

Effectivity of Popular Scientific Book “Pteridophyta in Area Loksado” to Improve Students ‘Critical Thinking Skills

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Abstract

Critical thinking is one of the skills that must be developed in the world of education. Students' critical thinking can be improved by optimizing learning, one of which is developing textbooks in the form of popular scientific books. Learning resources can be developed by utilizing the environment around students or locally based. The environment is a very rich source of learning following the demands of the curriculum. In this research, a popular scientific book on the diversity of ferns in the Haratai Loksado waterfall was developed. This study aims to develop popular scientific books based on the local potential to test the effectiveness of popular scientific books in improving students' critical thinking skills. This research is a research development research with formative evaluation using the Tessmer design. The effectiveness was tested at MAN 1 HSS with data on the effectiveness of popular scientific books seen from the average results of evaluation scores and practical results before and after being given popular scientific books. The results of the improvement in critical thinking skills and student learning outcomes were classified as high, namely at the third meeting with the acquisition of 93%. The increase occurred at each meeting as evidenced by the N-gain from the 1st to 3rd meeting with the high category with a value of 0.8.

Abstrak

Berpikir kritis adalah salah satu keterampilan yang harus dikembangkan oleh pendidikan. Berpikir kritis siswa dapat ditingkatkan dengan mengoptimalkan pembelajaran, salah satunya mengembangkan buku teks berupa buku ilmiah populer. Sumber belajar dapat dikembangkan dengan memanfaatkan lingkungan sekitar atau lokal siswa. Menurut persyaratan kursus, lingkungan merupakan sumber belajar yang sangat kaya. Dalam penelitian ini, dikembangkan buku ilmiah populer tentang keanekaragaman paku di kawasan air Terjun Haratai Loksado. Penelitian ini bertujuan untuk mengembangkan buku ilmiah populer berbasis potensi lokal untuk menguji keefektifan buku ilmiah populer dalam meningkatkan keterampilan berpikir kritis siswa. Kajian ini merupakan kajian penelitian dan pengembangan evaluasi formatif yang dirancang oleh Tessmer. Uji validitas dilakukan pada MAN 1 HSS yang menggunakan data validitas buku ilmiah populer, data diperoleh dari nilai evaluasi sebelum dan sesudah memperoleh buku ilmiah populer serta rata-rata hasil magang. Peningkatan kemampuan berpikir kritis dan hasil belajar siswa tergolong tinggi, yaitu 93% pembelajaran diperoleh pada pertemuan ketiga. N gain (kategori 0.8) dari pertemuan ke-1 sampai ke-3 mengalami peningkatan di setiap pertemuan yang merupakan hasil dari kenaikan tersebut.

A. Introduction

According to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 65 of 2013 concerning Process Standards, learning is a process of interaction between students and teachers and learning resources in the learning environment. To meet educational standards, the curriculum has been changed to adapt to technological advances that are occurring on a global scale. The 2013 curriculum development must be able to improve future abilities, such as readiness, wisdom based on one's talents or interests, and a sense of responsibility towards the environment. The abilities expected in the 2013 course are communication, critical thinking skills, creativity, and collaboration skills.

Critical thinking ability is a person's ability to logically, ideologically, systematically, and productively analyze one or more ideas to help make, evaluate, and make decisions about what they believe or do so that they can successfully solve existing problems.

Students must have critical thinking skills to meet the 2013 course requirements, and critical thinking skills cover at least three things. First, critical thinking is the process of solving problems in the context of interactions with oneself, the world of others, and/or their environment. Second, critical thinking is a process of reflective reasoning based on the previously received information and conclusions, the results of which are reflected in the conclusions. Third, critical thinking ends with decisions about beliefs and actions (Lambertus, 2009).

By using the right learning strategies and learning resources, you can develop critical thinking skills in the learning process. To accompany the learning process, it is necessary to use textbooks in the form of scientific books (Pusparatri, 2012). Learning resources can be developed by making use of the student's local or surrounding environment. According to the course requirements, the environment is a very rich source of learning. There are two forms of learning environment, one is an environment that is deliberately designed for learning, and the other is not designed for learning, but the environment in which it exists can be used for the learning process. These two types of environments can be used because they are very informative and can also be used directly as a place for student learning (Sanjaya, 2013).

Environment-based learning is classified as situational learning that can stimulate, train, and develop students' critical thinking skills. However, the fact is that many teachers still use direct teaching materials or buy finished products.

