

Integrating Local Cultural Wisdom in Project-Based Learning to Improve Science Education: A Study of Kudus

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Abstract

21st-century learning requires students to master the skills of 4C (critical thinking, creativity, communication, and collaboration). For this reason, teachers need to choose the right learning model to accommodate the needs and characteristics of students so that learning goals can be achieved optimally. This study aims to explore the implementation of the Project-Based Learning (PjBL) learning model contextualized with the local wisdom of Kudus culture in improving understanding of concepts and problem-solving skills in Madrasah Ibtidaiyah students. The approach used in this study is qualitative with a case study method. This research was conducted at Madrasah Ibtidaiyah, and the research subjects consisted of principals, teachers, and grade V students. Data was collected through interviews, observations, and documentation, then analyzed using interactive model data analysis techniques from Miles, Huberman, and Saldana, including the stages of data condensation, data presentation, and conclusion. The study results show that science learning using the PjBL model contextualized with the local wisdom of Kudus culture has a positive and practical impact in improving the understanding of concepts and problem-solving skills of Madrasah Ibtidaiyah students. The contribution of this research is to provide insight into the application of a project-based learning model that integrates local cultural values, which can be used as a reference in developing learning strategies that are more contextual and relevant to the needs of students in the era of globalization.

Keywords: Kudus Culture, Local Wisdom, Concept Understanding, Problem Solving

Article History:

Received: January 2025; Revised: February 2025; Accepted: March 2025

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DOI: <https://doi.org/10.61987/edsojou.v2i2.701>

How to Cite:

Cahyaningsih, E., Suprijati, H., & Azy, L. (2025). Integrating Local Cultural Wisdom in Project-Based Learning to Improve Science Education: A Study of Kudus. *Education and Sociedad Journal*, 2(2), 66–77.

INTRODUCTION

Learning in primary schools requires a creative and innovative approach to developing 21st-century skills, such as problem-solving, collaboration, and critical thinking. 21st-century learning is transitioning from teacher-centred to student-centred learning (Eksangkul et al., 2024; Pastini & Lilasari, 2023; Ross & Rajkoomar, 2024). Therefore, teachers are expected to be able to transform learning models that can accommodate the needs and the characteristics of the current generation (Akour & Alenezi, 2022; Azmiyah & Astutik, 2021), to achieve the expected learning goals (Damayanti et al., 2023; Montoya et al., 2021). The right learning model's design can affect students' success in learning (Yosintha et al., 2024; Zaini & Fahmi, 2023). However, the fact is that in the field, there are still many teachers who use a teacher-centred learning model. No exception to the results of observations at the research site, science learning in schools that is the research source by researchers was also found.

Natural Sciences (IPA) is one of the crucial subjects in the elementary school curriculum (Ekantini & Damayanti, 2023; Septiyani, 2023; Surul & Septiliana, 2023). This subject not only aims to introduce basic scientific concepts but also to develop curiosity, critical thinking skills (Prayogi & Asy'ari, 2021), and problem-solving skills in students (Agustini et al., 2024; Nurdiana et al., 2023). Science learning in elementary schools faces various challenges (Suryaningsih & Aisyah, 2024), including limited human resources, lack of student involvement and variations in learning abilities among students.

Applying a learning model to the steps encourages students to play an active and broad role in understanding learning (Maisuroh & Aisyah, 2024; Rahmawati et al., 2022). Student involvement in learning is significant because it can show that learning is student-centred, so that learning in schools runs smoothly and improves the quality of education (Lombardi et al., 2021; Sanjani, 2024). Science learning innovations can be carried out by choosing models, methods, and media, that are by the material and characteristics of students and can build students' character to be more motivated in participating in learning (F. Fahmi et al., 2022; Saharani & Diana, 2024; Zhai, 2021). Therefore, innovative and practical approaches are needed to overcome these challenges and improve the quality of learning.

