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The effectiveness of developing popular scientific books on Anacardiaceae to improve students' critical thinking skills

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Abstract

The development of innovative local potential-based teaching materials in the Ethnobotany course of the Anacardiaceae family, which has not been fully implemented, causes student boredom while studying. It is necessary to develop popular scientific books (PSB) to help students understand learning material and significantly improve students' critical thinking skills. This development research aims to describe the expected and actual effectiveness of PSBs developed to enhance students' critical thinking skills. The research method used Tessmer's formative evaluation design. Research results on the effectiveness of expectations get an average value of 72.7%, and actual effectiveness is 77.35%. The average value of N-gain is 0.5, which is included in the medium criteria. The conclusion from the research results shows that the PSB on Ethnobotany of the Anacardiaceae family that was developed is effective in improving students' critical thinking skills so that students in Ethnobotany courses can use it. In general, the benefit of the results of this research is that development products based on local potential can be developed according to the needs of teaching materials and by the principles of critical thinking skills for students.

Abstrak

Pengembangan bahan ajar berbasis potensi lokal yang inovatif pada mata kuliah Etnobotani famili Anacardiaceae yang belum sepenuhnya dilakukan menyebabkan kejenuhan mahasiswa saat belajar. Perlu dikembangkan buku ilmiah populer (BIP) untuk membantu mahasiswa memahami materi pembelajaran sekaligus salah satu upaya dalam meningkatkan keterampilan berpikir kritis mahasiswa. Penelitian pengembangan ini bertujuan untuk mendeskripsikan keefektifan harapan dan aktual dari pengembangan BIP untuk meningkatkan keterampilan berpikir kritis mahasiswa. Metode penelitian menggunakan desain evaluasi formatif Tessmer. Hasil penelitian pada keefektifan harapan memperoleh nilai rata-rata 72,7% dan keefektifan aktual memperoleh nilai rata-rata 77,35%%. Nilai rata-rata N-*gain* sebesar 0,5 yang termasuk ke dalam kriteria sedang. Kesimpulan dari hasil penelitian menunjukkan bahwa BIP Etnobotani famili Anacardiaceae yang dikembangkan efektif untuk meningkatkan keterampilan berpikir kritis mahasiswa sehingga dapat digunakan mahasiswa pada matakuliah Etnobotani. Secara umum, manfaat dari hasil penelitian ini adalah produk pengembangan berbasis potensi lokal dapat dikembangkan sesuai dengan kebutuhan bahan ajar dan sesuai dengan kaidah keterampilan berpikir kritis untuk mahasiswa.

A. Introduction

Indonesia has a tropical climate and crosses the equator, so it has high biodiversity, even called mega biodiversity (Suyanto, 2019). South Kalimantan has a particular forest area that still has high biodiversity. The forest area managed by Lambung Mangkurat University is known as Special Purpose Forest Area (KHDTK). The KHDTK area is exciting to highlight so that ULM students learn more about local potential.

The local potential is natural abundance that the community utilises as wisely as possible. Setiawan et al. (2020) said that the social interaction of the community around KHDTK ULM was going well. This ensures that interesting local potential is highlighted in learning. Still, several problems will arise in the learning process based on local potential, such as unclear pictures, the potential environment that is introduced being far from student residences, so they are not familiar with it, and the language is still stiff, so there is a need for innovation in learning resources.

Education in Indonesia is still far from expectations. This statement refers to the low results from the 2018 Program for International Student Assessment (PISA) in the reading ability category, Indonesia is ranked 74th out of 79 countries, while for science capabilities, Indonesia is ranked 73rd and 71st out of 79 PISA participating countries (Hewi & Shaleh, 2020). Teachers should focus more on student reading interests, metacognitive and critical thinking skills (Siti, 2021). Learning resources that contain public knowledge about plant ethnobotany must be preserved as a form of learning innovation. Seeing that there is no research regarding the potential of the Anacardiaceae family at KHDTK ULM, the researchers are interested in taking up this research aspect for the Ethnobotany course.

Ethnobotany is a course that studies interactions between local people and their environment, especially plants. This course discusses the benefits of various plant families, including the Anacardiaceae family. According to Steenis (2013), Anacardiaceae is a family of flowering plants (order Sapindales) originating from tropical and subtropical areas of the world. Several species are economically important fruit and nut plants.