Teachers should plan, obtain, produce and compile teaching materials themselves. Therefore, if the textbooks used are not contextual, unattractive, monotonous, and do not meet the needs of students, this risk is likely to occur (Zuriah *et al.*, 2016). This is one reason why it is difficult to improve students' critical thinking skills. Therefore, the development of learning resources in the form of popular scientific books based on local potential is an effort that aims to improve students' critical thinking skills towards ferns. Popular scientific books are scientific books that are presented in popular language or ordinary language so that they are easy to understand and interesting to read (Wardani, 2007). One of the advantages of popular scientific books is that they are written in popular languages and are not subject to scientific writing rules so that they attract reading interest and are easily understood by ordinary people (Dalman, 2014).

Previous research on the production of popular scientific books by Irwandi (2018) has developed a popular scientific book about turtle species and their protection, suitable for improving the critical thinking skills of high school students in coastal areas. From Nine Island. Handayanti (2019) develops popular scientific books that are suitable for improving critical thinking skills. Therefore, popular scientific books that have been developed are suitable for use as reading material for students and the public to improve critical thinking skills.

One of the SMA / MA materials that can be taught with environment-based learning is plant material. One of the sub-contents of plants is the diversity of ferns. The Haratai Loksado waterfall area is one of the areas with high biodiversity, various types are found there, one of which is ferns. Haratai Loksado Waterfall is one of the areas visited by many people, so it has the potential as a learning resource for students. If teachers take advantage of the wealth of biodiversity in secondary school biology learning, the potential is tremendous. Therefore, the researcher wants to study environment-based learning methods that are based on students' critical thinking abilities, and choose ferns in the Haratai Loksado waterfall area to complement these learning activities.

This research will develop a popular scientific book on the diversity of ferns that will connect students with the object to be studied through activities contained in popular scientific books. This popular scientific book is expected to be an independent teaching material for SMA / MA students, suitable for motivating students to learn biology based on the environment and being able to practice their critical thinking skills.

B. Materials and Method

This study is a formative evaluation development study from Tessmer (1993). The effectiveness of scientific books developed is obtained by evaluating the results of the internships before and after obtaining scientific books. Data on critical thinking skills are measured according to Facione (1990) standards, including 1) interpretation; 2) analysis; 3) evaluation; 4) inference. The validity test was carried out at MAN 1 HSS. The research data was taken from the results of the students' ability to do 3 practical activities or observe plants. Data on the effectiveness of popular scientific books can be obtained from the average score of evaluations obtained by students in practice, then classified according to critical thinking abilities:

Table 1 Percentage of Critical Thinking Ability

Percentage	Criteria
90.6 – 100%	Very high
75.6 – 90.5%	high
60.6 – 75.5%	Moderate
40.6 – 60.5%	Low
0 – 40.5%	Very low

Sugiono (2013)

Knowing the magnitude of the increase in critical thinking includes indicators of interpretation, analysis, evaluation, inference. Critical thinking skills are calculated using the formula for normalized gain value (N-Gain or g) as follows (Hake, 1999).

$$g = \frac{S_{posttest} - S_{pretest}}{S_{maksimum} - S_{pretest}}$$

Information:

g : Score gain

$S_{pretest}$: Score *pretest*

$S_{posttest}$: Score *posttest*

Determine the criteria for the level of normalized gain (N-gain) can be classified as follows:

Table 2 Classification N-Gain

Nilai g	Criteria
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Moderate
$g < 0.3$	Low

Adapted from Hake, 1999

C. Results and Discussions

Judging from the achievement of cognitive learning outcomes and students' critical thinking indicators during the three meetings described, the effectiveness of popular scientific books is

effective. From the first meeting to the third meeting, as each measurement, the effectiveness of the indicator is improved in the table below.

Table 3 Result of the Test Effectiveness of Popular Scientific Books (Meeting One)

No	Aspek	Rata-rata(%)
1	Interpretation	71
2	Analysis	57
3	Evaluation	71
4	Inference	67
Amount		267
Average (%)		67

Based on the results of critical thinking indicator data in Table 3 above, it can be seen that from the 4 aspects of these indicators it is known that at the first meeting the results of the effectiveness test obtained an average value of 67%.

Table 4 Result of Test of the Effectiveness of Popular Scientific Books (Meeting 2)

No	Aspek	Rata-rata(%)
1	Interpretation	66
2	Analysis	66
3	Evaluation	91
4	Inference	91
Amount		312
Average (%)		78

Based on the results of critical thinking indicator data in Table 4 above, it can be seen that from the 4 aspects of the indicator it is known that at the second meeting the results of the effectiveness test obtained an average value of 78%.

Table 5 Result of Test of the Effectiveness of Popular Scientific Books (Meeting 3)

No	Aspek	Rata-rata(%)
1	Interpretation	93
2	Analysis	93
3	Evaluation	95
4	Inference	91
Amount		372
Average (%)		93

Based on the results of critical thinking indicator data in Table 4 above, it can be seen that from the 4 aspects of these indicators it is known that at the second meeting the results of the effectiveness test obtained an average value of 78% at the third meeting.