The results of the interview with the informant (R1) as the principal obtained information that the current curriculum emphasizes the active involvement of students in participating in the learning process and understanding the context of the material (Principal (R1), 2024). Meanwhile, on another occasion, the informant (R2), as a teacher of class V, mentioned that in the process of learning science in class, V often faced students who were very active and enthusiastic. Unfortunately, this was not accompanied by a good understanding; students did not always focus on the material being taught. Four male students in the class tend to play alone and sometimes disturb their friends actively. "Indeed, most of the male students in my class this year tend to be very active," said the R2 (Class V (R2) Teacher, 2024) informant. This is a challenge in managing the classroom and ensuring all students benefit from learning. Students also often find it challenging to solve problems, especially those related to critical thinking and problem-solving skills.

In addition, students sometimes do not want to come forward to present the results of their discussions because they fear that the answers are inappropriate (Ataman et al., 2024; Said et al., 2021; Soesanto & Dirgantoro, 2021). Some students in the class lack the confidence to explain the results of their work (Nailasariy et al., 2023). Such problems often occur in the science learning process (He et al., 2023; Nungu et al., 2023). Teachers seek ways to overcome these problems by building a learning atmosphere that can foster students' active involvement in learning and capture the knowledge they want to achieve (Chen & Xiao, 2021; Khotimah et al., 2024; Sablić et al., 2021). The project-based learning (PjBL) learning model was chosen as an approach that can encourage students to instil an understanding of concepts in learning and cultivate project problem-solving skills.

Project-based learning is the primary focus of this study. Project-based learning (PjBL) has been recognized as a practical teaching approach because it encourages students to think critically, collaborative, systematic, creativity and student learning outcomes (Fitri et al., 2024; Zulyusri et al., 2023). PjBL refers to an educational approach that emphasizes student engagement and active learning through real-world project completion (Andini & Rusmini, 2022; Safitri, 2024). The use of project-based learning as a guideline in carrying out the mathematics learning process in madrasah ibtidaiyah is an innovative step taken by teachers to actively involve students in participating in the science learning process and have a positive impact on critical thinking skills (Asmi et al., 2022; Purwandari, 2023), collaboration, student activeness, honing creativity, and improving learning outcomes.

The material in science learning instils more abstract concepts than concrete ones. Teachers should strive for interesting methods to make it easier for students to understand basic concepts in science subjects (Permana & Utomo, 2021; Wissman et al., 2023). Integrating local wisdom or culture can encourage students to be interested and foster curiosity and motivation towards learning (Putri, 2024). In addition, through learning based on local wisdom, it is helpful for students to show local identity and foster a sense of pride to preserve culture (Shufa & Adji, 2024; Sungkowo et al., 2024). The researcher applies science learning through project-based learning in the context of the local culture of Kudus. The results of previous research show that the implementation of the project-based learning approach in the learning process can have a positive impact, such as improving science learning outcomes and students' critical thinking skills, PjBL affects students' critical thinking and psychomotor skills in physics learning, the implementation of the PjBL learning model has been proven to increase student creativity.

This study aims to determine the implementation of science learning with a project-based learning approach in the context of Kudus culture's local wisdom to understand concepts and problem-solving skills in madrasah ibtidaiyah students. The results of this research are expected to improve science learning quality at the madrasah ibtidaiyah or elementary school level. By applying the project-based learning (PjBL) approach in the context of the local wisdom of Kudus culture, this research can help improve conceptual understanding, foster problem-solving skills, and accommodate various learning styles of students, especially those with kinesthetic learning styles.

RESEARCH METHOD

This study uses a qualitative approach to case study methods. A case study is a research model that focuses on the study of detailed finite systems to gather specific and in-depth information on a problem (Hirose & Creswell, 2023). The qualitative approach is a method of investigation that aims to understand the role of individuals and groups or interactions in a certain social situation. The research data was taken from MI NU Tarbiyatuth Thullab Kudus in the odd semester of the 2024/2025 academic year. Researchers collected data through interviews, observations, and documentation.

