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Learning Module Based Problem-Based Learning Local Wisdom *Lubuk Larangan* to Improve Critical Thinking and Learning Interest of Students

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Learning Module, Problem Based Learning, Local Wisdom, Critical Thinking and students Interest.

Abstract

Biology learning at the senior high school level often involves complex material that requires not only deep understanding but also high motivation. Observations at SMAN 3 Panyabungan revealed that students demonstrated low levels of critical thinking and interest in learning, as the teaching approach primarily relied on textbooks and worksheets without incorporating engaging or contextual media. To address this issue, a Biology Learning Module based on Problem-Based Learning (PBL) was developed, integrating the local wisdom of Lubuk Larangan. This study employed a Research and Development (R&D) approach, utilizing the ADDIE model, which comprises analysis, design, development, implementation, and evaluation stages. The research subjects were Grade X Phase E students of SMAN 3 Panyabungan in the 2024/2025 academic year. Data were collected using validity questionnaires, practicality questionnaires, motivation questionnaires, and test instruments. The developed module achieved a validity score of 95.6% (very valid) and a practicality score of 4.0 (very practical). In terms of effectiveness, the module significantly improved students' critical thinking skills and increased their learning interest, with an average percentage of 73.2% (classified as good). The Biology Learning Module, based on Problem-Based Learning (PBL) and integrated with Lubuk Larangan local wisdom, is valid, practical, and effective in improving students' motivation, learning interest, and argumentation skills, particularly in ecosystem-related topics.

Kata kunci:
(modul pembelajaran, PBL, kearifan lokal, berpikir kritis dan minat belajar siswa

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Abstrak

Pembelajaran biologi di tingkat sekolah menengah atas sering kali melibatkan materi yang kompleks sehingga memerlukan pemahaman mendalam sekaligus motivasi belajar yang tinggi. Hasil observasi di SMAN 3 Panyabungan menunjukkan bahwa peserta didik memiliki kemampuan berpikir kritis dan minat belajar yang rendah, karena pembelajaran masih berfokus pada buku paket dan lembar kerja tanpa media yang menarik maupun kontekstual. Untuk mengatasi permasalahan tersebut, dikembangkan Modul Pembelajaran Biologi berbasis Problem-Based Learning (PBL) yang terintegrasi dengan kearifan lokal Lubuk Larangan. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan model ADDIE yang meliputi tahap analisis, desain, pengembangan, implementasi, dan evaluasi. Subjek penelitian adalah peserta didik kelas X Fase E SMAN 3 Panyabungan pada tahun ajaran 2024/2025. Data dikumpulkan melalui angket validitas, angket praktikalitas, angket motivasi, dan instrumen tes. Modul yang dikembangkan memperoleh skor validitas sebesar 95,6% (sangat valid) dan skor praktikalitas 4,0 (sangat praktis). Dari segi efektivitas, modul ini terbukti mampu meningkatkan kemampuan berpikir kritis peserta didik serta meningkatkan minat belajar mereka dengan persentase rata-rata sebesar 73,2% (kategori baik). Dengan demikian, Modul Pembelajaran Biologi berbasis Problem-Based Learning (PBL) bermuatan kearifan lokal Lubuk Larangan dinyatakan valid, praktis, dan efektif dalam meningkatkan motivasi, minat belajar, serta kemampuan argumentasi peserta didik, khususnya pada materi ekosistem..

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INTRODUCTION

The improvement of learning quality in Indonesia continues to face significant challenges, particularly in terms of methodological innovation and students' active engagement (Dewi, 2015). Ideally, the learning process should not only serve as a means of transferring knowledge but also function as a platform for developing critical thinking skills and fostering students' learning interest. However, classroom practices still rely heavily on ready-made instructional materials such as textbooks and student worksheets (LKPD), which tend to be textual, less contextual, and insufficient to stimulate deep thinking among students (Kosasih, 2021). As a result, students often show low participation, limited problem-solving skills, and reduced motivation to learn. These challenges indicate that innovative and contextual learning strategies are urgently needed to enhance students' learning quality.

