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Effectiveness of popular scientific books on Fabaceae plant in KHDTK ULM to improve critical thinking skill

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Abstract

Local potential can be used as a learning resource to preserve community knowledge in using specific plants and instil a sense of love in students for the potential in their area. Learning resources like Popular Scientific Books (PSB) based on local potential can train students' critical thinking skills. The research aims to describe the effectiveness of the PSB Fabaceae ethnobotany in Forest Areas with Special Purposes (KHDTK) ULM training students' critical thinking skills. The research method uses the Educational Design Research (EDR) model through Tessmer's formative evaluation. The development stages include a small group of 5 students and a field test of 20 Biology Education undergraduate students who have passed the Ethnobotany course one year. Students' critical thinking skills are improved through working on practicum guides and evaluation questions, which contain aspects of critical thinking skills. The research results of students' critical thinking skills are in the medium category, with an average N-Gain of 0.5. Based on these results, it can be concluded that BIP effectively improves students' critical thinking skills. Students who have critical thinking skills are expected to be able to improve the quality of human resources, especially in the field of education.

Abstrak

Potensi lokal dapat dijadikan sumber belajar untuk melestarikan pengetahuan masyarakat dalam pemanfaatan tumbuhan tertentu dan menanamkan rasa cinta mahasiswa terhadap potensi di daerahnya sendiri. Sumber belajar berupa Buku Ilmiah Populer (BIP) berbasis potensi lokal dapat melatihkan keterampilan berpikir kritis mahasiswa. Tujuan penelitian untuk mendeskripsikan keefektifan BIP etnobotani *Fabaceae* di Kawasan Hutan dengan Tujuan Khusus (KHDTK) ULM dalam melatihkan keterampilan berpikir kritis mahasiswa. Metode penelitian menggunakan model *Educational Desain Research* (*EDR*) melalui evaluasi formatif Tessmer. Tahapan pengembangan meliputi kelompok kecil 5 mahasiswa dan uji lapangan 20 mahasiswa S1 Pendidikan Biologi yang telah lulus mata kuliah Etnobotani. Keterampilan berpikir kritis mahasiswa ditingkatkan melalui pengerjaan penuntun praktikum dan soal evaluasi yang memuat aspek keterampilan berpikir kritis. Hasil penelitian keterampilan berpikir kritis mahasiswa berkategori sedang dengan rata-rata N-Gain 0,5. Berdasarkan hasil tersebut dapat disimpulkan BIP efektif dalam meningkatkan keterampilan berpikir kritis mahasiswa. Mahasiswa yang memiliki keterampilan berpikir kritis diharapkan mampu untuk meningkatkan kualitas sumber daya manusia khususnya di bidang pendidikan.

A. Introduction

South Kalimantan has a large forest area. According to Ansari & Tahir (2023), the forest area reached 1,779,982 ha or 42.3 per cent of the South Kalimantan administrative area of 3,700,406 ha. Sultan Adam Forest Park (Tahura) is one of the miniature tropical rainforest areas in South Kalimantan adjacent to the Forest Area with Special Purpose (KHDTK) of Lambung Mangkurat University (ULM). According to Phuspa et al. (2021), KHDTK ULM consists of two locations, namely covering the Gunung Waringin Forest and Babaris Mountains, with an area of 1,617 ha. This forest is rich in local potential and widely used by the surrounding community. Based on this, the local potential in the form of plants in the KHDTK is abundant, especially in the Fabaceae family.

The results of preliminary research on Fabaceae family plants found in KHDTK ULM are broad-leaf acacia (Acacia mangium), small-leaf acacia (Acacia auriculiformis), johar (Senna siamea), tamarind (Tamarindus indica), red dadap (Erythrina crista-galli), putri malu (Mimosa pudica), gelinggang (Cassia alata), peacock flower (Caesalpinia pulcherrima), sengon (Falcataria moluccana), and angsana (Pterocarpus indicus). Based on the results of interviews, it is known that the community utilises these plants in various fields. The interaction of the community with these plants is contained in ethnobotany.

Ethnobotany is an elective course in the Biology Education Study Programme at Lambung Mangkurat University, and this course teaches about the interaction between people and their environment. This study is a descriptive form of documenting the traditional botanical knowledge of the community around the KHDTK. According to Hamidah et al. (2022), ethnobotany learning, namely in the Biology Education Study Programme, has been running well using teaching materials in PSBs. So far, PSBs have been available in the learning process, but they still do not contain much information on local potential plants but contain general material. This shows that ethnobotanical data collection of local potential plants is essential.