In this study, the researcher used a semi-structured interview, an interview in which, in its implementation, the researcher asks several questions that have been prepared beforehand. Then, all questions are asked in-depth to the respondents to obtain detailed data (Chang-Tik, 2023). Interviews were conducted with one of the teachers of class V, the principal, and students of class V. Interviews were conducted for approximately 40 minutes with 15 questions. The researcher used participatory observation and traced the activities that took place during the activities in the school. The researcher uses the observation data as a source of research data. The researcher takes documentation in the form of activity notes, activity plans, pictures of student activities, and school situations and conditions. All data obtained were analyzed using an interactive model from Miles, Huberman, and Saldana with Figure 1 (Nasir & Sukmawati, 2023).

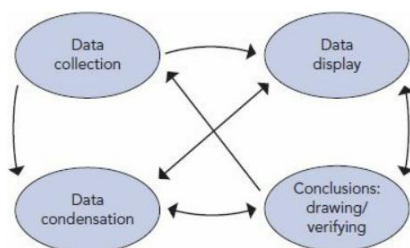


Figure 1. Data Analysis Techniques

After collecting data, the research continues by analyzing it through 3 stages: data condensation, data presentation, and finally, conclusion. The researcher triangulated the data by looking at the compatibility between observations, interviews, and documentation to keep the data valid.

FINDINGS AND DISCUSSION

Result

Project-Based Learning Science Learning Planning

Learning planning is the steps teachers take before teaching to ensure that the learning process runs effectively and efficiently and achieves the desired goals. Several important components need to be considered in developing a learning plan. The preparation of learning planning begins with analyzing the curriculum, setting learning objectives, selecting methods and models, planning learning activities, preparing resources and media, and preparing assessments and reflecting. "I usually prepare for lessons once a week on the weekends and Saturdays. So, the learning implementation plan was prepared that week. If there is a practicum or experimental activity, I will inform students in advance," said the R2 informant (Class V (R2) Teacher, 2024). Observations and documentation show that science learning at MI NU Tarbiyatuth Thullab Kudus uses an independent curriculum in class V to develop student's knowledge, skills, and scientific attitudes. This process involves various stages and strategies to create an engaging and meaningful learning experience.

Implementing the Project-Based Learning (PjBL) learning model in science learning at MI NU Tarbiyatuth Thullab Kudus has positively impacted students' understanding of concepts and problem-solving skills. The learning process in grade V is carried out using a project-based approach that integrates the local wisdom of Kudus culture. The findings show that students are actively involved in learning and can relate scientific knowledge to their daily lives. This PjBL model allows students to solve real problems through research and experiments relevant to the local cultural context. In addition, the use of various media and resources also supports the achievement of more effective and engaging learning objectives. Teachers also pay special attention to planning each stage of learning, from material preparation to evaluation, which makes the teaching and learning process more structured and efficient.

The study shows that science learning using PjBL at MI NU Tarbiyatuth Thullab Kudus has succeeded in integrating the local wisdom of Kudus culture in the context of science learning. As explained by informant R2, the grade V teacher prepares a learning plan every week and ensures that students are given prior information about the practicum or experiment activities. Students understand and apply the theory through projects that include field research and experiments. This facilitates students in developing their critical thinking skills, creativity, communication and collaboration skills. This study also found that project-based learning allows students to be more independent in finding solutions to problems while introducing local cultural values to each topic discussed.

Applying PjBL in science learning improves understanding of scientific concepts and enriches students' learning experiences within local culture. Using Kudus culture as part of science learning motivates students to see the relevance of the subject matter to their lives, which increases the appeal and effectiveness of learning. This success can be seen in students' enthusiasm to participate in projects connecting scientific knowledge with local wisdom. Teachers who can plan and adjust learning methods to student needs play a significant role in the success of PjBL implementation. Learning that prioritizes collaboration between students and integration with their social environment creates a pleasant atmosphere and positively impacts achieving learning

objectives.