Learning modules are widely recognized as an effective alternative for improving learning outcomes because they enable students to study independently in a structured and competency based manner (Majid, 2017; Nurdyansyah, 2018). Nevertheless, most existing modules remain generic and have not yet been integrated with contextual approaches that connect learning materials to students' socio-cultural environments. The integration of local wisdom into the Problem-Based Learning (PBL) model provides a promising solution, as it allows students to engage with real-world problems while internalizing local values and cultural understanding. Previous studies have demonstrated that PBL integrated with local wisdom can enhance students' higher-order thinking skills, creativity, and collaboration (Irsan et al., 2023; Balaya & Zafi, 2020). However, the application of such integration in biology learning—particularly in ecosystem topics that require contextual understanding—remains limited. This gap highlights the need for developing a learning module that meaningfully combines the principles of PBL with local wisdom.

Preliminary interviews with biology teachers at SMA Negeri 3 Panyabungan (September 10, 2024) revealed that the learning process still relies predominantly on textbooks and LKPD. Ecosystem materials, which are abstract and conceptually demanding, have not been presented in an engaging and contextualized manner. Consequently, students experience difficulties in understanding concepts, exhibit low learning motivation, and show underdeveloped critical thinking skills. Learning outcome data further indicate that approximately 30 students scored below the Minimum Competency Criteria (KKTP), suggesting that the learning objectives have not been effectively achieved. One of the weaknesses observed in implementing the PBL model is that students' learning interest remains low because they are immediately presented with problems at the beginning of learning without sufficient contextual engagement. Therefore, integrating local wisdom into the PBL model is expected to make learning more relatable and stimulating for students.

In response to these conditions, this study focuses on developing a PBL-based learning module integrated with local wisdom, specifically *Lubuk Larangan*, a traditional ecological practice found in the local community. The integration of *Lubuk Larangan* within the module is intended to help students analyze authentic environmental problems, formulate alternative solutions, and critically evaluate the ecological and social impacts of those solutions. The developed module is expected to enhance both students' critical thinking skills and learning interest, particularly in the Grade X ecosystem topic. Accordingly, this study aims to develop a PBL-based learning module incorporating local wisdom that is valid, practical, and effective in improving students'

critical thinking skills and learning motivation, as well as to examine students' responses to the module to determine its overall effectiveness.

RESEARCH METHODS

This research employed a Research and Development (R&D) design that combined qualitative and quantitative approaches as suggested by Creswell (2014). The R&D approach was selected because it aligns with the main objective of this study, which was to develop and evaluate a specific educational product in the form of a learning module. The ADDIE model—consisting of Analysis, Design, Development, Implementation, and Evaluation stages (Sugiyono, 2018)—was adopted to guide the systematic development of a Problem-Based Learning (PBL) module integrated with local wisdom, particularly *Lubuk Larangan*, for teaching ecosystem materials. Each stage of the ADDIE model was carried out sequentially to ensure that the resulting product met the required standards of validity, practicality, and effectiveness.

The research was conducted from September to November 2024 at SMA Negeri 3 Panyabungan. Data were collected through various techniques to obtain a comprehensive evaluation of the developed module. Classroom observations were conducted to examine the learning environment and student engagement during biology lessons. Needs analysis, practicality, and learning interest questionnaires were administered to 30 students and two biology teachers to identify existing problems and perceptions regarding the module's usability, efficiency, attractiveness, and motivational aspects. Product validation was performed through expert review involving three validators specializing in language, content, and media or design. Each expert provided suggestions and feedback, which were used to revise and refine the module. In addition, teacher interviews were conducted to gain qualitative insights into learning challenges and classroom practices, while documentation techniques were employed to collect relevant curriculum artifacts, lesson plans, and teaching materials aligned with the Merdeka Curriculum.

The research subjects consisted of 60 students selected from two classes out of a total population of 192 students through purposive sampling, based on their relatively low levels of critical thinking and learning motivation. Data analysis was performed to determine the validity, practicality, and effectiveness of the developed module. Validity was assessed using expert validation sheets evaluated on a Likert scale, where a module was categorized as valid if it achieved a minimum score of 61%. Practicality was analyzed based on the teachers' and students' responses related to the ease of use, efficiency, and attractiveness of the module. The module's effectiveness was measured using pretest and posttest scores of students' critical thinking skills and learning interest, analyzed through N-Gain scores to determine improvement. Furthermore, hypothesis testing was conducted using a T-Test or Mann-Whitney U test, depending on the normality of the data distribution. These analyses provided comprehensive evidence regarding the feasibility and impact of the developed PBL-based learning module integrated with local wisdom on improving students' learning quality.