It is feared that the development of the times will lead to the degradation of local knowledge about the ethnobotanical use of certain plants. Interviews conducted with communities around KHDTK ULM prove that knowledge about using Fabaceae plants is mostly only known by adults to older people. According to Harumi et al. (2015), the increasing flow of modernisation has resulted in the loss of ethnobotanical knowledge in society, evidenced by most of the informants being elderly. Pandapotan et al. (2018) also convey the importance of local knowledge and that an understanding of local culture is needed so that this local knowledge does not just disappear. Based on the above statements, preserving the ethnobotanical knowledge of Fabaceae in the community is essential by including it in learning resources.

Some examples of learning resources are student work, books, magazines, journals, and newspapers (Muhammad, 2018). Learning resources in the form of PSBs are expected to be able to train students' critical thinking skills. According to Irwandi et al. (2019), learning resources are good, structured, and have systematic steps in training critical thinking skills. The development of PSBs as a learning resource to train critical thinking was carried out by Yulianti et al. (2022) and Musliha et al. (2022). The developed BIP affects critical thinking skills.

Some research on the development of PSBs in the Fabaceae family was conducted by Yulianti et al. (2022) in the Banua Botanical Garden area and Putri et al. (2020) in the Tabanio coastal forest area. Other research on BIP development located in KHDTK was conducted by Noorannisa et al. (2022) on the development of a PSB on ethnobotany of Myrtaceae family and Nufus et al. (2022) on the development of a PSB on ethnobotany of Moraceae family. Based on the results of previous research, it is known that the development of PSBs in the ethnobotany of the Fabaceae family, especially those located in KHDTK ULM, has never been done before.

Based on the description above, researchers are encouraged to research the development of PSBs on Fabaceae Ethnobotany in the ULM Special Purpose Forest Area to improve students' critical thinking skills.

B. Material and Method

The research method used 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.

The assessment of critical thinking skills is from working on the practicum guide and evaluation questions by five students from the small group test and 20 from the field test. The small group test results are expected effectiveness, and the field group test results are actual effectiveness.

Expected and actual effectiveness data were obtained using Formula 1 through the modified formula of Fatmawati (2016). The test scores were

adjusted according to Table 1 to get the categories of students' critical thinking skills.

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

Table 1 Effectiveness Category

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

(Source: Fatmawati (2016)

The improvement of students' critical thinking skills was calculated using Hake's gain formula (1999) as Formula 2. The results of the N-gain calculation are adjusted in Table 2 to obtain the increased magnitude of student's critical thinking skills.

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

Description:
g = gain value
S = Score
After = Critical thinking skills score meeting 3
Before = Critical thinking skills score meeting 2

Table 2 The N-gain Category

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

(Source: Adaptation from Hake, 1999)

C. Results and Discussion

The data generated is in the form of expected effectiveness and actual effectiveness. The expected effectiveness test was repeated once to see whether the BIP was by the researcher's expectations in training students' critical thinking skills. The actual effectiveness test was conducted three times to see the improvement in training students' critical thinking skills.

Critical thinking is essential to develop because it can improve the quality of human resources and develop students' mindset in solving problems and providing solutions to existing problems, especially in everyday life (Della & Syamsurizal, 2021). A summary of expected and actual effectiveness data can be seen in Table 3.

Based on the results of the effectiveness of expectations in Table 3, it is known that the developed BIP is effective at 63.3. This shows that the BIP affects students' critical thinking skills so that if trained continuously, it can train them.

Table 3 Expected Effectiveness

No	Indicator	P	SE	R
1	Interpretation	65	60	62,5
2	Analysis	50	70	60
3	Evaluation	65	60	62,5
4	Inferences	70	70	70
5	Explanation	65	60	62,5
6	Self-Regulation	65	60	62,5
	Total	380	380	380
	Average	63,3	63,3	63,3

Description of Table 3, Table 4, Table 5, and Table 6: P = Practicum; SE = Evaluation Questions; R = Average

Table 4 Actual Effectiveness Meeting 1

No	Indicator	P	SE	R
1	Interpretation	53,8	70	61,9
2	Analysis	57,5	47,5	52,5
3	Evaluation	53,8	65	59,4
4	Inferences	62,5	75	68,8
5	Explanation	52,5	77,5	65
6	Self-Regulation	56,3	90	73,1
	Total	336,3	425,0	380,6
	Average	56,0	70,8	63,4

Table 5 Actual Effectiveness Meeting 2

No	Indicator	P	SE	R
1	Interpretation	66,3	95	81
2	Analysis	67,5	75	71
3	Evaluation	65,0	75	70
4	Inferences	60,0	85	73
5	Explanation	65,0	85	75
6	Self-Regulation	65,0	85	75
	Total	389	500	444
	Average	64,8	83,3	74,1

Table 6 Actual Effectiveness Meeting 3

No	Indicator	P	SE	R
1	Interpretation	88,8	95	91,9
2	Analysis	90,0	87,5	88,8
3	Evaluation	85,0	85,0	85,0
4	Inferences	82,5	95	88,8
5	Explanation	83,8	90	86,9
6	Self-Regulation	88,8	85	86,9
	Total	518,9	537,5	528,2
	Average	86,5	89,6	88,0

Based on the actual effectiveness results in Table 4, Table 5 and Table 6, it is known that the developed BIP is effective. There is an increase in each meeting so that the average reaches 88% in meeting three. This shows that BIP can improve critical thinking skills. Each indicator has increased,

showing the positive impact of using BIP on students' critical thinking skills. The increase in data is shown in Figure 1.