Based on preliminary research, there are eight species of the Anacardiaceae family in KHDTK ULM, namely Kasturi (*Mangifera casturi*), Kuweni (*Mangifera odorata*), Kedondong (*Spondias pinnata*), Ramania (*Bouea macrophylla*), Mangga gadung (*Mangifera indica*), Asam Hambawang Putar (*Mangifera foetida*), Cashew (*Anacardium occidentale*), and Ampelam (*Mangifera laurina*). Communities around KHDTK use these species for various needs ranging from food and shelter. This local potential can be utilized in Ethnobotany courses through the development of PSB.

Popular scientific books contain content about areas of knowledge and display phenomena and are written in simple language that attracts readers (Najmah et al., 2022). Critical thinking is the mental discipline activity of reflective and reasonable thinking to evaluate arguments or propositions to decide what to believe or do (Ennis, 2011). Research on the development of PSBs on ethnobotany has been carried out using similar critical thinking skills as carried out by Jannah et al. (2022), who developed a PSB about the diversity of crab species which can be used as enrichment material for students' critical thinking skills and was declared very valid with an average of 88.46%.

Nufus et al. (2022) and Noorannisa et al. (2022) have also developed a PSB on ethnobotany in Forest Areas with the Special Purpose of ULM, which is declared valid and can improve students' critical thinking skills. Rahayu et al. (2022) have developed a PSB on butterflies in the mangrove forest area of Sungai Bakau Village. The results showed that the BIP was 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. Ramadanti et al. (2023) have also developed a PSB on macrozoobenthos diversity as an application of local potential-based learning resources based on the implementation of BIP, which was developed on the implementation of expectations and actual implementation, getting results of 85.19% in the very good category to be used as enrichment material for Animal Ecology courses and can improve thinking skills student criticism. These studies are the basis of reference for developing teaching materials based on local potential.

According to Wayudi et al. (2020), critical thinking involves analyzing, synthesizing, making judgments, and creating and applying new knowledge in real-world situations. OECD (2015) states that one type of learning that can help improve critical thinking skills is environment-based learning. Fajeriadi et al. (2019) state that teaching materials, especially PSBs, are necessary to orient students to local potential.

Based on this, a forum is needed to accommodate local potential and knowledge regarding the use of plants around KHDTK ULM by the community. So far, no research has been

conducted on developing a PSB on ethnobotany for the Anacardiaceae family at KHDTK ULM. Popular scientific books that have been developed have questions at the end of each discussion with the aim that these questions will trigger students to think critically. The critical thinking indicators in PSBs that have been developed are interpretation, analysis, inference evaluation, explanation and self-regulation.

Based on the description above, it can be used as a basis for a study on "The Effectiveness of PSBs in the Anacardiacea Family for Improving Students' Critical Thinking Skills". The study is expected to contribute to developing effective ethnobotany teaching methods with PSBs.

B. Material and Method

The research method uses Tessmer's (1993) formative evaluation design. Data on critical thinking skills refers to Facione (1990), namely, 1) interpretation, 2) analysis, 3) evaluation, 4) inference, 5) explanation, and 6) self-regulation. Critical thinking skills are assessed by working on practicum guides and evaluation questions. The practical guide and evaluation questions contain questions that contain critical thinking indicators. If correct, each number is given a score of 10.

Work on the practical guide and evaluation questions by five students from the small group test and 20 from the field test. The results of the small group test are the expected effectiveness, and the results of the field group test are the actual effectiveness. Expected and actual effectiveness data were obtained through the Formula 1 modified from Fatmawati (2016). The test values are adjusted to Table 1 to obtain the effectiveness criteria.

$$Ex = \frac{\text{Total score obtained}}{\text{maximum score}} \times 100\% \text{.....Formula 1}$$

$$g = \frac{S_{after} - S_{before}}{S_{maximum} - S_{before}} \text{.....Formula 2}$$

Description:
Ex = Exhaustiveness
g = gain
S = Score

Table 1 Effectiveness Criteria

Percentage	Criteria
80,00 < x ≤ 100	Very effective
60,00< x ≤ 80,00	Effective
40,00< x ≤ 60,00	Effective enough
20,00< x ≤ 40,00	Less effective
0 < x ≤ 20,00	Ineffective

(Source: Modified from Fatmawati, 2016)

The magnitude of the increase in students' critical thinking skills is calculated using Formula 2. To find out the criteria for high and low gain (N-gain) according to Table 2.