Furthermore, the data is normalized by N-Gain to see the following increase.

Table 6 N-Gain Test Result

No	Score N-Gain		
	Meeting	Score	Category
1	1 to 2	0.4	Moderate
2	2 to 3	0.8	High
3	1 to 3	0.8	High

Based on a deeper search, the data obtained shows that popular scientific books that are often used can improve students' critical thinking skills effectively. At each meeting, you can see data about the effectiveness of student learning outcomes, and each meeting has improved. The N gain results prove the increase in critical thinking skills, and every meeting always shows an increase.

Wahyuni (2011) suggests that critical thinking is a skill that examines what is considered knowledge or something based on supporting evidence. Critical thinking is defined as reflective and rational thinking to decide what to believe or do. According to Ennis (1981) in Susantini *et al.* (2012) show that in Bloom's taxonomy, the cognitive domains that are considered to be defined by critical thinking are synthesis, analysis, and evaluation. According to the description above, the ability to think critically is characterized by proactive, reflective, and rational/rational processes, which are designed to convince something to be done.

To achieve the critical thinking skills indicators above, BIP is equipped with facts, concepts, illustrations, and examples. The facts can be seen in short articles containing factual news. This concept can be seen from the introduction of the material. Before introducing the main material, you can see an illustration from the introduction. At the same time, examples are given in every section of popular scientific books.

The questions in the LKPD have been adjusted to the questions in a popular scientific book that is being developed. Its purpose is to enable students to find themselves without teacher assistance and to match solutions to be adopted so that learning is student-centered rather than teacher-centered. Students will discuss with group friends to solve problems contained in the LKPD so that they can exchange opinions and consider each other's opinions. Therefore, students are expected to be able to answer current questions with critical thinking skills. Kerkman & Johnson (2014) shows that asking challenging questions can improve students' critical thinking skills. In this way, it will reduce the role of the teacher as a provider of information. The teacher only helps students solve problems and does not provide information. In this way, students' critical thinking skills will develop. This is consistent with the view of Duron *et al.*

(2006) argued that teacher-centered learning is difficult to improve critical thinking skills, learning must be student-centered, and students must actively participate in learning so that students can think critically. In line with Rosnawati (2009), students must play an active role in learning activities, in other words, they must be seen participating in the learning process.

Learning activities using scientific methods are an appropriate and effective means of achieving critical thinking skills indicators. This is following Corlu & Corlu's (2012) research which shows that the scientific method can help students develop critical thinking skills and enable students to think and construct their knowledge like scientists. This method requires students to think more when solving problems given by the teacher. Zaini & Asnida (2016) believe that the learning environment formed by teachers in the learning process aims to encourage reflective thinking, critical assessment, and efficient thinking.

This science-based learning refers to a contextual learning process in which students are brought directly to the crime scene to be observed. This emphasizes that students must think critically during the observation process. Teach students to recognize ferns from their shape, color, and size, the goal is to make students more careful when observing. Also, students are taught to analyze to hone their critical thinking skills. This kind of learning is also taught to collaborate with students so that students can more easily and quickly understand the material being taught. After observing students, students will report and introduce the results of their observations. The aim is to train students to conclude from the results of observations so that students can carry out experiments coherently so that they are accustomed to using their thinking to make decisions so that students can develop their critical thinking skills. Therefore, scientific learning is very suitable for measuring students' thinking abilities. Consistent with Yustyan *et al.* (2015) suggested that the scientific learning method made it easier for students to master the material, actively fostered students, and influenced the development of students' thinking processes, especially the development of students' critical thinking skills.

Infield observation activities, provide students with material and examples on identifying ferns. The goal is that students gain direct experience, which will form a positive attitude, namely a caring attitude. Consistent with Khanafiyah & Yulianti (2013), personal experiences can form positive or negative attitudes based on other factors, however, inexperience with psychological objects often leads to negative

attitudes towards these objects. Besides, a child's learning environment is very important for a child's academic achievement. This shows that attitudes towards the environment play an important role in children's academic achievement. This is in line with Azwar (Azwar, 2011) Azwar (2011) explains that personal characteristics include various variables, such as motivation, personality traits, and attitudes, which influence each other and then interact with environmental factors, interactions that determine behavior.

Based on the results of the application, it can be concluded in simple terms that the use of popular scientific books for learning plant material, especially ferns tends to improve the critical thinking skills of high school students. The suspected cause is characteristic of the popular scientific books developed as described in the previous section. How popular scientific books play a role in developing high school / MA students' critical thinking skills.

D. Conclusion

Based on the results of increased critical thinking skills and higher student learning outcomes, it was announced that the popular scientific books developed could be used effectively for learning, namely, 93% of the results were obtained at the third meeting. From the first to the third meeting, N gain (high category) increases by a value of 0.8 at each meeting.

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