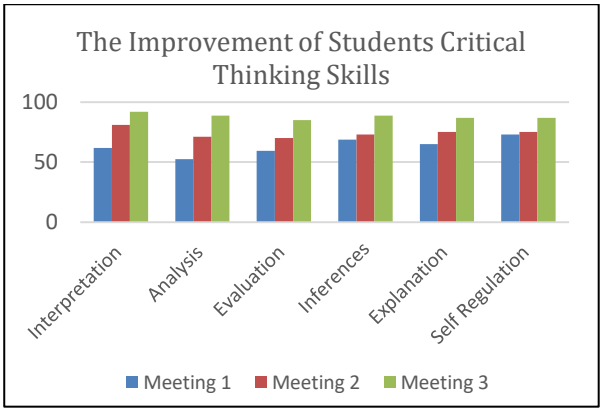

Figure 1
Graph of the improvement of students' critical thinking skills

Based on the data in Picture 1, it can be said that critical thinking skills increase with regular training. The results of Ridhana et al. (2021) show that the N-gain for each session always increases. According to Nuryanti et al. (2019), critical thinking skills are an indispensable skill for facing various social and personal problems.

Agnafia (2019) explains that critical thinking skills are important in solving problems, explaining reasons, and producing evaluations. Setyowati et al. (2018) stated that a student who thinks critically can explore and present a problem's relationship with other problems according to experiences relevant to the problem. In this case, it will be an organised thinking process to solve a problem by involving mental activities that include various abilities. Based on some of these opinions, it can be concluded that critical thinking skills are important for analysing and solving problems relevant to everyday life.

The improvement of student's critical thinking skills includes six indicators obtained in the field test. The results were obtained using the Gain value formula (N-gain or g), summarised in Table 7.

Based on the N-gain test data in Table 7, it can be seen that students' actual critical thinking skills averaged 0.5, which is included in the medium N-gain category. The results show that the BIP draft can train students' critical thinking skills. Effectiveness research has been conducted using a variety of development media using Facione's critical thinking aspects (Adawiyah et al. (2023); Qoni'ah & Kuntjoro (2023); Susilowati & Wisanti (2023) showed that the development product can train students critical thinking skills.

Table 7 Results of N-gain test of Critical Thinking Skills of Students

No	Indicator	N-gain
1	Interpretation	0,6
2	Analysis	0,6
3	Evaluation	0,5
4	Inferences	0,6
5	Explanation	0,5
6	Self-Regulation	0,5
	Average	**0,5**
	Category	**Medium**

Based on the data of each indicator, critical thinking skills in BIP used in learning are as follows.

1. Interpretation

The interpretation indicator in the expected effectiveness is 62.5%, categorised as effective. The actual effectiveness of meeting 1 is 61.9% because students are still adjusting their skills to the interpretation questions in the practicum guide and evaluation questions. Interpretation increased at meeting 2, namely 81% and meeting 2, namely 91.9%. The increase proves that the more interpretation skills are trained, the more students' skills improve. The N-gain value of interpretation is 0.6 in the medium category, indicating that using the developed BIP can train students' interpretation skills.

According to Putri et al. (2019), the interpretation aspect deals with the ability of students to understand the meaning of a concept or problem to measure the student's ability in the problem analysis process.

2. Analysis

The analysis indicator in the expected effectiveness is 60%, which is quite effective. This skill is expected to be higher in actual effectiveness data. The analysis at meeting 1 was 52.5% because students were less in-depth in analysing the practicum guide and evaluation questions. There was an increase in research at meeting two, 71%, and at meeting three, 88%. The N-gain value of analysis is 0.6 in the medium category, indicating that the developed BIP can train student's analysis skills.

According to Adawiyah et al. (2023), the analysis aspect gets a very good category, and this is related to the product developed by the criteria with students' ability to identify ideas. Students can identify plant morphology through questions in student worksheets.