Implementing the Project-Based Learning (PjBL) learning model contextualized with the local wisdom of Kudus culture at MI NU Tarbiyatuth Thullab Kudus effectively improves students' conceptual understanding and problem-solving skills. Project-based learning involving experiments and direct research deepens students' scientific understanding and develops 21st-century skills such as critical thinking, creativity, communication, and collaboration. Teachers skilled in planning learning and integrating local cultural values into teaching materials can create meaningful learning experiences. Therefore, this study recommends the implementation of PjBL based on local wisdom as an alternative learning model that other schools can adopt to improve the quality of science learning in Indonesia.

Implementation of Learning to Apply Concept Understanding

The project-based learning (PjBL) learning model is a learning approach that emphasizes the application of knowledge and skills in real projects. In this model, students work independently or in groups to complete projects that demand problem-solving, research, and creativity. The main goal of PjBL is to develop a deep understanding of certain concepts, critical, collaborative, and communicative thinking skills, as well as a proactive attitude towards learning and the surrounding environment.

Table 1. The Key Characteristics of PjBL Model

Key Characteristic	Description
Task-Based Projects	Students work on projects with clear, measurable goals, resulting in products, presentations, or solutions.
Student Engagement	Students actively participate in the learning process, including planning, execution, and evaluation.
Collaborative Learning	Students work in teams, learn to collaborate, and develop social skills.
Contextual Learning	Projects are relevant to students' real lives, motivating them to learn.
Problem-Based Learning	Projects address real problems or challenges, encouraging critical and creative thinking.
Discovery-Based Learning	Students develop knowledge through exploration, research, and experimentation, rather than just teacher input.
Authentic Evaluation	Evaluations are based on the project's quality and the student's progress toward learning objectives.

The PjBL model provides students with a well-rounded and immersive learning experience, preparing them for real-world challenges and developing skills essential for future success in Table 1. The R2 informant stated that students' understanding of concepts is more meaningful if they use the PjBL learning model. The PjBL model allows students to use their creativity to find solutions, generate new ideas, and build their science knowledge. Students are directed to use problem-solving skills, think critically, and collaborate with their peers in finding solutions. This learning process can help students develop important real-life skills (Class V (R2) Teacher, 2024).

Furthermore, the R2 informant stated, "This year's class V students are almost all super active males, but their understanding is still lacking, so I thought of ways to make these active ones also able to understand the material I teach," said the teacher of class V (Teacher of Class V (R2), 2024). Again, the R2 informant explained that through the PjBL learning model, students more easily accept and understand the concepts in learning. PjBL makes students more actively involved in the learning process. Through relevant and meaningful projects, students are more motivated to learn because they can see firsthand the benefits and applications of the science concepts they are learning. Students tend to be excited when they do activities that produce work.

For example, when students are directed to make a simple thermometer. Before creating a project, the teacher gives an LKPD (Student Worksheet), which contains learning objectives and then groups students based on the study group. Students brought tools and materials to make a

simple thermometer, which they had been informed of beforehand. After they successfully made a thermometer, they were asked to write down the steps, results of work and experiments, and their conclusions in the LKPD. The students are enthusiastic and excited; all the students look active and collaborate in creating a simple thermometer project. In addition to producing projects, it becomes easier to understand how thermometers work and more quickly understand the concept of temperature and how to measure it with a thermometer. After completing the project, the teacher asks students to present their work. It is proven that the PjBL learning model can foster active involvement and student confidence in explaining the experiment's conclusions. Spontaneously, students dared to come to the front of the class in scrambles to explain the results of their experiments. Teachers feel helped because they do not motivate students too much to present their work as before using the PjBL model. Even when the learning is over, students do not want to end learning. "Do not go home just yet, ma'am. We experiment again." Said the class student (Student 1 (R3), 2024).

Implementing the Project-Based Learning (PjBL) learning model in class V MI NU Tarbiyatuth Thullab Kudus has improved students' understanding of science concepts while developing important skills such as creativity, problem-solving, and collaboration. The PjBL model allows students to actively participate in learning through relevant and meaningful projects. Students not only understand the theories taught but can also apply them in the form of real experiments. For example, when making a simple thermometer, students work in groups, compile experimental steps, and analyze the results. This activity makes students more enthusiastic about learning and connecting science concepts with everyday life. The students' activeness and enthusiasm are also reflected in their desire to continue experimenting even after the lesson.

