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Integration of Local Wisdom in RBL-STEM Cascara Briquette Material to Improve Student Learning Outcomes

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Abstract

Local wisdom represents cultural heritage with immense potential for contextualized and meaningful education. This study integration of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes. The research utilized a quasi-experimental design involving high school students to evaluate the model's effectiveness. Instruments such as syllabus validation sheets, learning implementation plans, and achievement tests were validated with an average score of 92.4% (Very Valid). Results showed significant improvements in cognitive learning outcomes, with a normalized gain of 0.49 (Medium category) and a post-test average of 78.3. Teachers and students responded positively to the model, with average satisfaction rates of 88% and 78.8%, respectively. Challenges included limited implementation time and the need for teacher training on local wisdom integration. Overall, this study highlights the potential of RBL with local wisdom in enhancing critical thinking, cultural appreciation, and sustainable education. Future research should address scalability and long-term impacts.
Keywords: Local Wisdom, Research-Based Learning, STEM Education, Briquette Cascara

Abstrak

Kearifan lokal merupakan warisan budaya yang memiliki potensi besar untuk pendidikan yang bermakna dan kontekstual Penelitian ini mengintegrasikan kearifan lokal dalam bahan briket cascara RBL-STEM untuk meningkatkan hasil belajar siswa. Penelitian ini menggunakan desain kuasi-eksperimental yang melibatkan siswa sekolah menengah untuk mengevaluasi efektivitas model. Instrumen seperti lembar validasi silabus, rencana pelaksanaan pembelajaran, dan tes prestasi divalidasi dengan skor rata-rata 92.4% (Sangat Valid). Hasil penelitian menunjukkan peningkatan yang signifikan dalam hasil belajar kognitif, dengan perolehan normalisasi sebesar 0.49 (kategori Sedang) dan rata-rata pasca-tes sebesar 78.3. Guru dan siswa memberikan respons positif terhadap model tersebut, dengan tingkat kepuasan rata-rata masing-masing sebesar 88% dan 78.8%. Tantangan yang dihadapi termasuk keterbatasan waktu implementasi dan perlunya pelatihan guru tentang integrasi kearifan lokal. Secara keseluruhan, studi ini menyoroti potensi RBL dengan kearifan lokal dalam meningkatkan pemikiran kritis, apresiasi budaya, dan pendidikan berkelanjutan. Penelitian di masa mendatang harus membahas skalabilitas dan dampak jangka panjang.
Kata Kunci: Kearifan Lokal, Pembelajaran Berbasis Penelitian, Pendidikan STEM, Briket Cascara

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INTRODUCTION

Local wisdom is a cultural heritage that reflects the values, practices and traditions that have developed in a particular community. In Indonesia, the richness of diverse local wisdom offers great potential to support contextualized and relevant learning. In education, integrating local wisdom not only aims to preserve culture but also to provide meaningful learning experiences for students (Sawita, Nazurty, & Sulistyo, 2024). By utilizing local knowledge as part of the learning process, students can more easily relate the theories learned in class to everyday life, thus strengthening the relevance of education to the local context (Wantik, Laksmono, Lefaan, & Lumintang, 2024).

At the same time, research-based learning (RBL) has become one of the effective pedagogical approaches to develop critical thinking skills, creativity, and problem-solving ability among students (Andini, An, & Mu'tashimbillah, 2024). RBL provides space for students to engage in a process of investigation and exploration, which not only enhances conceptual understanding but also prepares them to face real-world challenges (Shah, et al., 2024). However, the application of RBL is often separated from the local context, so the opportunity to link it to the surrounding culture and environment is limited (Kusumastuti & Joyoatmojo, 2024).

Integrating local life-based learning into research-based learning (RBL) is a strategic approach that enhances educational relevance and cultural awareness among students (Harefa, Adnyana, Wesnawa, & Ariawan, 2024). This integration not only fosters academic skills necessary for global competitiveness but also nurtures a strong sense of identity rooted in local values. Research shows that local wisdom-based curriculum significantly improves student understanding and academic achievement (Salmia, Nursalam, & Bancong, 2024). Experiential learning that incorporates local wisdom, such as that from Nias, has been shown to increase student motivation and engagement (Harefa, Adnyana, Wesnawa, & Ariawan, 2024).

Integrating local wisdom into education is increasingly important in the context of globalization, as it helps balance the benefits of global knowledge with the preservation of local cultural identity. Utilizing local cultural practices in subjects can deepen students' understanding and engagement with the material (Laia, 2024). Local wisdom in education, particularly in science, promotes critical thinking and problem-solving skills, essential for modern learners (Dini & Rini, 2024). Integrating local wisdom in education enhances the preservation of cultural heritage while promoting the relevance and sustainability of education. This approach supports character development and addresses social and cultural disparities, making it important in the context of globalization's challenges to local identity (Arjaya, Suastra, & Redhana, 2024).

