

Effectiveness of popular scientific books “Ethnopharmacology of the Balinese community in Barambai Kolam Kanan Village” to train students’ critical thinking skill

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Abstract

Students need to be trained in critical thinking by developing teaching materials based on local potential, one of which is popular scientific books (PSB) that support the application of knowledge and critical thinking skills in understanding the surrounding environment. This research aims to test the effectiveness of PSB based on local potential regarding the ethnopharmacology of the Balinese community in Barambai Kolam Kanan Village in training students' critical thinking skills. This study is research into the development of formative evaluation based on the Tessmer design which focuses on students' critical thinking skills using a rubric of five indicators including interpretation, assumptions, deduction, argument evaluation, and inference. The effectiveness test subjects involved 5 students (expected effectiveness) and 20 students (actual effectiveness). The research results are based on the hope effectiveness test (small group) of the developed PSB with an average value of 64.0. Meanwhile, the actual effectiveness test (field test) obtained an average score of 73.7, increasing to 89.1. So the average N-gain score is 0.6 which is in the medium category. This illustrates that BIP based on local potential has been effectively implemented in learning to improve critical thinking skills.

Abstrak

Berpikir kritis mahasiswa perlu dilatih dengan mengembangkan bahan ajar berbasis potensi lokal salah satunya buku ilmiah populer (BIP) yang mendukung penerapan pengetahuan serta keterampilan berpikir kritis dalam pemahaman lingkungan sekitar. Penelitian ini bertujuan menguji keefektivan BIP berbasis potensi lokal tentang Etnofarmakologi masyarakat Bali di Desa Barambai Kolam Kanan dalam melatih keterampilan berpikir kritis mahasiswa. Kajian ini adalah penelitian pengembangan evaluasi formatif berdasarkan desain Tessmer yang berfokus pada keterampilan berpikir kritis mahasiswa dengan menggunakan rubrik lima indikator meliputi interpretasi, asumsi, deduksi, evaluasi argumen, dan inferensi. Subjek uji keefektivan melibatkan 5 orang mahasiswa (keefektivan harapan) dan 20 orang mahasiswa (keefektivan aktual). Hasil penelitian berdasarkan uji keefektivan harapan (*small group*) terhadap BIP yang dikembangkan dengan nilai rata-rata 64,0. Sedangkan uji keefektivan aktual (*field test*) mendapatkan nilai rata-rata 73,7 meningkat menjadi 89,1. Maka nilai rata-rata N-gain sebesar 0,6 yang berada pada kategori sedang. Hal tersebut menggambarkan BIP berbasis potensi lokal telah efektif dilaksanakan dalam pembelajaran dalam meningkatkan keterampilan berpikir kritis.

A. Introduction

Learning resources are information presented in various forms of media to make it for students to learn according to their wishes curriculum (Depdiknas, 2008). The developed curriculum must adapt to the potential of each region and, of course, can utilize students according to their potential and needs and the environment around them so that there are many opportunities for regions and education managers to make adjustments and contextualize the curriculum by their needs with regional potential and local realities in the field (Fitriansyah et al., 2018). Using the environment as a learning resource shows a higher willingness to learn from students (Irwandi & Fajeriadi, 2020). Some examples of learning resources are books, modules, handouts, worksheets, PSBs, videos, etc.

One type of teaching material is PSB. Regulation of the Head of the Indonesian Institute of Sciences Number 04/E/2012 Concerning Guidelines for Scientific Writing states that scientific books are scientific writings of in-depth discussion of current problems in science by summarizing the latest research results emphasizing theoretical aspects, guiding philosophical explanations of a step guide or a form of study that is printed in book format as well as an arrangement in sections or chapters that are made continuously and linked (Nurfatma et al., 2020). In contrast to other teaching materials, Wiana (2011) explains that PSBs are books that adhere to scientific standards but are displayed in a common language that is easy for the public to understand and attractive so that people are more interested in reading them.

