



Validity of Rubiaceae ethnobotany popular science book for developing students' critical thinking skills

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Abstract

The use of teaching materials based on local potential among university students remains limited; therefore, a popular science book has been developed to enhance students' critical thinking skills, thereby assisting them in higher education or the workforce. This study aims to describe the validity and practicality of the content of the Popular Science Book (PSB) on the ethnobotany of the Rubiaceae family among the Dayak Bakumpai community for training students' critical thinking skills. This study employed Education Design Research (EDR) using Tessmer's formative evaluation, limited to expert validation and one-to-one testing. The research data consisted of validator questionnaire forms and content appeal (practicality) questionnaire forms. The results of this study yielded a validity score of 91.03 (highly valid) and a content practicality score of 92.95 (very good). Based on these results, it is concluded that the BIP is suitable and practical for use as teaching material based on local potential that is relevant to students' needs in developing critical thinking skills.

Keyword: popular science books; validation; EDR; critical thinking; ethnobotany

Abstrak. Penggunaan bahan ajar pada mahasiswa berbasis potensi lokal masih belum banyak sehingga dikembangkan buku ilmiah populer yang dapat meningkatkan keterampilan berpikir kritis mahasiswa untuk membantu mahasiswa dalam Tingkat Pendidikan lanjutan ataupun dunia kerja. Penelitian ini bertujuan mendeskripsikan validitas dan kepraktisan isi Buku Ilmiah Populer (BIP) etnobotani famili Rubiaceae masyarakat Dayak Bakumpai untuk melatih keterampilan berpikir kritis mahasiswa. Jenis penelitian ini menggunakan Education Design Research (EDR) dengan evaluasi formatif Tessmer yang dibatasi hingga uji validasi ahli dan uji perorangan (one-to-one). Data penelitian ini berupa lembar angket validator dan lembar angket daya Tarik (kepraktisan isi). Hasil penelitian ini memperoleh hasil validitas sebesar 91,03 (sangat valid) dan hasil kepraktisan isi sebesar 92,95 (sangat baik). Berdasarkan hasil penelitian ini disimpulkan bahwa BIP layak dan praktis untuk digunakan sebagai bahan ajar berbasis potensi lokal yang relevan dengan kebutuhan mahasiswa dalam melatih keterampilan berpikir kritis.

INTRODUCTION

Critical thinking skills are among the most essential skills for both the present and the future (OECD, 2024). Higher education today requires students to possess critical thinking skills as an essential competency for solving complex problems and adapting to technological advancements (OECD, 2022). Several research findings indicate that students in Southeast Asia, including Indonesia, struggle to integrate logic when solving problems, particularly in science. Students often fail to identify and address problems, which are key components of critical thinking. Given these conditions, there is a clear need for more effective teaching approaches to develop critical thinking skills (Okolie et al., 2021).

Critical thinking skills are vital for students' academic performance in higher education and for preparing them to face a competitive job market (Facione, 2015). Through these skills, students can develop a strong sense of curiosity, an open-minded attitude, and the ability to think logically. Mastery of these various aspects is linked to improved academic performance and a better understanding of positive correlation analysis in statistics. Furthermore, critical thinking skills have been shown to have a greater impact on career performance than intellectual intelligence (IQ) (Abrami et al., 2015).

Currently, students' critical thinking skills need to be improved to help them navigate higher education and the future workforce (Fajeriadi et al., 2024; OECD, 2024). This is because students lack proficiency in the components of critical thinking skills. Furthermore, there are currently no teaching materials focused on the ethnobotanical study of the Rubiaceae family that help develop students' critical thinking skills. Survey results indicate that teaching materials based on local potential are still scarce. Such locally-based teaching materials can serve as an alternative in the learning process, creating meaningful experiences to stimulate critical thinking skills (Syahfitri & Muntahanah, 2024). Preliminary observations reveal that the Lepas Village possesses high biodiversity. There are several plants with uses employed by the Dayak Bakumpai community. These uses are related to the ethnobotany of plants across various fields of study. The studies conducted include ethnobotany combined with botanical, ethnolinguistic, ethnoeconomic, ethnopharmacological, ethnoecological, and ethnosociological research.