This research will make an important contribution to the educational literature by offering an innovative and contextually-based learning model. This model is not only relevant for Indonesia but can also be adapted in other countries that face similar challenges in integrating local values into modern education. Thus, this research has the potential to be a reference for educators, policy makers and researchers in the field of education to create a more inclusive and sustainable approach.

METHOD

This research is included in development research, which was conducted in high schools in Jember, East Java, Indonesia in 2024-2025. The research process begins with information collection, planning, initial product development, initial field testing, primary product revision, main field testing, operational product revision, operational field testing, final product revision, and socialization and implementation. Needs analysis is carried out by distributing the questionnaires needed to identify problems in the field. Literature review is carried out by collecting information from various accurate

sources. The planning stage is to prepare a design such as formulating objectives, determining the learning model until it is developed, and identifying activities carried out at each stage of the research. Integration of local wisdom in RBL-STEM cascara briquette material to improve student learning outcomes can be seen in Table 1.

Tabel 1. Explanation of Integration Of Local Wisdom In RBL-STEM Cascara Briquette Material To Improve Student Learning Outcomes

1. Identification of STEM problems and relevance	**2. Planning and Research**	**3.Experiment Implementation**
Identifying the problem of coffee skin waste (cascara) that has not been optimally utilized. The teacher explains the relevance of cascara in the context of STEM: • Science: The organic content of cascara that supports the combustion process. • Technology: Application of simple tools and techniques to make briquettes. • Engineering: Design of the briquette making process. • Mathematics: Calculation of the ratio of mixed materials and the resulting energy efficiency.	Students work in groups to design a briquette-making research. Each group determines: • Material composition (cascara, natural adhesives such as tapioca flour). • Research parameters (e.g., burning time, temperature, and calorific value). • Tools to be used (briquette mold, drying oven, scales).	Students conduct experiments with the designed procedures, including: • Drying cascara to reduce water content • Mixing cascara with adhesive according to the specified ratio. • Forming briquettes using molds. • Testing briquettes to measure combustion efficiency and emissions.
4. Data analysis and reaction	**5.Presentation and evaluation**	
Students process data from experimental results, such as: • Combustion efficiency (length of time it burns). • Calorific value (calculated from the heat produced). • Environmental impact analysis (smoke emissions). These results are compared with the theories that have been studied to find scientific relationships.	Students present their research results in the form of written reports and oral presentations. Group discussions are conducted to evaluate the results and learning process. Teachers provide feedback on the STEM aspects that have been implemented.	

While the cascara briquette making process can be seen in Figure 1.

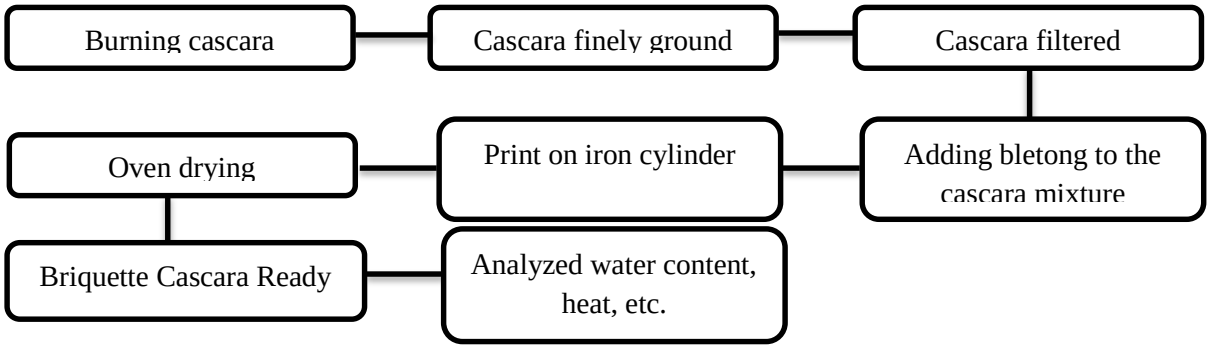

Figure 1. Cascara briquette making process

The development of data collection tools for the database forms the foundation of the product. If the initial field trial stage satisfies the correct criteria, it results in design one and limited trials, which are worthless. The field test stage is used to assess how effectively the learning that has been generated is working. This study simply concentrates on the product stage throughout the long-distance field test phase. This study included data from lesson plans, student learning outcomes, syllabus validation sheets, and validation local wisdom in RBL-STEM cascara briquette material to improve student learning outcomes.