Table 2 N-gain Criteria

G value	Criteria
G > 0,7	High
0,7 ≥ g ≥ 0,3	Medium
G < 0,3	Low

(Source: Adapted from Hake, 1999)

C. Results and Discussion

The PSB developed resulted from collecting data in the field, which included questions that could trigger students to think critically. After it was designed, its effectiveness was tested for the PSB. The expected effectiveness of PSB was obtained through small-group tests. This test is carried out in 1 repetition to see that the BIP meets expectations to improve students' critical thinking skills. The actual effectiveness of BIP is based on the results of field tests. This test was carried out three times to see improvements in training students' critical thinking skills.

The test was carried out through practicum using a practicum guide and answering multiple choice evaluation questions to determine the effectiveness of expectations and actual effectiveness. The results of the effectiveness of expectations were obtained in Table 3. Based on the expected effectiveness results in Table 3, it is known that the BIP developed is in the quite effective category with a value of 59. The actual effectiveness test results are in Tables 4, 5 and 6. Based on the actual effectiveness results in Table 4, it is known that the BIP developed is in the effective category. The actual effectiveness results in Table 5 show that the BIP developed is in the effective category. The actual effectiveness results in Table 6 show that the BIP developed is in the very effective category.

Based on the actual effectiveness results, it is known that there is an increase in each meeting. The BIP developed is categorized as effective in improving students' critical thinking skills. Effectiveness is related to the compatibility between main tasks, aspects of behaviour, and things to be achieved (Sholeh, 2016).

Improving students' critical thinking skills includes six indicators of critical thinking skills in field tests, where the BIP developed can be stated to have improved students' critical thinking skills if 4 of the six indicators obtain moderate N-Gain criteria. The results are obtained using the Gain value formula (N-gain or g) summarized in Table 7.

Table 3 The Effectiveness of Expectations

No	Indicator	Practice	Evaluation	Total	Mean
1	Interpretation	60	50	110	55
2	Analysis	50	60	110	55
3	Evaluation	60	60	120	60
4	Inference	65	60	125	63
5	Explanation	60	67	127	64
6	Self-regulation	55	60	115	58
Mean		58	60	118	59

Table 4 Actual Effectiveness of Meeting 1

No	Indicator	Practice	Evaluation	Total	Mean
1	Interpretation	55	53	108	54
2	Analysis	63	70	133	66
3	Evaluation	58	78	135	68
4	Inference	61	70	131	66
5	Explanation	50	60	110	55
6	Self-regulation	54	75	129	64
Mean		57	68	124	62

Table 5 Actual Effectiveness of Meeting 2

No	Indicator	Practice	Evaluation	Total	Mean
1	Interpretation	65	73	138	69
2	Analysis	69	80	149	74
3	Evaluation	63	75	138	69
4	Inference	63	70	133	66
5	Explanation	66	68	135	67
6	Self-regulation	65	80	145	73
Mean		65	74,3	139	70

Table 6 Actual Effectiveness of Meeting 3

No	Indicator	Practice	Evaluation	Total	Mean
1	Interpretation	91	83	174	87
2	Analysis	86	80	166	83
3	Evaluation	85	83	168	84
4	Inference	83	85	168	84
5	Explanation	80	83	163	82
6	Self-regulation	91	90	181	91
Mean		86	84	170	85

Table 7 N-gain Test Results for Students' Critical Thinking Skills

No	Critical Thinking Skills Indicator	N-gain	Criteria
1	Interpretation	0,6	Medium
2	Analysis	0,3	Low
3	Evaluation	0,6	Medium
4	Inference	0,4	Medium
5	Eksplanation	0,5	Medium
6	Self-regulation	0,6	Medium
Mean		**0,5**	
Criteria			**Medium**

The conformity of objectives in the BIP being developed will result in effectiveness, and ultimately, the BIP will help improve students' critical thinking skills. Zaini et al. (2018) said that critical thinking skills include formulating problems, formulating hypotheses, collecting data, analyzing data, and making conclusions in the good category.

Based on the N-gain test results data in Table 7, it can be seen that students' critical thinking skills in terms of actual effectiveness are an average of 0.5, which is included in the medium N-Gain category. Effectiveness research has also been carried out even with different developmental teaching materials, but using similar critical thinking skills, such as Qibtiya & Kustijono (2018) revealed in their research that using e-books is effective for training students' critical thinking skills. Maulyda et al. (2020) also developed teaching materials for fish species in the mangrove area for critical thinking skills with the results of the developed teaching materials also being declared effective because, based on the results, the actual effectiveness of N gain was high with an average value of formulating 0.9, formulating a hypothesis 0.7, collecting data 0.9, analyzing data is 0.8 and draws conclusions of 0.9 in the high category. Fitriani & Setiawan (2022) used an ethnoscience-based science module in their research and found that by using the N-Gain calculation, the result was 0.62, which was included in the medium category, and the results of the study showed that the ethnoscience-based science module could effectively improve students' critical thinking skills. Syehab et al. (2023) developed mathematics teaching materials for mathematical critical thinking. The results of delivery and implementation of mathematics teaching materials on mathematical critical thinking skills are quite strong, with an average of 62% in the quite effective category.