Popular scientific book is expected to be able to overcome problems in the Ethnobotany course, especially the limited learning resources for the concept of ethnopharmacology, which contains material with examples of plants from the surrounding or local environment that are used by specific communities or tribes, which causes students not to have excellence in research so that their learning results are not ideal. This is supported by Rizqia (2020), who argues that other facts that can hinder the learning process are the use of teaching materials that are not yet effective and the lack of examples in the learning process. So, it is necessary to develop teaching materials to support the learning process. The development of learning resources can make it easier for students to understand the material the teacher presents.

Helmina & Hidayah (2021) reported that the people of Kampung Padang, Sukamara District, use 47 traditional medicinal plants. Similar research was also conducted by Destryana & Ismawati

(2019), who found that there were 28 types of wild plants, including leaves, flowers, fruit and stems, used as traditional medicine by the Madurese people. In other research by Naghibi et al. (2022), there were 40 genera and 410 species and subspecies of plants used in traditional medicine. For this reason, there needs to be a unique approach so that the knowledge and use of these plants is widely known by the community, namely by making a PSB about Ethnopharmacology, which the Balinese community in Barambai Kolam Kanan Village use.

Critical thinking means thinking deeply about the problems or phenomena explained in learning. Developing PSB that leads to implementing knowledge and life experience is essential, especially in understanding the surrounding environment and practising critical thinking skills. Popular scientific books are worth developing in training students' critical thinking skills (Latifah et al., 2020).

Ridhana et al. (2021) conducted research on the effectiveness of PSB, with the results of PSB developed can be used effectively for learning. 93% of the results were obtained in the third meeting, and N-gain (high category) increased with a value of 0.8 at each meeting. In addition, Astuti et al. (2021) PSB are declared effective because the results of students' critical thinking skills have increased in the small group with an average of 94.5% and an N-gain of 0.8 in the high criteria so that they can be used as enrichment material to train high school students' critical thinking skills. The developed PSB was declared effective because it increased student learning outcomes with an average score of 88.30% with very good criteria and increased critical thinking skills by 0.71 with high criteria (Rahayu et al., 2022). Therefore, students critical thinking skills can be trained using PSB, developed by utilizing interactions between local communities and their living environment.

Based on the description above, the background to ethnopharmacology is environmental-based material. It is then published in PSB, which provides facts to train students' critical thinking skills. This research aims to evaluate the effectiveness of developing a PSB on Ethnopharmacology in the Balinese community of Barambai Kolam Kanan Village to Train Students' Critical Thinking Skills.

B. Material and Method

This research is a formative developmental evaluation research from Tessmer (1993). The expected effectiveness is obtained from the results

of small groups, and the actual effectiveness from the results of field tests. The subjects for the small group test were five students, and the field test was 20 students. Critical thinking skills are obtained from working on evaluation test questions and practical guides based on PSB using the critical thinking skills rubric. Critical thinking skills are acquired from students' answers to test questions and practical guidance adapted from Watson & Glaser (2012). The five indicators assessed in this research are interpretation, assumption, deduction, argument evaluation, and inference which calculated using Formula 1. The categorization of these indicators is in Table 1. The increase of students' critical thinking skills is calculated using the gain formula by Hake (1999) as Formula 2. The categorization of high and low N-gain is in Table 2.

$$X = \frac{\text{Total score obtained}}{\text{Maximum score possible}} \times 100\% \dots \text{Formula 1}$$

Table 1 Critical Thinking Skills Category

Percentage	Category
80,00 < x ≤ 100,00	Very Good
60,00 < x ≤ 80,00	Good
40,00 < x ≤ 60,00	Enough
20,00 < x ≤ 40,00	Less Good
0 < x ≤ 20,00	Not Good

(Source: Modified from Ramadhan et al., 2020)

Table 3 PSB Expectations Effectiveness Test Results

No	Indicator	Meeting Score 1			Mean	Category
		Practicum guide	Evaluation	Σ		
1	Interpretation	60,0	60,0	120,0	60,0	Enough
2	Assumptions	60,0	70,0	130,0	65,0	Good
3	Deduction	60,0	70,0	130,0	65,0	Good
4	Argument evaluation	65,0	70,0	135,0	67,5	Good
5	Inference	65,0	60,0	125,0	62,5	Good
Mean		62,0	66,0	128,0	64,0	Good

