INTERNATIONAL JOURNAL OF CONTEMPORARY STUDIES IN EDUCATION
IJ-CSE
https://journals.eduped.org/index.php/ijcse
E-ISSN 2963-0282, P-ISSN 2963-5993

Culturally Responsive Problem-Based Learning: The Impact of Marharoan Bolon Local Wisdom on Elementary Science Learning Outcomes

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Received: 09/09/2025 Revised: 02/11/2025 Accepted: 08/12/2025

ABSTRACT

Purpose – This study aims to investigate the effect of a Problem-Based Learning (PBL) model grounded in the local wisdom of Simalungun *Marharoan Bolon* on the Natural Science learning outcomes of fourth-grade students at UPTD SD Negeri 094155 Rambung Merah. The study is motivated by the need to integrate culturally relevant approaches to improve elementary science achievement.

Methodology – The research employed a pre-experimental method using a One-Group Pretest–Posttest Design. The population comprised all fourth-grade students, with a purposive sample of 28 students selected based on class availability and feasibility. The intervention consisted of implementing the Marharoan Bolon-based PBL model during science instruction. Research instruments were tested for validity, reliability, item difficulty, and discriminating power. Data analysis included normality testing, paired sample t-test, and N-Gain analysis to determine learning improvement.

Findings – The results indicate a significant improvement in students' learning outcomes after the intervention. Statistical analysis showed t_count = 15.29, which exceeded t_table = 2.052, with a significance value of 0.00 < 0.05. These findings confirm that the Marharoan Bolon-based PBL model had a significant positive effect on students' science achievement.

Novelty – This study integrates a modern instructional model (PBL) with indigenous local wisdom, demonstrating the effectiveness of culturally responsive pedagogy in elementary science education.

Significance – The findings benefit elementary teachers, curriculum developers, and education policymakers seeking culturally grounded strategies to enhance science learning outcomes.

Keywords: Culturally responsive learning; Elementary science education; Learning outcomes; Local wisdom; Problem-based learning; Simalungun Marharoan Bolon.

How to cite: Simanjuntak, C. J., Thesalonika, E., & Sitio, H. (2026). Culturally Responsive Problem-Based Learning: The Impact of Marharoan Bolon Local Wisdom on Elementary Science Learning Outcomes. *International Journal of Contemporary Studies in Education, 05*(1), pp, 27-36, doi: https://doi.org/10.56855/ijcse.v5i1.1719

1. Introduction

Education is one of the most important aspects of human life. Through education, people are able to anticipate changes in life. Education is a process that not only provides intellectual skills in reading, writing, and arithmetic, but also optimally develops students' intellectual, social, and personal abilities. The role of education in today's era of globalization is crucial, as education itself is now a primary factor in improving the quality of human resources. An educational process that prioritizes educational components is expected to produce a high-quality future generation (Saprudin, 2020). The quality of a nation's human resources can generally be seen from the quality of its education. Improving educational quality, one way to do this is through the learning models implemented in schools, which can foster innovative and creative attitudes and behaviors in students (Adolph 2021). According to Gagne in (Ma'rifah 2020), learning is a type of change manifested in behavior, differing from the individual's state before the learning situation and after engaging in a similar activity. Change occurs as a result of experience or practice. Therefore,selecting appropriate learning models plays a crucial role in ensuring that these behaviorial changes lead to meaningful and measurable learning outcomes.

Crowther, (2021) states that learning is a process of personal change, in which improvements occur in behavior, knowledge, skills, thinking ability, understanding, and attitudes. According to Hardiani, (2022), learning outcomes are not limited to memorizing verbal or theoretical knowledge; students also develop cognitive skills, attitudes, and motor abilities. Learning outcomes are generally viewed as behavioral indicators that reflect knowledge mastery, which is also the main goal of conventional learning.

To achieve these outcomes effectively, innovative learning models are required. One of the most effective approaches is the *Problem Based Learning* model. According to Handayani and Koeswanti, (2021), explain that the *Problem Based Learning* model helps students enhance problem-solving abilities, deepen understanding and knowledge, and become more actively engaged in learning. One effective approach to achieving this goal is the *Problem-Based Learning* model. One effective approach to achieving these learning outcomes is the Problem-Based Learning model. PBL is a student-centered learning approach that presents learners with real and contextual problems, encouraging them to collaborate and develop appropriate solutions (Ramadhani et al. 2024). This model provides a meaningful context for students to develop critical thinking and problem-solving skills while mastering essential concepts from the subject matter (Masniladevi 2020).