Although students initially had a low conceptual understanding, implementing the PjBL model positively impacted their involvement in the learning process. The fifth-grade teacher revealed that students who were initially very active but did not understand the material could more easily absorb science concepts through problem-based projects. PjBL allows them to find solutions, collaborate with friends, and develop critical thinking skills. Projects that connect material to real life, such as making a thermometer, make students not only understand the theory but also see its application. This activity increases students' motivation and confidence in learning; they even want to continue the experiment after the learning is complete. This shows that PjBL can improve students' understanding and encourage them to be more actively involved in learning.

Cultural Local Wisdom to Cultivate Problem-Solving Skills

In Kudus's local culture, project-based learning has increased learning activity and student involvement. Students feel clearer about the subject matter because they feel they have a match and closeness to the material learned through the local culture they are already familiar with. Thus, students can easily understand the concepts taught by the teacher. Kudus has a variety of local wisdom including *buka luwur*, earth alms, *gusjigang*, *ruwatan*, traditional *jenang* food, *lenkog tanjung*, *sego jangkring*, even tourist attractions such as the kretek museum, the holy tower, eating *sunan muria*, *sunan kudus* tomb, to mount *muria*.

The R2 informant stated that he has often associated the local culture of Kudus with learning and has proven effective in attracting students to concentrate and arouse more curiosity about the material. One example, during science learning (Grade V (R2), 2024) using the PjBL model in the context of the local culture of Kudus *Gunung Muria* to teach material on changes in the appearance of the earth's surface due to natural disaster factors has proven to be effective in fostering problem-solving skills. "Students are more interested if the material is collaborated with practice. If it is history or lectures, Shiva is bored a lot," said a teacher of Class V (R2), 2024).

Informant R2 added that the learning process using the PjBL model is completely student-centred. The teacher acts as a facilitator, provides feedback, and confirms.

Meanwhile, the teacher observes all activities carried out by students and ensures that all students take part and contribute to carrying out project activities. Students are asked to fill out the LKPD containing steps, results, and conclusions. After all activities to make a project and fill out the LKPD are completed, students are asked to come forward to present the results of their projects.

The worksheet is titled "Simulasi Gunung Meletus" and features a volcano illustration in the top right corner. It contains the following sections:

- Nama:** _____
- Kelompok:** _____
- Tajawa Proyek:** _____
- Alat:** _____
- Bahan:** _____
- Diskusi Perencanaan:** _____
- Langkah-langkah:** _____
- Hasil:** _____
- Kesimpulan:** _____

Figure 2. LKPD Simulated Eruption

After making a simulation project on an eruption mountain, students are also asked to fill out the LKPD and display it as evaluation and assessment material in front of the class. At the time of making the eruption mountain experiment, one group experienced an obstacle, namely the simulation of the mountain not being able to erupt optimally. However, all the group members actively participated in overcoming the problems at hand; they thought about what obstacles were causing the mountain simulation not to be able to erupt perfectly, analyzing the steps they had taken before. Finally, they can find a solution. "Mountains cannot erupt because there is too little water," said (Student 2 (R4), 2024). "This is what surprised me: students can do problem-solving. I just directed them. Try to find out where the problem is, and finally, they solve it themselves," added a teacher of Class V (R2), 2024).



Figure 3. It Appears that Group Two Put in Water but Too Little

In figure 3, it appears that the eruption experiment could not erupt perfectly because there was too little water put into the bottle.



Figure 4. Simulation of a Mountain Can Erupt Perfectly

As seen in Figure 4, students managed to make a simulation of a mountain eruption well after they were able to analyze the obstacles faced and improve the steps they took earlier. Finally, they can solve the problems at hand. During the learning material, the appearance of the earth's surface changes due to natural disaster factors. Before entering the learning material, the teacher provides stimulation through images of natural appearances such as earthquakes, tsunamis, volcanic eruptions, floods, landslides, abrasion, drought, and forest fires. Teachers spark students' understanding through the local culture of Mount Muria in Kudus. Teachers also relate to the culture around Mount Muria and the life of people in mountainous areas. Then, students are invited to make a simple project.