(Source: Data Processing Results)

Table 4 PSB Actual Effectiveness Test Results

No	Indicator	Meeting Score 2				Meeting Score 4			
		Pg	Evaluation	Mean	Category	Pg	Evaluation	Mean	Category
1	Interpretation	78,0	67,5	72,8	Good	93,8	85,0	89,4	Very good
2	Assumptions	70,0	70,0	70,0	Good	85,0	90,0	87,5	Very good
3	Deduction	75,0	72,5	73,8	Good	92,5	80,0	86,3	Very good
4	Argument evaluation	75,0	72,5	73,8	Good	95,0	82,5	88,8	Very good
5	Inference	81,3	75,0	78,2	Good	95,0	92,5	93,8	Very good
Mean		75,9	71,5	73,7	Good	92,3	86,0	89,1	Very good

(Source: Data Processing Results)

Description: Pg = Practicum guide

Students' critical thinking skills were analyzed from the assessment of filling in the practicum guide and answering evaluation questions before being given the PSB and after being given the PSB. Table 3 shows that the

$$g = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{max}} - S_{\text{pre}}} \dots \text{Formula 2}$$

Descriptions:

- g = Score gain
- S_{pre} = Score pretest
- S_{post} = Score posttest
- S_{max} = Score maximum

Table 2 Classification N-Gain

g Score	Category
g > 0,7	High
0,7 > g > 0,3	Medium
g < 0,3	Low

(Source: Adaptation Hake, 1999)

C. Results and Discussion

The effectiveness of the PSB as a result of the development was obtained from the results of the small group test in the form of expected effectiveness, and the results of the field tests obtained actual effectiveness data. Based on the summary of students' critical thinking skills data analyzed from the results of filling in the practicum guide and answering evaluation questions before being given the PSB and after being given the PSB in the small group test, the results of the student's expectations of critical thinking skills were obtained as shown in Table 3. Actual effectiveness data from the field test can be seen in Table 4.

effectiveness of expectations in the small group test for PSB is developed according to expectations with an average value before using PSB, which is 64,0.

The results of the PSB field test effectiveness also increased. At meeting two, the average was

73.7 and increased to 89.1 at meeting 4. Based on these data, the field test's actual effectiveness on the developed PSB is categorized as effective. The increase occurred due to periodic repetition, making it easier for students to remember learning material and acquire previous answers. This is also

inseparable from the PSB used by students, which, based on the percentage of data in Table 3 and Table 4, the developed PSB has an effective category to be used as enrichment material for Ethnobotany courses to train students' critical thinking skills.

Table 5 N-Gain Test Results for Students' Critical Thinking Skills

No	Critical Thinking Skills Indicator	Meeting 2	Meeting 4	N-Gain	Category
1	Interpretation	72,8	89,4	0,6	Medium
2	Assumptions	70,0	87,5	0,6	Medium
3	Deduction	73,8	86,3	0,5	Medium
4	Argument evaluation	73,8	88,8	0,6	Medium
5	Inference	78,2	93,8	0,7	Medium
Mean				0,6	Medium

(Source: Data Processing Results)

Improving the critical thinking skills of students participating in the Ethnobotany course at meetings 2 and 4 using the PSB development result, which includes five indicators on the small group test and field test calculated using the formula for the normalized gain value (N-gain or g) and the results are as shown in Table 5.

The effectiveness of the PSB "Ethnopharmacology of the Balinese community in Barambai Kolam Kanan Village" seen from the results of the small group test obtained the effectiveness of expectations, and from the results of the field test received the actual effectiveness of student learning outcomes in the Table 5, it can be seen that the effectiveness of the small group and the effectiveness of the field test has ratings are not much different. This shows that PSBs that have been developed are effectively used in teaching Ethnopharmacology to train students' critical thinking skills.

