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Improving Student Learning Outcomes in Science: A Culturally Responsive Approach Using Problem-Based Learning

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Abstract: This study aimed to improve student learning outcomes through the Problem-Based Learning (PBL) model combined with the Culturally Responsive Teaching (CRT) approach. The research focused on teaching the concept of metamorphosis in animals using the local folklore, "*Tetuntel-tuntel dan Tegodek-godek,*" which involves frogs (complete metamorphosis) and monkeys (no metamorphosis). Conducted as a Classroom Action Research (CAR) in two cycles, the study involved 28 third-grade students at SD Negeri 29 Ampenan during the 2024/2025 academic year. Instruments used included pre-tests, post-tests, observation sheets, and interview guidelines to measure learning outcomes and engagement. The minimum competency criterion (KKM) was set at 75. The results revealed significant improvements in learning outcomes: the average test score increased from 70.00 in the first cycle, where 67.86% of students achieved mastery, to 81.00 in the second cycle, with 96.43% of students meeting or exceeding the KKM. The integration of PBL and CRT created an engaging and culturally relevant learning environment, which enhanced students' comprehension of metamorphosis while fostering cultural appreciation. This study highlights the effectiveness of combining culturally enriched materials with active learning strategies in science education to improve academic performance and student engagement.

Keywords: Problem-Based Learning; Culturally Responsive Teaching; Folklore; Metamorphosis.

Introduction

Effective teaching methods that integrate students' cultural backgrounds can significantly enhance learning experiences and outcomes. In science education, linking abstract concepts with culturally familiar elements not only fosters better understanding but also promotes engagement and motivation (Krajcik, & Czerniak, 2018). This study investigates the combination of two instructional strategies—Problem-Based Learning (PBL) and Culturally Responsive Teaching (CRT)—to improve students' understanding of metamorphosis in animals among third-grade students at SDN 29 Ampenan.

According to Hafizah, et al. (2024). The PBL model encourages students to actively engage in problem-solving tasks, work collaboratively, and apply critical thinking skills. This student-centered approach enhances their ability to connect theory with real-world situations. According to researchers such as Hattie and Timperley (2007), integrating CRT within PBL creates an inclusive learning environment that promotes context-based understanding and enriches teaching methods with diverse cultural perspectives. On the other hand, Culturally Responsive Teaching emphasizes the importance of integrating students' cultural contexts into the learning process. As noted by Ladson-Billings (2022), culturally responsive teaching supports a constructivist view of knowledge that helps students build on their personal and cultural strengths, creating a more inclusive classroom environment.

According to the previous studies integrating cultural elements into science education has shown significant benefits in improving students' understanding of scientific concepts while fostering appreciation for local heritage. This study builds on findings that highlight the importance of contextualizing learning within students' cultural environments to enhance engagement and academic outcomes. According to Hikmawati et al. (2024), incorporating local cultural contexts into science education significantly impacts both cognitive and affective domains. Their research demonstrated an increase in cognitive domain scores from 32.2 in the pretest to 87.5 in the posttest and a rise in affective domain scores from 76.3 to 93.8. These results suggest that culturally relevant teaching strategies not only improve understanding but also create a more effective and engaging learning environment.

The combination of Problem-Based Learning (PBL) and Culturally Responsive Teaching (CRT) offers a

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powerful framework for enhancing student learning outcomes (Campbell-Whatley, & Reynolds, 2021). PBL emphasizes critical thinking and problem-solving, enabling students to actively engage with content and apply their knowledge in meaningful contexts. Meanwhile, CRT ensures that teaching is inclusive and relatable, allowing students to connect abstract scientific concepts with their cultural backgrounds. As noted by Hikmawati et al. (2024), ethnoscience learning, which integrates cultural knowledge into science education, significantly improves both cognitive and affective outcomes. This dual approach aligns with the constructivist principles of education, fostering deeper comprehension and sustained interest among students.

Moreover, utilizing culturally enriched materials, such as folklore, addresses the practical aspects of teaching by making the content more accessible and engaging for students. Research by Hikmawati et al. (2024) on the practicality of Google Sites-based teaching materials highlights the value of innovative, culturally responsive teaching tools in improving student learning outcomes. Their study found that both teachers and students rated these materials as highly practical, with scores of 93.4 and 95.5, respectively. This demonstrates the importance of using interactive and relevant teaching resources that resonate with students' lived experiences and cultural identities.

By embedding the concept of metamorphosis within the local folklore "Tetuntel-tuntel dan Tegodek-godek," this study provides a meaningful way for students to connect their cultural heritage with scientific concepts. Such approaches reinforce the findings of Hikmawati et al. (2024), who observed that ethnoscience learning positively influences cognitive and affective domains by leveraging familiar cultural narratives to enrich the learning process. This integration not only enhances students' academic achievements but also instills a sense of pride and respect for their cultural heritage, creating a holistic educational experience.