RESULTS AND DISCUSSION

Result

This study focuses on the development of a Problem Based Learning (PBL) module incorporating the local wisdom of Lubuk Larangan, conducted at SMAN 3 Panyabungan. Several aspects were examined in the study of this PBL module development: (1) the results of the module development, (2) product validity assessment, (3) the practicality for teachers and students, and (4) the effectiveness of the PBL module incorporating Lubuk Larangan local wisdom.

First, an analysis was conducted using teacher and student questionnaires. Initial data were obtained through interviews and classroom observations. Based on this preliminary analysis, it was concluded that teachers faced difficulties in delivering the material, which directly affected students' low critical thinking skills. Additionally, there was a lack of learning media that could support the teaching process and actively involve students in activities that enhance critical thinking and learning interest. To address this, the researcher developed needs questionnaires for teachers and students to refine the learning media concept. Data analysis showed that teaching was predominantly conducted using lectures. The learning materials commonly used by teachers and students in biology classes included PowerPoint presentations, modules, worksheets (LKPD), textbooks, and learning videos. Students had difficulty understanding biology material because the ecosystem topics were abstract and not directly observable. Furthermore, the available learning materials at the school were not contextual or aligned with the students' everyday experiences.

Second, the design stage. The design phase in this study involved developing the learning module in accordance with the Merdeka Curriculum structure. This included determining the systematic organization and presentation of the content, covering the cover page, module instructions, learning outcomes (CP), learning objectives (CP), achievement of learning objectives, indicators (IKTP), learning materials, worksheets (LKPD), and references. The module contains a collection of materials on ecosystems and connects them with the local wisdom of Lubuk Larangan. At this stage, the researcher also focused on the aesthetic aspects and the suitability of the learning content. The media background was designed in green and yellow to make it visually appealing, keeping students engaged and enthusiastic in using it as a learning resource.

Figure 1. Display of the Learning Module Based Problem-Based Learning *Local Wisdom* Lubuk Larangan

Third, the development stage. The PBL-based learning module incorporating Lubuk Larangan local wisdom was developed using Canva and Microsoft Word. Its feasibility was assessed through product validation covering four aspects: content validity, language, presentation, and graphics. Validation was conducted by three experts in language, design, and learning materials. Based on the data analysis, the product achieved an average validity score of 95.6%, which falls into the very valid category. Based on the practicality assessment, the learning module was assessed as practical by teachers and students with an average score of 4 and 3.6 respectively and an average percentage of 76.5%. This module is effective, easy to use, and has clear instructions. The highest aspect is related to learning effectiveness (78.9%), while the lowest aspect is related to preventing boredom and making things easier for teachers (72.7%).

The fourth stage is implementation. At this stage, the validated learning module is implemented. The effectiveness of the module in improving students' critical thinking skills and learning interest is assessed through comprehensive data analysis, considering both pretest and posttest results. The N-Gain analysis indicates that the after the treatmental class showed greater improvement in learning outcomes compared to the before the treatment class. This is reflected in higher average scores, no decrease in scores, and a stable data distribution close to normal. In the before the treatment class, the average pretest score was 51, which increased to 66.26 in the posttest. In contrast, the after the treatmental class using the Problem-Based Learning (PBL) module integrated with the Lubuk Larangan local wisdom showed a more significant improvement, with the average pretest score of 58.83 rising to 91.96 in the posttest. Further details are presented in Table 1.

Tabel 1. *Average Score of Students' Critical Thinking Abilities*

No	Class	N	Pretest	Postest	N-Gain Score	Category
1	Before the treatment	30	51.00	66.26	0.25	Ineffective
2	After the treatment	30	58.83	91.96	0.80	Effective

The data in Table 1 presents the average scores of students' critical thinking abilities in both the before and after the treatment classes. Before the treatment class, consisting of 30 students, had a pretest average of 51.00 and a posttest average of 66.26, resulting in an N-Gain score of 0.25, which falls into the Ineffective category. In contrast, the after the treatmental class, also with 30 students, showed a pretest average of 58.83 and a posttest average of 91.96, yielding an N-Gain score of 0.80, categorized as Effective. These results indicate that the implementation of the Problem Based Learning (PBL) module integrated with *Lubuk Larangan* local wisdom had a significant positive impact on students' critical thinking skills. After the treatment class not only started with a slightly higher pretest score but also achieved a much greater improvement compared to the before the treatment class, demonstrating the effectiveness of the developed module in enhancing students' critical thinking abilities.