Problem Based Learning is a learning model that uses real problems as the main focus to develop students' curiosity and critical thinking skills in analyzing and solving problems (Melindawati et al. 2022). Hasil et al (2022), the *Problem Based Learning* model has several essential characteristics. First, learning activities center on real-life problems encountered by students. Second, the learning process emphasizes student engagement, adopting a student-centered approach. Third, the role of the educator shifts from a knowledge transmitter to a facilitator who supports and guides students throughout the learning process. Fourth, students are encouraged to collaborate in groups to share knowledge and exchange ideas.

Furthermore, learning activities are conducted in meaningful contexts related to real-life situations, and the learning process integrates various fields of study to promote a comprehensive understanding.

David Johnson and Johnson (Arifin 2021) state that there are five steps in *Problem Based Learning* through group activities. The first step is defining the problem, where students formulate the problem from an event containing a conflict issue so that the issue to be studied becomes clear. The second step is diagnosing the problem, which involves determining the cause of the problem and analyzing various factors, including inhibiting and supporting factors, in solving the problem. Next, the third step is determining alternative strategies. At this stage, students test each formulated action through class discussions and are encouraged to think, express opinions, and argue about possible actions. The fourth step is determining and implementing strategic choices by deciding which strategy to implement. Finally, an evaluation is conducted, both process and outcome evaluation. The evaluation process includes an assessment of all activities, while the evaluation of outcomes assesses the consequences of implementing the strategies used.

According to Robert Sibarani (Damanik, 2020) The section on local wisdom presents a solid conceptual foundation, yet it would be more engaging and meaningful if supported with contextual examples or recent scholarly perspectives. Kearifan and Antropologis (2021), explains that local wisdom should be defined as "wisdom in traditional culture," noting that the term refers to the traditional culture of ethnic groups. The term "wisdom" should also be understood in its broadest sense, encompassing not only cultural norms and values but also all elements of ideas, including those affecting technology, healthcare, and aesthetics.

Fajarini, (2020), defines local wisdom as the intellectual and cultural intelligence possessed by a particular ethnic group, developed through collective community experiences. In other words, local wisdom emerges as the result of a community's long-term interaction with its environment and social realities—knowledge and values that may not be shared by other communities. These values become deeply rooted and are continuously preserved throughout the community's existence. Meanwhile, according to Damanik, (2023), Marharoan Bolon is an oral tradition passed down from generation to generation by the Batak Simalungun ethnic group. Explains that Marharoan Bolon represents an oral tradition among the Batak Simalungun people, transmitted from generation to generation without external interference. This tradition, whether inherited or practiced through direct participation, serves as a cultural mechanism that strengthens solidarity and cooperation among community members. Marharoan Bolon promotes mutual assistance, where collective cooperation lightens individual burdens and encourages communal harmony. Marharoan Bolon is described as a system of working together so that tasks that feel heavy will be light (Saragih 2024). This spirit of togetherness aligns closely with the principles of humanity and shared responsibility within the community.

2. Methods

In this study, the author used an experimental research method with data types using a quantitative research approach. According to Sugiyono, (2019), the experimental research is a quantitative method designed to test the effect of an independent variable (treatment) on a dependent variable (result) under controlled conditions. So the purpose of this experimental research is the same as the purpose of the research that will be carried out by the author, namely to find the effect of the Problem Based Learning learning model based on local wisdom in the subject of Natural Sciences on the learning outcomes of fourth grade students of UPTD SD Negeri 094155 Rambung Merah.

This design was chosen because it allows researchers to directly observe the effect of the intervention on the same group of participants without requiring a control group. This design was carried out by measuring the learning outcomes of fourth grade students twice. The first measurement (Pretest) was carried out to see the condition of students before carrying out the treatment, namely to see the results of student learning in the learning process in grade IV before the application of the Problem Based Learning model based on local wisdom and the second measurement (Post-test) was carried out to find out the results of student learning after the application of the Problem Based Learning model based on local wisdom by the author.

