BIO-INOVED
Jurnal Biologi-Inovasi Pendidikan
Volume 4, Issue 3, October 2022 page. 328-334

P-ISSN : 2684-9062 | E-ISSN : 2714-9803
https://ppjp.ulm.ac.id/journal/index.php/bino
DOI: 10.20527/bino.v4i3.14148

Integrated science teaching materials with local wisdom insights to improve students' critical thinking ability

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Article Information

Keyword:
Critical thinking skills; Local culture; Science learning; Industrial revolution 4.0

Kata Kunci:
Kemampuan berpikir kritis; Kearifan lokal; Pembelajaran IPA; Revolusi industri 4.0

History:
Received : 11/08/2022
Accepted : 21/10/2022

Abstract

Critical thinking in science learning emphasizes students' knowledge and understanding of scientific concepts and processes needed to make decisions in real conditions. Students who have the ability to think critically are expected to be able to face problems and make decisions intelligently and based on information to live a better life. This study aims to improve students' critical thinking skills by developing teaching materials based on local wisdom. The results showed that the learning carried out significantly affected the level of critical thinking of students, both viewed as a whole (z=-4.731; p-value=0.000<0.05) or based on three aspects of critical thinking separately (p-value=0.000<0.05). The results of this study recommend that the use of teaching materials with local wisdom in science learning materials, especially materials that make up the ecosystem, must be optimized, both at the school and university levels.

Abstrak

Berpikir kritis dalam pembelajaran sains menekankan pada pengetahuan dan pemahaman mahasiswa terhadap konsep-konsep ilmiah dan proses yang diperlukan untuk mengambil keputusan dalam kondisi nyata. Mahasiswa yang memiliki kemampuan berpikir kritis diharapkan mampu menghadapi masalah serta mengambil keputusan secara cerdas dan berbasis informasi agar dapat menjalani kehidupan yang lebih baik. Penelitian ini bertujuan untuk meningkatkan keterampilan berpikir kritis mahasiswa dengan mengembangkan bahan ajar berwawasan kearifan lokal. Hasil penelitian menunjukkan bahwa pembelajaran yang dilakukan mempengaruhi tingkat berpikir kritis mahasiswa secara signifikan, baik dilihat secara keseluruhan (z=-4,731; p-value=0,000<0,05), maupun berdasarkan tiga aspek berpikir kritis secara terpisah (p-value=0,000<0,05). Hasil penelitian ini merekomendasikan agar penggunaan bahan ajar berwawasan kearifan lokal dalam materi pembelajaran sains khususnya materi yang membentuk ekosistem perlu dioptimalkan, baik dalam level sekolah maupun pada tingkat perguruan tinggi.

A. Introduction

21st Century Education is education that emphasizes deep skills (Zubaidah, 2016; Fahmi et al., 2022), cannot be separated from the involvement of technology (Hidayat et al., 2019), as well as direct interaction with the culture and culture of the surrounding community (Widodo, 2020). Therefore, ready or not, the realms of science, technology, and culture have become part of our lives. Moreover, the rapid development of science and technology today has encouraged the world of education to innovate related to technology and its relation to social life (Ford & Yore, 2012; Trianto, 2014).

Science learning at the university level is more meaningful if it not only integrates science but can also integrate environmental insights into the learning climate in the classroom. Because every human activity in the environment is inseparable from science which requires one to think deeply and critically, learning to integrate all of these things is very necessary so that prospective educators are created who can teach someone to face the challenges of the times (Fahmi & Irhasyuarna, 2019; Putra et al., 2022). Environmentally friendly learning has proven to be in demand and has received positive responses from students to improve various aspects of learning outcomes (Irwandi & Fajeriadi, 2019).

The top three levels of Bloom's taxonomy are often identified with critical thinking. Nevertheless, there is a problem because one is not fully hierarchical but interdependent. For example, synthesis and evaluation require analysis, but analysis generally also requires synthesis and evaluation (Setiadi, 2018).