3. Evaluation

The evaluation indicator on the effectiveness of expectations is 62.5% in the effective category. This category has met researchers' expectations, so it is hoped that it can be further improved. The evaluation at meeting 1 was 59.4% because students were less careful in determining the most appropriate things in the practicum guide and evaluation questions. There was an increase in analysis at meeting 2, namely 70% and meeting 3, namely 85%. The evaluation N-gain value of 0.5 is medium, indicating that the developed BIP can train student's evaluation skills.

According to Putri et al. (2019), the evaluation indicator concerns the reasons' validity. In general, the questions prepared can access the improvement of critical thinking skills supported by accommodations in learning activities. According to Adawiyah et al. (2020), evaluation ability is the ability to test the truth of statements used to convey thoughts, perceptions, views, decisions, reasons, and opinions.

4. Inferences

The inference indicator on the effectiveness of expectations is 70% effective category. These results have met the expectations of researchers. The actual effectiveness data of inference at meeting 1 is 68.8% because students have not been accurate in concluding practicum guides and evaluation questions. There was an increase in inference at meeting 2, 73% and at meeting 3, 88.8%. The N-gain analysis value of 0.6 is medium, indicating that the developed BIP can train students' inference skills.

According to Putri et al. (2019), that explanation is the ability to provide logical arguments based on the data that has been obtained. Other research results submitted by Nuraini (2017) show that students' skills in inferring also have good criteria, meaning that students can conclude a subject matter based on arguments and relevant information.

5. Explanation

The explanation indicator on the effectiveness of expectations is 62.5% in the effective category. This result has met the expectations of the researcher. The actual effectiveness data of the explanation at meeting 1 is 65% because students have not been accurate in conveying arguments related to explanatory questions in working on practicum guides and evaluation questions. There was an increase in explanation at meeting 2, namely 75% and meeting 3, namely 86.9%. The N-gain analysis value 0.5 is medium, indicating that the developed BIP can train students' explanation skills. According to Nuraini (2017), the skills of explaining biology students have sufficient criteria because, in reality, biology students have not been able to explain the results, procedures and arguments presented in the problem. The ability to explain to students is still in the stage of explaining according to the concepts they see or meet in reading books only. The ability to explain that is classified as sufficient can be influenced by several factors, including student accuracy in analysing questions or student knowledge because they do not follow the learning process seriously and systematically.

6. Self-Regulation

The self-regulation indicator on the effectiveness of expectations is 62.5% in the effective category. These results have met the expectations of the researchers. The actual effectiveness data of self-regulation has increased per meeting. This shows that the more self-regulation is practised, the more skilled students are in regulating and correcting self-regulation skills. Meeting 1 is 73.1%, meeting 2 is 75% and meeting 3 is 86.9%. The N-gain value of self-regulation is 0.5 in the medium category, indicating that the developed BIP can improve students' self-regulation skills. The research findings of Hyytinen et al. (2023) show that the contribution of self-regulation in test-taking to undergraduate students' critical thinking performance is limited and interestingly mediated by other factors that show the complexity and situationality of the process. Another reason for the limited relationship between self-regulation and critical thinking maybe that time pressure prevents students from using their self-regulatory capacity to the fullest.

According to Nuraini (2017), biology students' self-regulation skills are related to the awareness of each individual to regulate how they learn, recognise weaknesses and strengths in themselves, manage their knowledge well, and monitor and evaluate themselves during the teaching and learning process. Friskilia & Winata (2018), factors that can affect self-regulation in learning are knowledge, motivation and self-discipline or self-will.

Aspects of critical thinking skills in popular science books increased with each session, so that by session three, the average reached 88%, and the average N gain category was medium. Popular science books developed by Ridhana et al. (2021) can be used effectively for learning, with 93% of the results achieved by the third session. The N gain (high category) increased by 0.8 at each session from the first to the third session. Rusmana

et al. (2023) obtained an average N-gain value of 0.5 with a medium category. This indicates that the developed BIP can train critical thinking and is effectively applied in biology learning. Based on the results of previous research, it can be concluded that the developed BIP effectively improves critical thinking skills and can be used in education.

The different data of N-gain results per aspect suggest those students' abilities as research subjects are also different and influenced by certain factors. Aston (2023) showed in his research findings that students can feel the benefits of their critical thinking in terms of skill development and the nature of exploring psychological aspects and sociological factors that influence thinking. Based on the factors mentioned, it can be concluded that critical thinking can be improved internally and externally.

D. Conclusion

The research results on developing BIP "Ethnobotany of Fabaceae in Forest Areas with Special Purposes ULM" were declared effective in improving critical thinking skills. The expected effectiveness of 63% was categorised as effective as expected by the researcher, and the actual effectiveness results from 63.4% to 88%. The average N-gain of 0.5 is included in the medium category, indicating that the developed BIP can improve students' critical thinking skills.

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