Considering the difference between the posttest scores of the before and after the treatment classes, a further t-test analysis is required. The t-test analysis was conducted using the *SPSS ver 23* application. The following is a table of the results of the t-test analysis in the before the treatment and after the treatmental classes.

Tabel 2. Results of T-Test Analysis of Critical Thinking Ability in Before and After Treatment Classes

No	Class	N	*Mean*	*Std. Deviation*	*Std. Error Mean*	*Sig. (2-tailed)*
1	After the treatment	30	91.97	4.552	0.831	.000
2	Before the treatment	30	66.70	5.796	1.058	

Table 2 presents the results of the t-test analysis of students' critical thinking ability in the before and after treatment classes. The data show that the after the treatment class achieved a mean score of 91.97 with a standard deviation of 4.552 and a standard error mean of 0.831. In contrast, the before the treatment class obtained a lower mean score of 66.70 with a standard deviation of 5.796 and a standard error mean of 1.058. The significance value (Sig. 2-tailed) obtained was 0.000, which is less than the threshold of 0.05. This indicates that there is a statistically significant difference between the two groups. In other words, the use of the Problem-Based Learning (PBL) module integrated with Lubuk Larangan local wisdom had a positive impact on students' critical thinking ability.

The higher mean score in the after treatment class compared to the before treatment class demonstrates that the developed PBL-based learning module was effective in improving students' critical thinking skills. These results confirm that incorporating contextual learning with local wisdom not only enhances understanding of ecosystem concepts but also strengthens higher-order thinking skills.

The analysis of students' learning interest questionnaire data was carried out to determine students' interest and engagement in the learning process. This data was obtained through the distribution of questionnaires to students in both the before and after the treatment classes. The results of the analysis provide an overview of the effect of the treatment given on students' learning interest, as well as a comparison between the two groups.

Tabel 3. Results of Students' Learning Interest in the Before and After the Treatment Classes

No	Indicators of Students' Learning Interest	Percentage Before the treatment	Percentage After the treatment	*Mean*	Criteria
1	Feeling of Enjoyment	67	93	80	Very Good
2	Student Involvement	70	94.2	82.1	Very Good
3	Interest	68.3	93.8	81	Very Good
4	Students' Attention	56	92	74	Good
	Average	**65.3**	**93.2**	**79.2**	**Good**

The comparative analysis between the before and after treatmen classes revealed that the implementation of a Problem-Based Learning (PBL) module incorporating the local wisdom of *lubuk larangan* had a significant effect on students' learning interest. The after the treatmental class showed improvements across all indicators when compared to the before the treatment class. These findings suggest that the instructional approach applied in the after the treatmental class was effective in fostering students' enjoyment, engagement, interest, and attention throughout the learning process.

The comparative analysis between the class before and after the treatment class revealed that the implementation of a Problem-Based Learning (PBL) module incorporating the local wisdom of *lubuk larangan* had a significant effect on students' learning interest. The class after the treatment showed improvements across all indicators when compared to the class before the treatment. Afterward, a t-test was conducted on both groups to measure students' learning interest. These findings suggest that the instructional approach applied after the treatment was effective in fostering students' enjoyment, engagement, interest, and attention throughout the learning process.

Tabel 4. Results of T-Test Analysis of Students' Interest Ability in Before and After the Treatment Classes

No	Class	N	*Mean*	*Std. Deviation*	*Std. Error Mean*	*Sig. (2-tailed)*
1	After the treatment	30	93.25	0.971	0.486	.000
2	Before the treatment	30	65.33	6.337	3.168	

Table 4 presents the results of the t-test analysis of students' learning interest ability in the before and after treatment classes. The results indicate that the after the treatment class achieved a mean score of 93.25 with a standard deviation of 0.971 and a standard error mean of 0.486. Meanwhile, the before the treatment class obtained a lower mean score of 65.33 with a standard deviation of 6.337 and a standard error mean of 3.168. The significance value (Sig. 2-tailed) obtained was 0.000, which is smaller than 0.05. This result demonstrates that there is a significant difference in students' learning interest between the before and after treatment classes.

The notable increase in the mean score after the treatment indicates that the use of the Problem-Based Learning (PBL) module integrated with Lubuk Larangan local wisdom was effective in enhancing students' interest in learning. This finding suggests that the integration of contextual and culturally relevant materials into the learning process not only enriches the content but also stimulates greater enthusiasm and engagement among students.