Experts who define critical thinking are reasoned and reflective thinking with an emphasis on deciding what to believe or do (Vieira & Tenrelro-Vieira, 2016; Fahmi, 2018). In other words, decision-making is taken after reflecting and evaluating what is learned and believed. Fachrurazi (2011) suggests that critical thinking is a systematic process that provides opportunities for students to formulate and evaluate their own beliefs and opinions. Meanwhile (Facione, 2012) suggests that critical thinking is a process of thinking precisely, directed, reasoned, and reflective in making decisions that can be trusted. Someone who thinks critically is seen from the process of solving problems in the context of interacting with the world and other people. So it can be concluded that critical thinking ability is an ability that everyone has to analyze ideas or ideas in a more specific direction to pursue relevant knowledge about the world by evaluating evidence.

Critical thinking skills are needed to analyze a problem to the stage of finding a solution to solve it. Watson & Glaser (2012) explain that someone who can think critically must have three aspects. First, an investigative attitude that involves the ability to recognize a problem and a general acceptance of the evidence needed to support an assertion to be true. Second, knowledge of valid conclusions, abstractions, and heavy generalizations or the accuracy of various types of evidence is logically determined. Third, skills in using and applying these attitudes and knowledge (decision-making skills). According to Reddington (2012), the most effective way to develop critical thinking skills is to include them in every lesson. Teaching critical thinking is an ongoing process. This process cannot be limited to classroom sessions but should be incorporated through various questions, lessons, and activities that focus on higher-level thinking skills.

For example, in the realm of learning in the classroom, it is important to combine critical thinking skills and use teaching materials with the insight of local wisdom. Combining critical thinking indicators and local wisdom that contains a collection of facts, concepts of belief, and public perceptions about the world around them, solving problems and validating information. Then it is possible to increase the level of thinking about how knowledge is generated, stored, applied, managed, and passed on (Fahmi, 2016). Based on the description above, critical thinking skills are very important because thinking is an abstract activity. In everyday life, humans encounter problems or issues that are easy or difficult to solve, and some are still gray or unclear, so critical thinking skills are needed.

B. Material and Method

1. Type of Research

This research was conducted using a quasi-experimental method with a single variable and a one-group pretest-posttest design (Fraenkel et al., 2012). The flow of the implementation and calculation of the research is described in Table 1.

Tabel 1 One group pretest-posttest design

0	X	0
Pretest	Treat	postest

2. Research Subject

The research data were obtained from the participants of this study, namely 30 students of the Science Education Study Program at Lambung

Mangkurat University. Before learning begins, students do a pretest on critical thinking ability tests, and then get treatment in the form of learning using teaching materials with local wisdom for four weeks. After that, the learning outcomes test was carried out as a post-test. Finally, the same treatment was tested in different classes as repetition.

The critical thinking instrument used was adopted from the initial instrument (RED model) in the form of objective test questions with arguments compiled by Watson & Glaser while still using three main indicators, namely; 1) recognize assumptions, 2) evaluate arguments, and 3) draw conclusions.

Figure 1
Flow of critical thinking instrument RED model

3. Data Analysis Techniques

The analytical technique used in this study uses the gain normality test (n-gain) to determine the average increase in students' critical thinking scores. The calculation of the gain score is based on the formula Hake used (1998). The criteria for learning outcomes in the knowledge aspect are based on the provisions shown in Table 2.

Furthermore, the Wilcoxon test was conducted to compare paired data after calculating the data using the Kolmogorov-Smlmof and Saphiro-Wilk tests.

Table 2 Criteria for increasing knowledge aspects

N-gain	Category
(g) > 0,7	High
0,3 < (g) < 0,7	Medium
(g) < 0,3	Low

C. Results and Discussion

This research was conducted in eight meetings in four weeks. In the first meeting before the lecture, students were asked to do a pretest with an instrument standardized for validity and reliability. After that, for the next six meetings, learning was carried out using teaching materials with local wisdom insight with elements that met the criteria for critical thinking that had been developed (valid, practical, and effective). Finally, the eighth meeting of students again conducted a post-test to see how far the students' thinking levels had increased.