Several studies of popular scientific books have been conducted by Ridhana et al. (2021), who state that PSB is very effective in improving critical thinking skills. This was reinforced by Astuti et al. (2021), who explains that student involvement in the environmental education process will increase critical thinking skills so that the material is easy to understand and remember. That is, practising critical thinking skills can improve students' cognitive abilities.

Based on the implementation results, it can be stated that using PSB developed in Ethnopharmacology learning (small group and field tests) can train students' critical thinking skills. Factors suspected of causing this are the unique characteristics and advantages PSB developed, as described in the previous section. As stated by Utami (2017), PSB learning media is appropriate for use in the learning process both at school and in independent learning. Therefore, the

implementation of PSB that has been developed has a positive impact on improving critical thinking skills.

Suardipa & Primayana (2020) explain that evaluation is a systematic process to determine to what extent learners achieve instructional objectives. Evaluation position is critical to deciding on the success of the learning process (Hidayat & Asyafah, 2019). Then, to assess the increase in students' critical thinking skills seen from the five indicators of critical thinking, namely interpretation, assumptions, deduction, argument evaluation, and inference.

1. Interpretation

Based on the critical thinking skills data in Table 5, it can be seen that there has been a change in all indicators of students' critical thinking skills. The interpretation indicator for the N-gain value is 0.6. The interpretation carried out by students during the practicum can be seen when reading the narration in the practicum guide. Students can examine a problem from the narration and then formulate the problem appropriately.

Improving students' skills in interpreting obtains a moderate score because the PSB used has several advantages, one of which is having content or material that is arranged neatly and clearly to make it easier for students in the learning process and identify problems to be solved so that students can be directly involved in determining the problem to be solved. According to Cahyani & Azizah (2019), interpretation is the activity of formulating questions from issues, which are carried out to understand and give meaning to a problem. Meanwhile, according to Hidayati et al. (2021), interpretation, namely understanding the problem presented and being able to write down what is known and understood correctly and correctly. If you understand the concept well and

understand the information about the problem as a whole, then students will be successful in fulfilling the interpretation indicators in critical thinking skills (Basri & As'ari, 2019).

Students' interpretation skills will make determining problems regarding the Ethnopharmacology of the Balinese community in Barambai Kolam Kanan Village easier. If students can find the problem correctly, then students will complete a hypothesis correctly. Interpretation skills increase, one of which is also influenced by the high curiosity of students and the ability and confidence of students in working on the questions given. This is feedback from curious students so that they can interpret and understand the meaning of a problem, and then they are actively involved in group discussion activities while solving problems that are sensitive in case studies can develop critical thinking skills (Agnafia, 2019; Saputra et al., 2019).

2. Assumptions

The assumption indicator has a value with an N-Gain of 0.6 in the medium category for students' ability to identify facts to determine solutions to problems and provide precise assumptions from answers. The student's ability to make assumptions gets a moderate score because, in the learning process, students make assumptions from facts in the field and use PSBs that have been developed. According to Rohman & Kusaeri (2021), an indicator of assumption is the ability to identify what is implied in a statement, problem, or phenomenon.

Assumptions are made to identify facts to determine the solution to the problem. If the data collection procedure is correct, then the data that has been collected will also be by the demands of the process. Therefore, students are responsible for their learning activities, where students can use the assumption indicators to determine solutions to problems found during the learning process. The assumption skills carried out by students are skills in finding various existing facts (various assumptions) and then assessing the most appropriate assumptions (Rohman & Kusaeri, 2021).

3. Deduction

The deduction indicator obtained an N-gain of 0.5, classified as medium. Students' skills in deduction can be seen when they can interpret information, measure evidence, and decide whether to generalize or draw conclusions. Improving students' critical thinking skills in making deductions obtains a medium score because, in the

learning process, students are involved in assessing opinions or statements from a problem-solving.

Students who can make deductions or formulate solutions to problems from general to specific correctly and sequentially can quickly develop their critical thinking skills. Student achievement in improving critical thinking skills is inseparable from good evaluation tools that measure students' critical thinking skills. This is in line with the statement of Hidayati et al. (2021), which states that students' critical thinking emerges, hence the need for evaluation in learning.