Based on field observations, the Rubiaceae family is one of the families with high species diversity utilized by the Dayak Bakumpai community. Eight species were studied for inclusion in a popular science book: jejaruman (*Tarenna fragrans*), gardenia (*Gardenia jasminoides*), noni (*Morinda citrifolia*), cat's claw (*Uncaria tomentosa*), bangkal (*Nauclea subdita* (Korth.) Steud.), red needle flower (*Ixora paludosa* (Blume) Kurz), yellow needle flower (*Ixora coccinea* L.), and balik angin (*Mussaenda frondosa*). Therefore, it is necessary to develop teaching materials based on local potential, one of which is a popular scientific book on the ethnobotany of the Rubiaceae family among the Dayak Bakumpai community to train students' critical thinking skills. Some relevant studies related to ethnobotany research in Lepas Village include general pharmacological studies that produced popular science books with highly valid and effective results in fostering critical thinking skills (Mardhatillah, 2024). Another study involved the development of a popular science book on the ethno-economics of plants utilized by the Dayak Bakumpai community, yielding practical and effective results for enhancing students' critical thinking skills (Khalidi et al., 2024). In addition, there is also research on the development of a popular science book on the ethnobotany of traditional 7-month bath plants to enhance students' critical thinking skills, which yielded highly valid, practical, and effective results in training students' critical thinking skills (Halwa, 2024).

This previous research demonstrates that the use of popular science books as teaching materials is indeed effective as supplementary materials for ethnobotany courses in training students' critical thinking skills. However, these studies have not yet addressed specific research on the diversity and local potential of the Rubiaceae family. Yet this family exhibits exceptionally high diversity in the region, with at least 8 species frequently utilized by the Dayak Bakumpai community. Consequently, this local potential has not yet been integrated into the curriculum through teaching materials such as popular science books to foster critical thinking skills.

Integrating local potential into learning materials is crucial because students can solve environmental problems more easily when learning resources align with the challenges in their surrounding environment (Mumpuni et al., 2013). Given that the Rubiaceae family exhibits high species diversity in terms of local utilization, it is highly suitable for study and research. The objective of this study is to determine the validity and practicality of the content of the popular science book that has been developed. The validity test aims

to assess the book's suitability for use and to proceed to subsequent research phases. The practicality test aims to evaluate the product's appeal and usability as assessed by users (students).

The benefit of this research is the production of a book that can serve as a primary resource for teaching the ethnobotany course by the instructor. For students, it can help develop their critical thinking skills. Additionally, the findings of this book review can summarize various plants used by the Dayak Bakumpai community in various aspects of ethnobotany studies, so that they not only understand the practical uses of plants but also gain knowledge of their utilization based on scientific principles. Therefore, the researchers were interested in determining the validity, practicality, and effectiveness of using the BIP for an ethnobotanical study of the Rubiaceae family among the Dayak Bakumpai community to develop students' critical thinking skills.

RESEARCH METHODS

The method used in this study was EDR (Educational Design Research) employing Tessmer's (1993) formative evaluation design. There are five stages in Tessmer's formative evaluation process: the self-evaluation stage during product design, the expert review to determine the results of BIP expert validation, and the one-to-one evaluation to assess the practicality of the content. The research stages are illustrated in Figure 1. The research period is 2024–2025. The research subjects for the expert review consisted of three expert lecturers, while the one-to-one evaluation consisted of three students; the small number of subjects was due to the limited number of students taking the ethnobotany course. Data collection techniques involved using the results of the validity questionnaire test (aspects: coherence, vocabulary, meaning, and readability) and the practicality test (aspects: presentation and delivery of material).

In the validity test, calculations were performed using the validity formula shown in Formula 1 and the formula for calculating content practicality shown in Formula 2. Categorization was then performed based on several validity assessment indicators shown in Table 1 and the practicality assessment categories in Table 2. The research instruments used were an expert validation questionnaire and a content practicality questionnaire. The research analysis was conducted using quantitative descriptive research, specifically regarding validity and content practicality.

$$\text{Average validity} = \frac{\text{Average number per validator}}{\text{Number of validators}} \dots\dots\dots \text{Formula 1}$$

$$\text{Average practicality} = \frac{\text{Total score obtained}}{\text{Maximum score}} \times 100 \dots\dots\dots \text{Formula 2}$$

Table 1 Validity Assessment Categories

No.	Scale (%)	Categories
1.	85 – 100	Highly valid (Appropriate)
2.	65 – 84	Valid (Appropriate)
3.	45 – 64	Less Than Ideal (Appropriate)
4.	0 – 44	Not Valid (Not Appropriate)