During the learning process using teaching materials based on local wisdom, students are introduced to how the environment and surrounding culture can become a source of science learning. During the learning process, students are guided to recognize various kinds of science material related to the surrounding environment, such as object classification, classification of living things, acids and bases, environmental biology, and other materials that make up the ecosystem.

The data obtained in this study are quantitative data on students' critical thinking tests on Integrated Science lecture material. The data on the test results for improving students' critical thinking skills at the pretest and post-test are presented in full in Table 3.

Table 3 Test results of students' critical thinking skills

Competency Aspect	Pretest	Posttest	N-gain (3/0)	Z-score	P-value
Overall result	49,92	83,90	72,14	-4,731	0,000
Indicators of recognizing assumptions	64,52	91,94	72,04	-4,480	0,000
Indicators of evaluate arguments	44,19	85,48	70,06	-4,815	0,000
Indicators of draw conclusions	61,83	91,40	71,67	-4,274	0,000

Based on Table 3 above, it can be seen that learning using Integrated Science teaching materials with local wisdom insight can show an increase in students' critical thinking skills with an overall gain score of 72.14% in the high category. Furthermore, to find out how the teaching materials influenced improving critical thinking skills using the Wilcoxon test. The test results show that learning using Integrated Science teaching materials significantly influences students' critical thinking skills in each aspect of their critical thinking competence. This significant effect can be seen from the p-value, which is smaller than the z-score.

In this research, students are first taught how to apply science concepts to various environmental problems, especially in a wetland environment. In addition, students are faced with various kinds of life problems in a wetland environment that require solutions in the form of rational and empirical solutions. At the final stage of learning, students are given a test using a critical

thinking test instrument that has met the valid and reliable criteria, as shown in Figures 2 and 3.

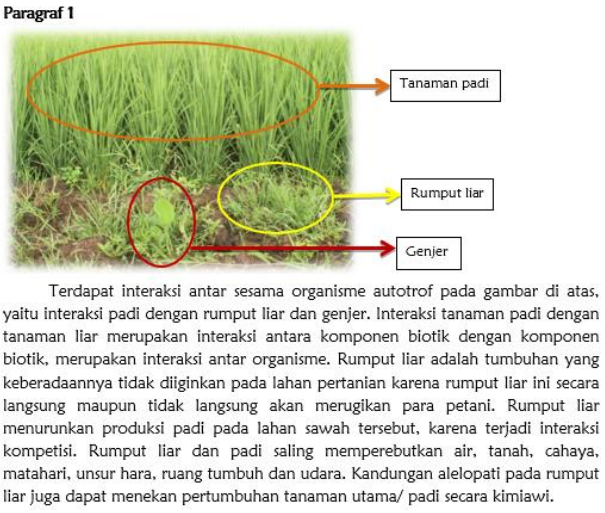

Figure 2
Information paragraph before the question is given (in Indonesia)

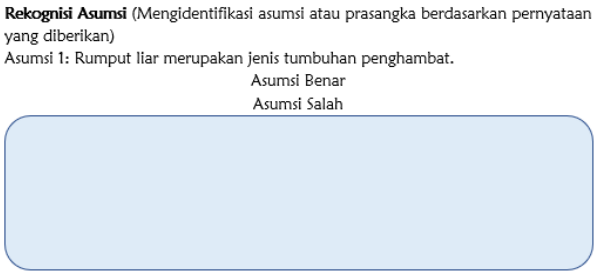

Figure 3
The form of statements and test instruments given at the pretest and posttest (in Indonesia)

Seeing the importance of learning that can bring individuals into a problem and environmental issues makes the ability of lecturers as teachers to integrate these in the learning process becomes important. This can be interpreted that the success of learning cannot be separated from the important role of the teacher to provide understanding to individuals or groups who are taught using appropriate teaching materials to achieve learning objectives.