Validity

Data from lesson plans, learning outcomes, student response rates, teacher response rates, and validation integration of local wisdom in RBL-STEM cascara briquette material to improve student learning outcomes were the types of data used in this study. Following the basic product form, the following criteria were used for ranking:

1. Score 4, when the validator gives an excellent rating
2. Score 3, when the validator gives a good rating
3. Score 2, when the validator gives a bad rating
4. Score 1, when the validator gives an abysmal rating

Data obtained from the results were analyzed using a technique for presenting data analysis.

$$V = \frac{T_{SE}}{T_{SM}} x100$$

Information:

V = Percentage rating

T_{SE} = Total empirical score acquired

T_{SM} = Total maximum score

Using the evaluation criteria listed in Table 2, the percentage of data derived from the aforementioned algorithm was transformed into descriptive qualitative data.

Table. 2 Criteria for validation local wisdom in RBL-STEM cascara briquette material to improve student learning outcomes.

No	Percentage (%)	Category	Adjudgment
1	$81{,}25 \leq x < 100$	Very valid	Product becomes available onsite for real learning activities.
2	$62{,}5 \leq x < 81{,}25$	Valid	The product can continue by adding something less. Certain considerations of addition are less substantial and less fundamental.
3	$43{,}75 \leq x < 62{,}5$	A poor valid	Revise by carefully reviewing and looking for specific weaknesses in the product.
4	$25 \leq x < 43{,}75$	Invalid	Extensive and fundamental content revision of the product.

The aforementioned validation criteria were altered. If a score of 62.5 was achieved in the validation, the development product was improved by including a missing feature.

Effectiveness

In addition to categorization, researchers used the normalized gain (g) formula to determine the value of learning outcomes. This was the normalized gain formula.

$$\textit{Normalized gain (g)} = \frac{\text{FInal scores} - \text{Initial Scores}}{\text{Maximal Scores} - \text{Initial scores}}$$

The scale of values used on normalized gain data (g) is on the following table 3.

Table 3. Criteria *Normalized gain* (g)

Score *Normalized gain*	**Criteria *Normalized gain***
0,70 < *normalized gain*	Upper
0,30 < *normalized gain* < 0,70	Moderate
normalized gain < 0,30	Lower

Practicality

The percentage of responses from both the teacher and the students was calculated using the following formula.

$$\text{Percentage} = \frac{\sum scores\ obtained}{\sum Maximum\ Score}\ x\ 100\%$$

Feasibility percentage of learning tools developed from instructor analysis and student responses, which were then converted to qualitative data using the criteria in Table 4.

Table 4. Educators and Student Response Criteria

No	**Percentage**	**Category**
1	81,25 ≤ x < 100	Very good
2	62,5 ≤ x < 81,25	Good
3	43,75 ≤ x < 62,5	Less good
4	25 ≤ x < 43,75	Not good

RESULTS AND DISCUSSION

Analyzing the needs and reviewing the literature supplied in the information collection stage was the first step in creating a learning model. Formulating objectives, identifying activities, and building learning models were the first steps in the product development process. A guidebook, a set of models, and data gathering tools were subsequently created. Following product validation, the instrument was validated once the final product was completed. The validated research instruments include syllabus validation sheets, lesson plans, learning achievement tests, teacher and student response questionnaires, observation guideline sheets, and local wisdom integration learning handbooks on RBL-STEM cascara briquette material to improve student learning outcomes.

Validity

The following formula was used to determine the percentage of answers from teachers and students.

Table 5. Instrument Validation Results

No	**Instrument**	**Percentage (%)**	**Category**	**Category**

1	Guide to the Instrument Validation Sheet written by experts for the integration of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes.	90%	Very Valid	No Revision
2	Validation Sheet for Local Wisdom Integration Instrument on Cascara Briquette RBL-STEM Material to Improve Student Learning Outcomes	92%	Very Valid	No Revision
3	Validation Instrument sheet for Learning Implementation Plan	94%	Very Valid	No Revision
4	Syllabus Validation Instrument sheet	91%	Very Valid	No Revision
5	Learning outcomes test sheet is instrument	95%	Very Valid	No Revision

With a very valid category, the average validation result for all instruments was 92.4%. All instruments can therefore be used for the following step since the validation's results meet the requirements.