In addition, the questions on the deduction indicator have been previously studied using the PSB, which has been developed to make it easier for students to answer the evaluation questions given. Indah & Fauzan (2019) stated that there are evaluation questions that can help students hone critical thinking skills. So, it is assumed that students' critical thinking skills can positively impact learning activities and improve student learning outcomes (Pardede et al., 2020).

4. Argument Evaluation

The argument evaluation indicator gets an N-gain of 0.6. Students' skills in evaluating arguments can be seen when these students can distinguish between strong and weak arguments when making important decisions. According to Rohman & Kusaeri (2021), argument evaluation is a skill in evaluating the strength and relevance of an argument related to a particular issue or problem.

Students who can evaluate arguments show that these students carry out the analysis correctly because students must evaluate which arguments are strong and relevant. These results were also obtained because students followed the learning stages using PSB developed coherently, making it easier for students to determine the evaluation of arguments.

Based on the overall N-gain value, all of which are in the medium category. The results of the argument evaluation indicator indicated a medium change in critical thinking skills between meeting one and meeting four, both in the small group test and the field test in learning using the developed PSB. This illustrates that PSB has been effectively implemented in learning.

5. Inference

The N-gain value inference indicator is in the medium category. Expected effectiveness is in the good category, and actual effectiveness is in the very good category. Student skills in inference can be seen when the student can conclude the correct solution he finds. Improving students' critical

thinking skills in making inferences obtains a moderate score because students use PSB, which has the advantage of one of which is that each plant listed in the PSB is presented with a description, classification and local names so that it can make it easier for students to draw conclusions based on the problem at hand.

Students who can make inferences or withdrawals conclusions correctly show that they are doing the analysis correctly because they must do data analysis with the proper process for a problem so that the conclusions obtained are correct. These results were also obtained because students followed the learning stages using PSB, which had been developed coherently. They are making it easier for students to determine inferences.

Based on the data results, the overall N-gain value for improving students' thinking skills obtained an average of 0.6 in the small group test and field test and received the medium category. This means using PSB Ethnopharmacology of the Balinese community in Barambai Kolam Kanan Village can train and improve students' critical thinking skills. This shows that the PSB that has been developed is effective for implementation in learning.

Improving students' critical thinking skills is inseparable from the learning process. Therefore, it can be seen that differences in the final results of students' interpretation, assumption, deduction, argument evaluation, and inference skills occur by implementing PSB. Interpretation, assumption, deduction, argument evaluation, and inference skills are high for students because, during learning activities, students make observations and answer evaluation questions very well.

Involving students in direct learning will improve critical thinking skills so that material is easily understood and recalled. This is related to the fact that the more you read, the easier it will be to understand and remember the material. According to Mahanal et al. (2019), it is stated that an increase in reading activities supported an increase in students' critical thinking skills. That is, increasing critical thinking skills can improve students' cognitive abilities. According to Astuti et al. (2021), student involvement in the environmental education process will enhance critical thinking skills, making the material easy to understand and remember. That is, increasing critical thinking skills can improve students' cognitive abilities. In line with that, Antika (2015) states that increasing students' critical thinking in learning is one variable that enhances students' cognitive learning outcomes. Later, critical thinking

skills will influence communication skills and achieve in-depth understanding that leads to continuous learning over a long period (Fahmi et al., 2019; Ridlo, 2020).

D. Conclusion

The popular scientific book developed was declared effective in use based on improving students' critical thinking skills, which experienced an increase in the small group test with an average score of 64.0 in the good category. The interpretation indicator field test was 72.8, an increase of 89.4, assuming from 70.0 to 87.5, deduction from 73.8 to 86.3, argument evaluation from 73.8 to 88.8, and inference from 78.2 to 89.1. So, the average score is 73.7 to 89.1 in the very good category. The overall average N-gain is 0.6 (medium category). PSB is based on local potential, which can train critical thinking skills related to solving problems so that students can actively find solutions or conclusions.

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