1. Interpretation

The interpretation indicator obtained an N-gain of 0.6 in the medium category based on research data. According to Agnafia (2019), interpretation is the ability to understand a problem's meaning. In line with the statement of Suriati et al. (2021), interpretation is a skill in explaining the definition of a problem. Students' ability to think critically can be said to increase in interpretation. Students carry out practicums using the BIP that has been developed. In the BIP, some questions and statements direct students to orient themselves in studying the problem, where a solution to the problem will be sought. So, it can be seen that students' abilities in the interpretation aspect have increased.

2. Analysis

The N-gain value for the interpretation aspect is 0.3 in the low category. Hasyim (2018) states that analytical skills are divided into three categories: differentiating, organizing and attributing. Students use BIP to help formulate solutions to problems presented in the discourse in the practicum guide. The BIP developed contains lessons that become information to train students in analysis. The low increase in the analytical aspect is because some students are not thorough in making hypotheses, collecting data, and analyzing. Some of the discrepancies exist between the hypothesis and the data analyzed. Research by Benyamin et al. (2021) also reveals that the analyzing aspect is still relatively low.

3. Evaluation

The N-gain value for the evaluation aspect is 0.6 in the medium category. Students' skills in evaluating are visible when students can evaluate an opinion or statement presented in the BIP. Pranoto (2014) said that two abilities describe the ability to evaluate: the ability to assess the credibility of statements and the ability to assess arguments. The BIP that has been developed has several statements where students evaluate the statements so that students' ability to evaluate can be seen.

4. Inference

The inference indicator gets an N-gain for the inference aspect of 0.4 in the medium category. Concluding the solutions found correctly is a critical thinking skill on inference indicators. Students can conclude problems correctly, as Fitrah & Luthfiyah (2018) state, that students' ability to conclude is seen when they interpret data arranged logically and systematically into causal ties for an object of observation. The BIP developed has a logical and systematic structure, enabling students to make accurate conclusions.

5. Explanation

The explanation indicator obtained an N-gain of 0.5 in the medium category. Students' ability to explain can be seen when students identify and describe facts for alleged solutions to problems and can provide appropriate statements regarding these allegations. According to Solikhin & Fauziah (2021), explanation skills are the skills to believe in information logically and provide reasonable arguments based on the results obtained. In BIP, apart from inviting you to formulate a problem and

then look for a solution and ultimately make a conclusion, after making this conclusion, students are directed to be able to explain and provide arguments from the conclusions drawn logically.

6. Self-regulation

The self-regulation indicator obtained an N-gain of 0.6 in the medium category. Self-regulation is a student's ability to regulate their existence when solving a problem. In line with what Sari et al. (2018) stated, the high percentage of self-regulation indicators in their research is because it can be seen from the answers of students who can express opinions on a problem. BIP makes students not only able to express opinions but also able to organize everything about themselves.

Based on the research results, BIP was categorized as effective based on the practicum and evaluation questions results, where a moderate N-gain was obtained with five indicators of medium thinking skills and one indicator of low. It can be concluded that the BIP developed is effective and can improve students' critical thinking skills.

However, the result of developing BIP based on local potential is that it facilitates students in orienting themselves towards the local potential around them (Irwandi & Fajeriadi, 2019; Ridhana et al., 2021; Rahayu et al., 2022), and learning becomes more meaningful with observation activities (Nurlita et al., 2021; Jannah et al., 2022; Fitriani et al., 2022). The existence of this BIP connects students, the environment and ethnobotanical concepts. More broadly, teaching materials developed based on local potential can be adapted to students' critical thinking skills. This potential is promising because it can solve Indonesia's educational challenges, especially regarding reading interests and science skills.

D. Conclusion

The results of research on the development of the PSB "Ethnobotany of the Anacardiaceae Family at KHDTK, Lambung Mangkurat University" can be declared effective in improving students' critical thinking skills with an average N-gain of 0.5, which is in the medium category. This research contributes to developing effective teaching methods for Ethnobotany with PSBs and creating teaching material to improve critical thinking skills.

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