Students are asked to create a volcano project and simulate the process of a volcano erupting. In the previous meeting, the teacher provided students with information about how to bring tools and materials. The teacher conveys the learning objectives, prepares a student worksheet (LKPD), and distributes it to each group. Students are asked to work with their respective groups. Each group discussed the steps in making a simulated mountain eruption. Students are free to discuss and look for information in books. After that, students experimented to simulate a mountain eruption based on the steps they had discussed.

Discussion

Six steps in learning use the PjBL model: Providing triggering questions, Preparing project planning, compiling project schedules, implementing projects, conducting assessments, and evaluating experiences. There are five important things teachers do in the learning planning process using the PjBL model—knowledge of student learning and the experience of the Communist Party: The five important themes include time, teachers, effects, learning experiences, and teachers' preparation to enter the classroom (Eksangkul et al., 2024; Surul & Septiliana, 2023). The process of teaching and learning activities, there are at least three important things that need to be done by teachers, namely, planning, implementation, and evaluation or assessment (Agustini et al., 2024; Ekantini & Damayanti, 2023; Zuhdi et al., 2024). Teachers need to make maximum planning a supporting factor for success to improve the quality of education.

PjBL allows students to delve deeper into science concepts through in-depth exploration and research. This helps them understand the material more deeply compared to conventional learning methods, which are more surface learning. Project-based learning attracts students and helps them become more involved in the learning process (Nurdiana et al., 2023). PjBL can also help

students improve their reasoning skills in learning (Arifin, 2024; Fitri et al., 2024). The PjBL model improves student competence.

PjBL has been shown to increase student engagement in learning by giving them direct responsibility for their learning outcomes. Purwandari (2023) noted that PjBL helps students develop 21st-century skills like collaboration, creativity, and problem-solving. PjBL provides a deeper learning experience by linking learning materials to real-life situations, thus motivating students to learn more actively (Ekantini & Damayanti, 2023; Fahmi et al., 2024). Putri (2024) showed that PjBL also develops students' critical thinking skills because they face problems requiring deep thinking. PjBL improves understanding of science concepts and develops students' social and cognitive skills needed in the real world.

Learning carried out using the PjBL model in the context of Kudus local culture through the introduction of Mount Muria stimulation at MI NU Tarbiyatuth Thullab has been proven to foster problem-solving skills in students. Previous research also discussed that learning integrated with local wisdom and, according to the content, can provide a meaningful experience for students (Andini & Rusmini, 2022). Students welcome the implementation of learning that applies local wisdom and makes students enthusiastic during learning.

The research contributes to developing a Project-Based Learning (PjBL) learning model contextualized with the local wisdom of Kudus culture. The findings show that integrating local wisdom in science learning improves students' understanding of scientific concepts and develops important skills such as problem-solving, creativity, collaboration, and critical thinking. The integration of local wisdom in learning can be a model that inspires the application of similar approaches in various cultural contexts in Indonesia. In 21st-century education, students must master theoretical knowledge and social and cognitive skills relevant to the real world. The PjBL model contextualized with local culture can be applied more widely in other schools in Indonesia to improve learning motivation and the quality of education.

CONCLUSION

The implementation of project-based learning in the context of local wisdom shows a tendency to have a positive and effective impact on learning. It has been proven that the PjBL model is effective in fostering students' understanding of concepts and problem-solving skills. They can actively participate in learning and dare to appear in front of the class without special encouragement. In addition, students get a fun learning experience and can relate to everyday life and solve problems in the projects they are working on. Not only play an active role but can understand the material quickly and easily. This research has limitations, namely that the instrument does not only assess cognitive concept understanding but can be developed in the aspect of attitude. The researcher suggests that writers or researchers in the future can develop research instruments in the form of observation sheets or questionnaires for attitude assessment and can further explore the types of local wisdom that can be integrated into learning through traditional media, songs or games.

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