In the realm of critical thinking on the indicators of recognizing assumptions, students can provide answers and arguments to strengthen their assumptions properly. These findings are in line with what was conveyed by Fachrurazi (2011) in his research which showed that critical thinking is a systematic process that provides an opportunity for a person to identify initial assumptions or assumptions based on the data provided.

The evaluate arguments indicator describes the strength and relevance of the arguments concerning a particular question or problem. In this indicator, students can assess something accurately, validly, abstractly, and generalize and connect with various types of rational evidence. This finding is in line with previous research by Liu et al. (2009); Af'idayani et al. (2018); Rahayu et al. (2018), which explains that the term being able to assess something accurately is to connect what is learned and how that knowledge is used in real conditions with strong and rational arguments.

Draw a conclusions indicator that shows whether the conclusions follow logically or make sense from the information provided. In this indicator, students who become the research sample can make the right decisions in a relatively short time. This shows that the research objectives and learning objectives are also achieved in this indicator. This is in line with research conducted by Fahmi (2016), which explains that a person is said to be able to critical thinking if he can find how to research, integrate, make decisions, and create and apply new knowledge they have gained during the learning process in real-life situations.

Overall, this study shows that learning by using teaching materials with local wisdom insight can significantly improve students' critical thinking skills. This effect is because, according to Fahmi et al. (2019); Fahmi et al. (2021a); Fahmi et al. (2021b); Kusasi et al. (2021), learning by presenting a real environment in the classroom has the potential to help students learn the core of the concepts being studied, as well as being a bridge to support student activity during the learning process. Furthermore, according to Fitriani et al. (2022); Musliha et al. (2022); Nurlita et al. (2021), science learning materials in the field of biodiversity are easier for students to accept using local wisdom-based learning resources that are integrated with critical thinking skills.

This study's results align with Ramdani et al. (2021), which state that the application of science teaching materials with 5E integrated with local wisdom positively affected students' critical thinking skills. In addition, Ridho et al. (2021) also concluded that the local wisdom-based products developed were suitable to be used as an alternative source of additional science learning materials in the face of the 21st century, the industrial revolution 4.0, and provided an increase in critical thinking skills. In addition, Arti & Ikhsan (2021) also conclude that outdoor learning based on local wisdom can be implemented to improve critical thinking skills and level of concept mastery.

Based on this comparison with previous research, learning materials integrated with local wisdom positively improve students' critical thinking skills. Nevertheless, it does not stop there. Preparing students with good critical thinking skills is the goal of Indonesian education in the 21st century and the 4.0 industrial revolution, which began in 2010. According to Lase (2019), current and future educational curricula must be developed by complimenting students' abilities in several dimensions, one of which is critical thinking skills. Furthermore, Syamsuar & Reflianto (2018) explain that education management policies in Indonesia encourage all levels of education to take advantage of advances in digital and computing technology.

In addition, literacy and competence are needed to deal with technological advances in various aspects of life. Local wisdom is like something contrary to technological progress but can be integrated to prepare students with critical thinking skills. According to Rahman (2019), new literacy in the form of new understanding gained by teachers must be considered by educational institutions. This new literacy consists of technological and data literacy, but local wisdom must still be preserved. Sumartias et al. (2020) explained that the development of digital media is also very important in sustainably managing local wisdom. In addition, Budiarti et al. (2020); Prasadi et al. (2020); Aditia & Muhlisin (2022) state that local wisdom can be integrated with various learning media to improve students' critical thinking skills.

D. Conclusion

The results of the research that has been carried out show that learning by using teaching materials with the insight of local wisdom to improve higher-order thinking skills is significantly successful. This result is indicated by data on increasing critical thinking skills as a whole (z=-4.731; p-value=0.000<0.05), as well as based on three indicators of critical thinking separately (p-value=0.000<0.05). Therefore, this study recommends that the use of local wisdom-based teaching materials in science learning materials must be continued both at the school and tertiary levels.

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