(Source: Adaptation by Akbar, 2013)

Table 2 Practicality Assessment Categories

No.	Scale (%)	Categories
1.	80 < P ≤ 100	Very good
2.	60 < P ≤ 80	Good
3.	40 < P ≤ 60	Good enough
4.	20 < P ≤ 40	Not good
5.	< 20	Bad

(Source: Ramadhan et al., 2020)

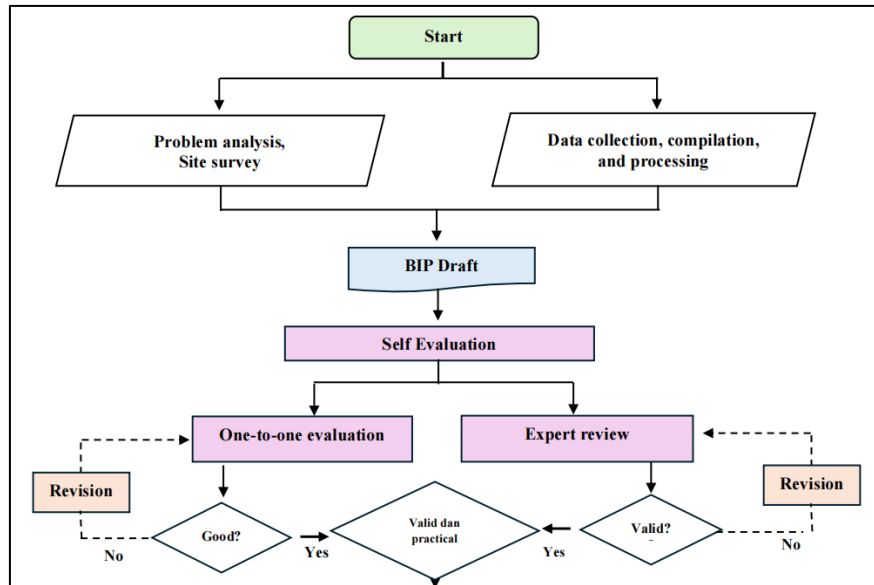


Figure 1 The research stages (Source: Adaptation from Tessmer, 1993)

RESULTS AND DISCUSSION

This study produced validity to test the quality of popular scientific books from expert validation questionnaires based on comments or input from experts. This stage is necessary and important because authors can identify weaknesses and shortcomings in their products based on criticism and input from validators (Husna et al., 2025). Then, after being declared valid, an individual test (one-to-one evaluation) was conducted to determine the attractiveness of the product (Fahmi et al., 2021).

Based on the results of the expert validation test assessed by three expert lecturers on the popular science book that had been developed, the overall average score was 91.03, which is classified as highly valid. A summary graph of the expert validation results can be seen in Figure 2. According to the assessment criteria by Akbar (2013), a score with an average of more than 70% can be said to be valid, and a score of more than 85% is categorized as highly valid. These results indicate that the book is well organized and can be used. Books that have been validated and declared to be logically structured can be used even without prior revision (Husna et al., 2025).

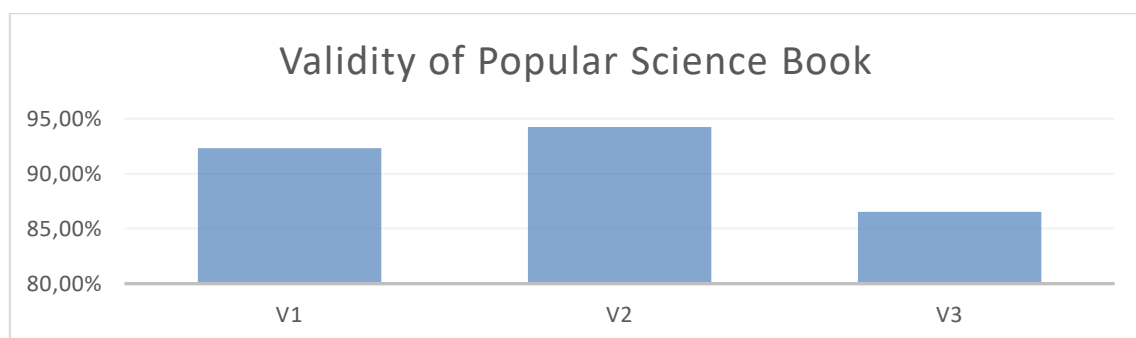


Figure 2 Results of validity of popular science book

Description:

V1 = Validator 1; V2 = Validator 2; V3 = Validator 3

Popular science books are one of the learning media that can help students understand their studies because they use a popular presentation style with accurate scientific studies, making it easier for students to understand various complex concepts in a more enjoyable and practical way (Husna et al., 2025). The validity of popular science books is assessed by evaluating several aspects, namely coherence, readability, vocabulary, active and passive sentences, word meaning, application and implications, definitions and

explanations, and other stylistic devices. Based on the validation results, several aspects were assessed as highly valid, namely readability, vocabulary usage, active and passive sentence usage, word meaning (format), three writing criteria in terms of coherence, application and implication, definitions and explanations, and other stylistic devices. This proves that the coherence in terms of clear and systematically arranged main ideas in each paragraph, the sentences that make up the paragraph are consistent and lead to an understanding of a single concept.

In terms of readability and vocabulary selection, it is appropriate for higher education and the use of excessive expressions has been reduced. This is in line with the characteristics of popular scientific books that prioritize language efficiency without reducing their scientific weight. The selection of active sentences and avoidance of ambiguous words makes it easier for students to grasp concepts quickly. Meanwhile, in terms of scientific communication strategies, analogies and narratives are the main strengths of this book. This is because the use of simple words and operational verbs facilitates students in practicing their critical thinking skills and raises current issues and their implementation in the real world, making the material not only theoretical but also practical and relevant to the readers' needs. This is in line with Firmansyah et al. (2023), who state that the use of simple narratives and real issues in the content of popular science books is the main key to improving science literacy, because students feel more connected to the concepts presented than conventional textbooks, which tend to be rigid. Then there is one aspect that has the lowest score even though it is valid, namely the use of connecting words between paragraphs, which needs improvement. Putri et al. (2020) added that the proportional use of active and passive sentences in the narrative of popular science books helps students understand scientific steps more intuitively.

Several previous studies support this research because they share the same research area and similar concepts but focus on different aspects: Khalidi et al. (2024) specifically, an ethno-economic study; Mardhatillah (2024), an ethno-pharmacological study; and Halwa (2024), an ethno-botanical study of plants used in the 7-month postpartum bathing tradition. Therefore, this study complements previous research on the ethnobotany of plants utilized by the Dayak Bakumpai community to develop students' critical thinking skills. All these studies have proven to produce valid and practically applicable popular science books based on local potential; however, this study offers a more detailed research context, specifically focusing on the Rubiaceae family

A weakness of the book developed in this study lies in the coherence of the transitional words used between paragraphs; therefore, improvements are needed so that readers can better understand the book and more effectively develop their critical thinking skills. After making revisions based on the validators' feedback, the next step was to test the content's appeal or practicality through an individual evaluation (one-to-one evaluation). This stage is crucial for assessing the quality and suitability of the content for students or readers. A summary of the results of the content practicality test is shown in Figure 3.