Thus in this study, the integration of PBL and CRT is explored through the use of local folklore—specifically, the story "Tetuntel-tuntel dan Tegodek-godek." This story features animals like frogs, which undergo complete metamorphosis, and monkeys, which do not undergo metamorphosis, providing a culturally rich context for understanding the scientific concept of metamorphosis. The goal is to make the concept of metamorphosis more relatable and memorable by connecting it to a story familiar to the students.

This research aims to assess whether the combination of PBL and CRT can enhance students' comprehension of metamorphosis and increase their appreciation for their cultural heritage. By using culturally relevant materials, we hypothesize that students will not only achieve better learning outcomes but also develop a deeper connection to the subject matter. This study contributes to the growing body of research that explores the intersection of culturally responsive pedagogy and active learning strategies in primary education.

Method

This study used a Classroom Action Research (CAR) design, which was conducted in two cycles. According to Arikunto, (2021). Classroom Action Research is a systematic approach that allows teachers to identify and address specific learning issues within their classrooms through reflective practice. Thus, this study's design aligns with established research principles that advocate for iterative cycles of planning, action, observation, and reflection as a means to foster continuous improvement in educational practices.

1. **Planning**: During this phase, the researchers designed learning activities that incorporated the Problem-Based Learning (PBL) model and the Culturally Responsive Teaching (CRT) approach. The activities were centered around teaching the concept of metamorphosis in animals using the local folklore, "Tetuntel-tuntel dan Tegodek-godek," which involves animals like frogs (complete metamorphosis) and monkeys (no metamorphosis).
2. **Implementation**: In this phase, the researchers implemented the designed activities in the classroom. The lessons included storytelling, group discussions, and problem-solving tasks that helped students explore the concept of metamorphosis. The folklore was used to contextualize scientific concepts, making them more relatable to the students.
3. **Observation**: The researchers observed students' participation during the activities, including their engagement in group discussions and the application of their knowledge in problem-solving tasks. This phase also involved collecting data on students' performance during the learning activities.
4. **Reflection**: After each cycle, the researchers analyzed the data collected from the observations, student tests, and interviews to evaluate the effectiveness of the learning activities. Based on the analysis, adjustments were made to improve the next cycle.

The study involved 28 third-grade students from SDN 29 Ampenan during the 2024/2025 academic year. Data were collected in the form of pre-tests and post-tests, student observations, and interviews.

For data analysis:

1. **Quantitative data**: Pre- and post-test scores were analyzed to measure changes in students' learning outcomes. The percentage of students achieving the minimum competency criterion (KKM) was calculated.
2. **Qualitative data**: The observations and interviews were analyzed descriptively to understand how students engaged with the content and how they responded to the culturally relevant teaching approach.

Result and Discussion

Results

The analysis of student evaluation scores from the two cycles shows significant improvement in learning outcomes can be seen in Table 1.

Table 1. The result of Average Score and Percentage of Mastery

Cycle	Average Score	Percentage of Mastery
Cycle I	70.00	67.86
Cycle II	81.00	96.43

The average value of each cycle can be seen in Figure 1.

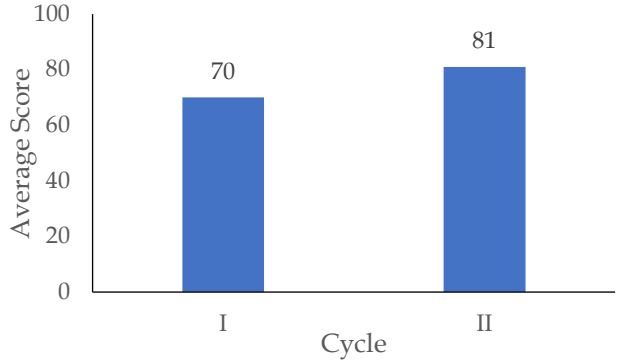

Figure 1. The average value of each cycle

The percentage of learning completeness (mastery) per cycle can be seen in Figure 2.

