N-Gain Value	Category
G > 0.7	High
0.3 < G < 0.7	Medium
G < 0.3	Low

Students in each category were then analyzed further to find out a description of their thinking skills using observation and interview techniques.

3. Results and Discussion

Based on the results of the quantitative analysis, it is known that students have critical thinking skills in the low category. Meanwhile, the indicators of students' critical thinking skills, from highest to lowest percentage in sequence, are: interpretation, analysis, evaluation and interference. The results of observations and interviews show that the findings are influenced by external and internal factors. The details of the analysis results can be seen in the following tables.

Table 3. Students' Critical Thinking Skills Categories

Category	Frequency	Percentage
Very good	7	6,42
Good	13	11,93
Good enough	49	44,95
Not good	22	20,18
Not very good	18	16,51

Table 4. Students' Critical Thinking Skills Indicators

Indicator	Percentage
Interpretation	37.72
Analysis	24.77
Evaluation	16.94
Interference	20.57

Table 5. N-Gain Analysis

Indicator	N-Gain	Criteria
Interpretation	0.71	High
Analysis	0.68	Medium
Evaluation	0.69	Medium
Interference	0.63	Medium

Data collection begins at the beginning of the learning process, by giving pre-test questions to students. Then the teacher carries out a biology learning process on biodiversity material using the Problem Based Learning model through an integrated approach.

Integrated biology learning activities were carried out in four meetings. The choice of the integrated biology approach (Science, Religion, Environment, Technology, and Society/ SRETS) was based on several things, including: the place where the research was carried out was a madrasah where students learn a lot of religious knowledge, the realm of technology had not been explored much in madrasah education, by connecting various disciplines students become more challenged and motivated, and can improve students' critical thinking abilities.

At the last meeting, students were given post test questions to determine the level of students' critical thinking abilities. The questions are designed to measure students' critical thinking abilities using four indicators, namely: interpretation, analysis, evaluation and inference. The obtained scores were then analyzed to determine the category of students' critical thinking ability level and the percentage of each indicator of students' critical thinking skills. Then, student sampling was carried out in each category to find further information regarding students' critical thinking skills.

Based on the results of the analysis, it is known that students have critical thinking skills in the low category. The findings were influenced by various things, both internal and external factors. Internal factors that influence students' thinking skills, include: 1) students have not been able to understand the meaning of the graph given (as a question stimulus), 2) students have not been able to conclude the question stimulus in the form of text or narrative correctly, 3) students have not been able to understand the meaning or essence of the question independently, 4) students have not been able to connect the information, and 5) students do not yet have the confidence to express their opinions and thoughts. According to Melyana & Pujiastuti (2020), students' self-confidence influences their critical thinking skills. Leonard & Amanah (2014) explains that students with high self-confidence can be optimistic in solving the problems they face.

In response, teachers should be able to design a learning process and develop evaluation instruments that can not only develop students' knowledge, but also increase their thinking abilities. According to Dewi & Ichsan (2018), providing various forms of stimulus in preparing questions is useful for stimulating students' critical skills. Research by Masru'ah et al. (2021) shows that the obstacles faced by teachers in preparing question instruments to develop students' thinking skills, include: the teacher's own literacy abilities, lack of references, limited time, not being able to prepare question stimuli well, and lack of guidance and supervision.

It is hoped that this can be done by the entire teacher council consistently and continuously because this action will increase student enthusiasm and accustom students to think critically. According to Prayogi et al. (2017), critical thinking skills need to be trained consistently so that students' critical thinking skills will improve. Aizikovitsh-Udi & Cheng (2015) explained that if teachers consistently and systematically encourage critical thinking in the classroom by applying lesson material to real life problems, encouraging discussions and planning investigations in the learning process, they can develop students' critical thinking skills.