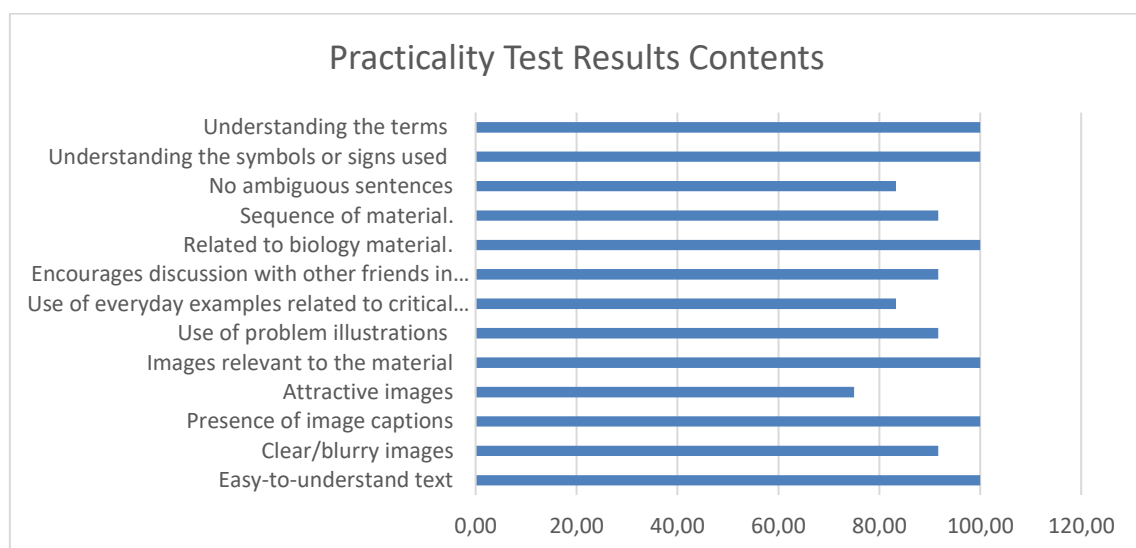


Figure 3 Practicality test results contents

The results of this practicality test obtained an overall average score of 92.95% with a very good category. This high score indicates that this book has met the standards as a suitable learning medium at the university level. The score is supported by the use of terms and symbols that are easy for students to understand and are related to critical thinking. The material in the book is also easy to understand, the images are of good quality, and each image has a description that is relevant to the context of the material. This finding is supported by the research of Husna et al. (2025) that the validity and practicality of locally-based teaching materials are highly dependent on the clarity of the narrative and visualization of the material, which is able to bridge theory with the reality in the field. This is because the use of high-quality images accompanied by contextual descriptions minimizes ambiguity in students' understanding.

The book explains concepts using real-life examples and scenarios designed to stimulate critical thinking. This critical thinking has the potential to encourage students to engage in discussions with their peers. The use of biology material in the Ethnobotany course, integrated with real-life problem scenarios, has the potential to help students understand the subject in a more realistic and scientific manner. As noted by Firmansyah et al. (2023), instructional materials that present problems in a realistic manner and use operational terms can enhance students' cognitive engagement. Dharmono et al. (2020) added that textbooks capable of sparking group discussions indicate that the content is not only informative but also intellectually provocative, which aligns with the principles of Research-Based Learning in higher education.

The logical flow of the material and the use of unambiguous sentences make it easy for students to grasp the material quickly. Furthermore, a crucial aspect of this book is its ability to stimulate critical thinking, which ultimately fosters social interaction through discussions among students. This aligns with the view of Irianti et al. (2021) that popular science books can be considered highly valid and practical because they simplify complex scientific classifications through the use of analogies and illustrations; thus, the narrative supports the idea that such books are effective because they successfully avoid unnecessary jargon. Consequently, students' comprehension becomes more focused and efficient.

Areas that need improvement in this research phase include the use of more real-life examples related to critical thinking, as well as the need for more engaging images. This is due to the limited number of images the researcher could obtain, as it was difficult to find sources because of time constraints and flooding in the area. Therefore, future researchers need to conduct more in-depth research to obtain engaging images that align with the context of the book being developed. This is necessary to further increase student engagement.

CONCLUSION

The expert review of the popular science book yielded an overall average score of 91.03%, classified as "highly valid," making it suitable for the next phase of testing—the one-to-one evaluation—to assess the practicality of its content. The content practicality results yielded an average score of 92.25%, categorized as "very good." This indicates that the popular science book is highly valid and practical, allowing it to proceed to the next research phase—the effectiveness phase—before implementation. A recommendation for future research is to continue the study through an actual effectiveness test to determine the effectiveness of using popular science books. Additionally, researchers should integrate digital technology to enhance the visual and interactive aspects—which have already been rated positively—to align with modern learning needs that demand more dynamic and easily accessible instructional materials.

REFERENCES

- Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, A. A., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research*, 85(2), 275–314. <https://doi.org/10.3102/0034654314551063>
- Akbar, S. (2013). *Instrumen perangkat pembelajaran*. Remaja Rosdakarya.
- Dharmono, D., Mahrudin, M., & Riefani, M. K. (2019). Kepraktisan handout struktur populasi tumbuhan rawa dalam meningkatkan keterampilan berpikir kritis mahasiswa pendidikan biologi. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 1(2), 99-104. <https://dx.doi.org/10.20527/binov.v1i2.7864>
- Facione, P. A. (2013). *Critical thinking: What it is and why it counts*. Insight Assessment. <https://www.law.uh.edu/blakely/advocacy-survey/Critical%20Thinking%20Skills.pdf>