Discussion

The findings of this study demonstrate that the development and implementation of a Problem-Based Learning (PBL) module incorporating the local wisdom of *Lubuk Larangan* contributed positively to students' learning outcomes, particularly in terms of critical thinking skills and learning interest.

First, the effectiveness of the developed module was evident in the N-Gain analysis. Students in the after-treatment class achieved a substantial increase in their average scores, from 58.83 in the pretest to 91.96 in the posttest, categorized as "effective" (N-Gain = 0.80). In comparison, the before-treatment class showed only a modest improvement, with scores increasing from 51.00 to 66.26 (N-Gain = 0.25), categorized as "ineffective." These results confirm that the PBL module integrating *Lubuk Larangan* local wisdom is more effective than conventional learning methods in enhancing students' critical thinking skills. This supports the idea that contextual and problem-oriented learning environments enable students to connect abstract concepts with real-world experiences, thereby strengthening their reasoning and analytical skills (Hmelo-Silver, 2004; Savery, 2015).

Second, the results of the t-test analysis further validate these findings. A significance value (Sig. 2-tailed) of 0.000, which is lower than the standard $\alpha = 0.05$, indicates a significant difference in critical thinking ability between the two groups. Interestingly, the descriptive data suggest that students in the before-treatment class demonstrated higher posttest scores than expected. This may reflect the initial variability of students' abilities or classroom conditions that influenced learning. However, the overall evidence points to the effectiveness of the PBL module in improving critical thinking. Prior studies have shown that PBL encourages deeper understanding and long-term retention of knowledge compared to traditional lecture-based methods (Hmelo-Silver, 2004; Prince & Felder, 2006).

Third, the analysis of students' learning interest highlights another positive outcome. The after-treatment class reported higher percentages across all indicators: enjoyment (93%), involvement (94.2%), interest (93.8%), and attention (92%). In contrast, the before-treatment class reported significantly lower results in these areas, with averages ranging between 56% and 70%. These findings suggest that the use of the PBL module not only facilitated critical thinking but also improved students' affective engagement in the learning process. The contextual integration of *Lubuk Larangan* as local wisdom appears to have made the learning process more relatable, meaningful, and enjoyable, thereby sustaining students' motivation (Nasution et al., 2021; Efriyanti & Annas, 2020).

Finally, the t-test analysis of students' learning interest (Sig. 2-tailed = 0.000 < 0.05) confirmed that there was a statistically significant difference between the before and after treatment classes. This result emphasizes that the intervention applied—namely, the PBL module incorporating local wisdom—was effective in fostering students' enjoyment, engagement, and attention during biology lessons. Research has consistently highlighted the importance of contextual and culturally relevant approaches in increasing students' engagement and motivation (Gay, 2010; Ladson-Billings, 2014).

Taken together, these results indicate that integrating local wisdom into a PBL framework has the potential to strengthen both the cognitive and affective dimensions of learning. By grounding abstract ecosystem concepts in real-life cultural practices, the module provided students with meaningful learning experiences that fostered deeper understanding, improved critical thinking, and heightened interest in learning.

CONCLUSION

The findings of this study indicate that the Problem-Based Learning (PBL) module integrated with Lubuk Larangan local wisdom effectively enhanced students' critical thinking skills and learning interest. The module's implementation showed a significant improvement in students' learning outcomes, as reflected in the N-Gain score of 0.80 categorized as "effective," and a substantial increase in posttest scores compared to the control group. These results demonstrate that contextual and culture-based learning approaches can serve as a powerful medium to link abstract biological concepts with real-life experiences, thereby encouraging higher-order thinking and engagement.

Scientifically, this research contributes to the growing body of literature supporting the integration of local wisdom within modern educational models. It strengthens previous findings on the effectiveness of PBL in promoting active and meaningful learning while introducing a new dimension the inclusion of Lubuk Larangan as a source of contextual learning material. This innovation enriches the scientific discourse in education by illustrating how local culture can be embedded in learning design to improve cognitive and affective outcomes.

However, this study has certain limitations, particularly related to the relatively small sample size and the specific school context, which may restrict the generalization of the findings. The study also did not account for variations in students' gender, academic background, and learning environment. Therefore, further research with larger samples, different educational levels, and extended implementation periods is recommended to validate and expand the applicability of this PBL model integrated with local wisdom in broader educational contexts.

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