According to Anggraeni (2009), in the learning process, teachers tend to focus on mastering material concepts and teachers are less trained in designing effective learning designs. Meanwhile, research by Ramdiah et al. (2019) shows that teachers have designed learning well, but it is not done continuously and ignores the development of students' thinking abilities. The same thing was also found in this research. The results of observations and interviews show that the learning design commonly used by teachers in madrasas is teacher based learning. This has an impact on students' thinking abilities which are less developed.

The perception of "difficult questions" when the questions are accompanied by various stimuli also becomes an obstacle to students' critical thinking skills. It makes students feel confused in solving questions, or even makes students lazy to understand the questions well. So, the teacher must provide correct understanding and examples regarding the concept of a good question. Fanani (2018) explains that the use of contextual and interesting stimuli is the basis for creating questions to measure students' thinking skills, so teacher creativity is really needed.

The tendency of students to like memorization model questions also influences students' critical thinking abilities. Facts show that students feel "strange" towards the design of the questions given by the teacher. Some of them admitted that this was the first time they had worked on questions with various stimulus designs. Students said that at the previous grade level (junior high school), the teachers always gave types of questions that were easy to answer and the contents of the answers were always in the book. In conclusion, students are accustomed to learning by rote. So when they are given questions with a design (language or images) that is different from the book, they are less able to understand them well, even though the essence of the questions has been discussed and stated in the book. It was proven during the question discussion activity, when the teacher explained the contents of the questions

using the language style or plot in the book, the students were able to answer the questions correctly.

Memorization is the ability to remember data stored in human memory (Nggermanto, 2005). According to Aliyah (2021), active repetition of material will strengthen the brain's ability to remember and use it as material for thinking. However, repeating simply to memorize without appreciating the meaning can actually dull the power of critical and creative skills of students.

As for the results of the analysis of students' critical thinking incicators, the evaluation have the smallest percentage value, namely 11.10%, while the interpretation indicators have the highest percentage, namely 24.72%. Evaluation is the ability to use the right strategy to solve problems completely and correctly (Fitriyah, 2020) as well as the ability to formulate hypotheses and plan or create something (Ramos, et al., 2018). In Bloom's taxonomy, the ability to evaluate is one of the levels of high-level thinking abilities. Krathwohl (2002) explains that the ability to evaluate is the ability to judge something according to predetermined criteria or standards.

Nurhayati & Angraeni (2017) argue that the ability to evaluate begins with the planning process, implementing the plan, understanding the content of the question, and giving correct reasons. Based on this description, literacy is one of the skills that students must have in order to improve their critical thinking abilities. When connected to the data obtained, students tend to have low literacy skills, which also impact to their critical thinking abilities. It can be observed when students cannot understand the stimulus presented in the question correctly independently. It is in accordance with the research results of Masru'ah et al. (2022) that literacy skills greatly influence students' thinking skills.

Interpretation is the student's ability to understand the problems presented by inventorying them verbaly or written (Fitriyah, 2020). Maslakhatunni'mah (2019) explains that interpretation is understanding and expressing the meaning of experiences, situations, etc. The aspect of interpretation is related to students' ability to understand and express the meaning of various experiences of data, events, decisions and procedures. A high score on the interpretation indicator can be seen when students are able to solve questions using simple stimuli correctly. Indicators of being able to interpret are also visible during reflection activities at the end of the lesson. Students are able to write down what they have understood or not from the learning process. Students' interpretation abilities can also be observed from students' ability to record various new things they discover during the learning process. According to Rustaman (2015)), the ability to record observation results (collecting relevant facts or data and writing them in tables completely and precisely) is an indicator of interpretation ability.

4. Conclusion

Students' critical thinking abilities are in the low category. It is influenced by several factors, including: students' ability to process and relate the information or knowledge they have, students' habits of using rote methods in studying biology, and so on. Based on the findings above, it is hoped that teachers can design learning that not only aims to increase students' knowledge, but also develop students' thinking abilities. Moreover, this can be done continuously and consistently.

5. Acknowledgement

We would like to thank all parties who have helped in carrying out this research, especially the school principal who has given permission and support for the success of this project.

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