- Fahmi, F., Fajeriadi, H., & Irhasyuarna, Y. (2021). Feasibility of the prototype of teaching materials on the topic of classification of living things based on the advantage of local wetland. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 3(2), 113-118. <https://dx.doi.org/10.20527/bino.v3i2.10322>
- Fajeriadi, H., Zaini, M., Dharmono, D., Nugroho, B. A., Fahmi, F., & Fitriani, A. (2024). The popular scientific book-based coastal gastropod's diversity as local potential: Practicality and effectiveness on student's critical thinking ability. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 10(2), 580-590. <https://doi.org/10.22219/jpbi.v10i2.32255>
- Firmansyah, R., Habib, I. M. A., & Prihandini, D. R. (2023). Application of popular scientific books to improve students' scientific literacy. *International Social Sciences and Humanities*, 2(2). <https://doi.org/10.32528/issv.v2i2.262>
- Halwa, A. (2024). *Pengembangan buku ilmiah populer etnobotani tumbuhan tradisi mandi tujuh bulan pada masyarakat Dayak Bakumpai Kelurahan Lepas untuk melatih kemampuan berpikir kritis* (Unpublished master's thesis). Universitas Lambung Mangkurat.
- Husna, D. K., Mahrudin, M., & Utami, N. H. (2025). Validitas buku ilmiah populer keragaman jenis vegetasi pohon di tepian sungai kawasan Bendung Amandit Desa Malutu pada mata kuliah ekologi lahan basah. *ORYZA: Jurnal Pendidikan Biologi*, 14(2). <https://doi.org/10.33627/oz.v14i2.3537>
- Irianti, R., Dharmono, & Mahrudin, M. (2021). Analisis kepraktisan buku ilmiah populer keanekaragaman jenis ikan berbasis penelitian sebagai bahan pengayaan mata kuliah zoologi vertebrata konsep ikan. *Wahana-Bio: Jurnal Biologi dan Pembelajarannya*, 13(1), 52-63. <https://ppjp.ulm.ac.id/journal/index.php/wb/article/download/9599/7318>
- Khalidi, M., Zaini, M., & Kaspul, K. (2024). Pengembangan lembar kerja peserta didik elektronik kelas reptilia untuk keterampilan berpikir kritis siswa dan keterampilan kinerja siswa SMA. *Jurnal Inovasi Pembelajaran Biologi*, 5(1), 12-21. <https://doi.org/10.26740/jipb.v5n1.p12-21>
- Mardhatillah, R. (2024). *Pengembangan buku ilmiah populer etno-farmakologi pada masyarakat Dayak Bakumpai untuk melatih keterampilan berpikir kritis mahasiswa* (Unpublished master's thesis). Universitas Lambung Mangkurat.
- Mumpuni, K. E., Susilo, H., & Fathur, R. (2013). Potensi tumbuhan lokal sebagai sumber belajar biologi. In *Prosiding Seminar Nasional XI Pendidikan Biologi FKIP UNS* (pp. 823-829). <https://jurnal.uns.ac.id/prosbi/article/download/7922/7086>
- OECD. (2022). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://www.oecd.org/en/publications/pisa-2022-results-volume-i_53f23881-en.html
- OECD. (2024). *Education at a glance 2024: OECD indicators*. OECD Publishing. https://www.oecd.org/en/publications/education-at-a-glance-2024_c00cad36-en.html
- Okolie, O. T., Igwenagu, P. C., & Uzordinma, C. E. (2021). Enhancing students' critical thinking skills through engagement with innovative pedagogical practices in the Global South. *Higher Education Research & Development*, 41(4), 1-15. <https://doi.org/10.1080/07294360.2021.1896482>
- Putri, A. I., Dharmono, D., & Zaini, M. (2020). Validitas buku ilmiah populer keanekaragaman spesies family Fabaceae dalam meningkatkan keterampilan proses sains mahasiswa. *Quantum: Jurnal Inovasi Pendidikan Sains*, 11(2), 186-195. <https://doi.org/10.20527/quantum.v11i2.8822>
- Ramadhan, F., Soendjoto, M. A., & Dharmono, D. (2020). Practicality pocketbook "Keanekaragaman Lepidoptera di hutan mangrof". *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 2(2), 71-75. <https://dx.doi.org/10.20527/bino.v2i2.8551>
- Syahfitri, J., & Muntahanah, M. (2024). The effectiveness of local wisdom-based interactive digital module on students' critical thinking disposition. *International Journal of Evaluation and Research in Education*, 13(4), 2171-2178. <https://doi.org/10.11591/ijere.v13i4.28256>
- Tessmer, M. (1993). *Planning and conducting formative evaluations*. Cogan Page.