Table 6. Product Validation by Experts

No	Validator	Instrument	Percentage (%)	Category	Category
1	Expert	Validation of textbooks on integration of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes.	84	Very Valid	No Revision
	Teacher		87.02		
2	Expert	Development Validation	88.5	Very Valid	No Revision
	Teacher		87.3		
3	Expert	Learning implementation plan Validation	92.38	Very Valid	No Revision
	Teacher		88		
4	Expert	Syllabus validation	91.9	Very Valid	No Revision
	Teacher		92.2		
5	Expert	Test validation of learning outcomes	93	Very Valid	No Revision
	Teacher		90.8		

Table 6 shows that experts' and practitioners' average total product had a very valid category of 89.51%.

Effectiveness

Table 7 shows the limitations of the cognitive learning achievement statistics derived from the pre-test and post-test results.

Table 7 . Cognitive Learning Outcomes Field Test / Large Group Test

No	Cognitive Learning Outcomes	Total students	Average ± SD	*Normalized gain* (g)	Category
1	*Pre-test*	62	48.1 ± 20.5	*0.49*	Medium category
2	*Post-test*	62	78.3 ± 11.8		

Based on Table 7 it can be seen that the cognitive learning outcomes of students *post-test* scores are greater than the *pre-test* scores. The mean *pre-test was* 48.1 while the *post-*

test average *was* 78.3. *Normalized gain* (g) for the cognitive learning outcomes of large groups is 0.49 in the medium category.

Practicallity

Table 8 shows the results of large group assessments that included information on teachers' opinions about the integration of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes.

Table 8. Information from the huge group/field test about instructors' reactions to the of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes.

No	Indicator	Average	Category
1	Achievement of competencies and learning objectives	92	Very good
2	Student Response	78	Well
3	Degree of Difficulties in Implementing	90	Very good
4	Adequacy of Time	92	Very good
Average Teacher Response		88	Very good

Student response data on the large group tests is presented in Table 9

Table 9. Student Response Data to the of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes.in the Large Group Test

No	Indicator	Average	Category
1	Interest in learning	74.9	Well
2	Usefulness in learning	75.2	Well
3	Interest in learning the next chapter	86.3	Very good
	Average student response	78.8	Well

The average learning interest was moderate at 74.9, and the benefit of joining the learning for the following chapter was good at 75.2, according to data from students' answers on the of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes. in the large group exam. At 86.3, the average level of enthusiasm in following the lessons for the upcoming chapter was great. The of local wisdom in the RBL-STEM cascara briquette material to improve student learning outcomes might be used for a proper analysis based on the results of the huge group test.

Discussion

The results of the study showed that the integration of local wisdom into research-based learning (RBL) had a significant positive impact on improving student learning outcomes. This is in line with the principle of contextual learning, which emphasizes the relevance of teaching materials to students' real lives. In this context, local wisdom is not only a medium of learning but also a means of preserving culture (Salmia, Nursalam, & Bancong, 2024). Project-based learning that combines local wisdom improves scientific literacy by connecting theoretical concepts with real-life applications (Fuad, Sholahuddin, & Mahardika, 2024).

Integrating local wisdom into education presents both opportunities and challenges. While the positive impact on student engagement and cultural identity is evident, constraints such as time constraints and inadequate teacher training hinder effective implementation. Collaboration with local communities has emerged as an important strategy to address this issue. The complexity of the research

process often results in time constraints in incorporating local elements into the curriculum. Effective integration requires substantial planning and adaptation, which can be time-consuming for educators. Many teachers lack adequate knowledge of local wisdom, thus requiring targeted training programs (Harefa, Adnyana, Wesnawa, & Ariawan, 2024). Professional development initiatives can equip educators with the resources and understanding needed to teach local content effectively. Standardization of guidelines and financial support for implementation need to be addressed to maximize the benefits of local wisdom in education (Sugiharto, 2024) Overall, the integration of local wisdom in RBL offers an innovative and relevant approach to 21st-century education. By combining academic theory with real-life contexts, students not only gain knowledge but also build essential life skills, strengthen cultural appreciation, and increase their awareness of social and environmental sustainability (Dini & Rini, 2024). This approach has great potential to be adopted in various education systems, especially in countries with abundant cultural richness such as Indonesia.

CONCLUSION

This study shows that the integration of local wisdom into research-based learning (RBL) is effective in improving student learning outcomes. The validation results show that the learning instruments and products are categorized as "Very Valid" (average 92.4%), with effectiveness shown through increased cognitive learning outcomes (gain 0.49, medium category). This model is well received by teachers and students, with average responses of 88% and 78.8%, respectively. Despite challenges such as time constraints and the need for teacher training, this integration has the potential to be a strategic approach in education, connecting academic knowledge with local cultural values.

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