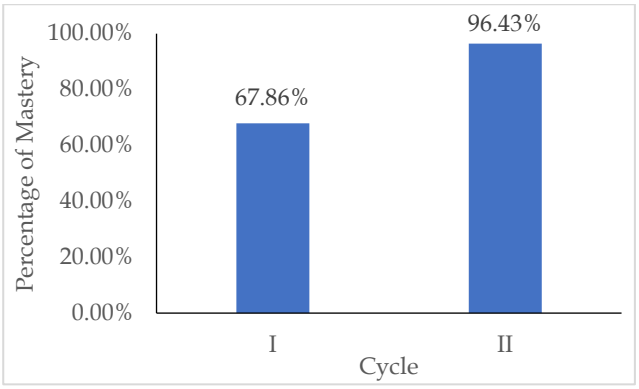

Figure 2. The percentage of learning completeness per cycle

In Cycle II, 96.43% of students achieved the minimum competency criterion (KKM) score of 75, a significant increase from 67.86% in Cycle I. This improvement indicates that the combined PBL and CRT approach was effective in enhancing students' learning outcomes. The students were more engaged in the learning process, as evidenced by their active participation during group discussions and storytelling activities.

Discussion

The use of local folklore as a teaching tool played a crucial role in making the concept of metamorphosis more relatable and memorable for the students. This approach aligns with findings by Sotés Rodríguez (2023), which emphasize the potential of cultural and narrative materials, such as myths and legends, to enhance student creativity, motivation, and cultural respect. Similarly, the study by Hikmawati et al. (2024) demonstrates the effectiveness of incorporating Problem-Based Learning (PBL) with innovative teaching aids like three-dimensional media and interactive games to improve learning outcomes across cognitive, affective, and psychomotor domains. Their research highlights the positive impact of active and interactive learning strategies on student collaboration, responsibility, and conceptual understanding, supporting the constructivist view of education.

In this study, the folklore "Tetuntel-tuntel dan Tegodek-godek" facilitated understanding of metamorphosis by linking abstract biological concepts with culturally familiar contexts. This cultural integration is consistent with findings from Hikmawati et al. (2024), which underscore the importance of experiential and hands-on learning in improving conceptual grasp and engagement. The significant increase in mastery from 67.86% in Cycle I to 96.43% in Cycle II further illustrates the power of combining PBL and culturally relevant pedagogy.

The importance of validation and expert feedback in designing ethnoscience-based teaching materials further supports the effectiveness of integrating cultural contexts into teaching strategies. According to Hikmawati et al. (2024), expert validation of teaching materials, with an overall score of 95.7 in the "Very Valid" category, highlighted the necessity of refining materials to ensure their relevance and effectiveness. Key adjustments, such as adding indicators, revising visual elements, and including ethnoscience-based investigative activities, emphasize how iterative improvements can lead to a well-rounded and effective learning experience.

Moreover, local wisdom-based learning has been shown to significantly enhance creativity and engagement. Hikmawati and Suastra (2023) report an N-gain value of 86 in student creativity through the integration of 17 types of local wisdom in high school physics courses. These findings affirm that the use of culturally grounded teaching resources can foster students' critical thinking, caring attitudes, and creative capacities, which resonate with the outcomes observed in this study. The integration of local folklore in this research aligns with these results by providing a familiar context that not only improves cognitive outcomes but also instills a deeper appreciation for local culture.

Additionally, the ethnoscience context in teaching has been proven effective in various educational settings. Hikmawati and Syahidi (2022) demonstrated that learning in an ethnoscience context positively influenced cognitive learning outcomes and professional competence in physics teacher candidates. This evidence

further supports the approach taken in this study, where cultural and scientific integration enhanced learning outcomes and bridged the gap between abstract concepts and students' lived experiences.

Finally, the storytelling, group discussions, and problem-solving tasks implemented in this study resonate with findings by Hikmawati et al. (2024), which highlight the role of dynamic, interactive media in fostering holistic learning improvements. The results of this study reinforce the idea that integrating PBL with culturally enriched teaching materials can serve as a comprehensive approach to improving both academic performance and students' personal and cultural growth.

This research confirms that local folklore, when combined with effective teaching strategies, can transform the learning experience into one that is not only academically enriching but also personally meaningful, thus providing a template for future educators seeking to incorporate culturally responsive methods into their teaching.

Conclusion

The combination of Problem-Based Learning (PBL) and Culturally Responsive Teaching (CRT) significantly improved students' understanding of metamorphosis and enhanced their cultural awareness. By integrating local folklore into the science lessons, students were able to connect scientific concepts to their own cultural experiences, making the learning more meaningful and engaging.

The results of this study show that using culturally relevant materials, like the story "Tetuntel-tuntel dan Tegodek-godek," helped students better understand complex biological concepts such as metamorphosis. Furthermore, the approach fostered active participation, critical thinking, and a deeper appreciation for local culture.

This study suggests that science educators can benefit from incorporating culturally responsive strategies into their teaching, as it not only improves students' academic performance but also strengthens their connection to the subject matter. Future research could explore the application of this approach to other science topics and educational levels to further assess its effectiveness.

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Conflicts of Interest
The authors declare no conflict of interest.

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