Table 1 - Research Design

Pretest	Treatment	Posttest
O_1	**X**	O_2

2.1 Question Validity Test Results

Validity is a measure that shows how valid an instrument is. The data used to find the results of the trial of the research instrument consisting of 30 multiple choice questions. The results of the question validity analysis can be seen in the following table:

Table 2 - Validity Test Results

Number of Questions	r_{count}	r_{table}	Information
1,2,3,4,5,6,7,8,9,11,12,13,14,15,17,19,20,21,23,24	0,36-0,81	0,361	Valid
10,16,18,22,25	0,30-0,35	0,361	Invalid

In the table 2 above, it is known that there are 5 items that have a correlation smaller than the r table, namely question numbers 10, 16, 18, 23, and 25. This means that the number of questions that can be used in this research or are declared valid is 25 questions.

2.2 Reliability Test Results

Reliability testing shows the extent to which an instrument can provide consistent results. Reliability testing is only carried out on valid items obtained through validity in the previous stage using the Cronbach's alpha formula.

Table 3 - Reliability Analysis

Cronbach's Alpha	N of items
.942	25

Instrument trial, the Crohn's alpha value was 0.94. Thus it is known that the instruments used in the research are reliable and have high reliability.

2.3 Question Difficulty Test Results

The results of the analysis of the level of difficulty of valid question items can be seen in the table below.

Table 4 - Difficulty Level

Number of Questions	Information
1,2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,18,19,20,23,24	Easy
5,8,21,22,25	Currently

Based on table 4, it shows that of the 25 questions tested, 20 were in the easy category and 5 were in the medium category.

2.4 Discriminatory Power Test

After determining the difficulty level of each test item, the next step was to analyze its discriminatory power. Discriminatory power indicates how well an item can differentiate between high-performing and low-performing students. In essence, items with strong discriminatory power are those that can clearly distinguish students who have mastered the material from those who have not. This analysis helps ensure that each test item accurately reflects variations in students' understanding and contributes to the overall validity of the assessment.

Table 5 - Differentiating Power of Questions

Number of Questions	Information
3,4,5,6,7,8,9,13,15,17,18,20,23,24,25	Good
1,2,10,11,12,1416,19,22	Very good
21	Sufficient

The data in table 5 shows that each test item has a differentiating power, namely 9 items in the Very Good category, 15 items in the Good category, and 1 item in the Sufficient category.

3. Results and Discussion

3.1 Results

Research was conducted at UPTD SD Negeri 094155 Rambung Merah on August 19-26 in class IV with 28 students as research samples. Before administering the pretest, the researcher provided the learning materials and instructions to the students on how to answer the pretest questions. After the instruction, the researcher provided the pretest questions and answer sheets. The pretest lasted 45 minutes. The posttest was administered after the treatment, which involved implementing the *Marharoan Bolon* based *Problem Based Learning* model. During the posttest, the researcher provided students with instructions on how to answer the questions. Afterward, the researcher provided the students with the question and answer sheets, giving them 45 minutes to complete the test.

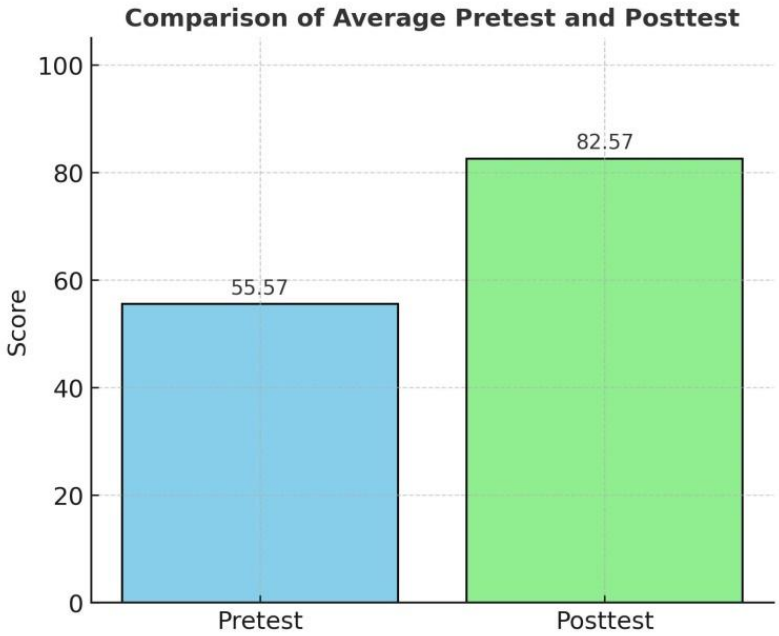

Figure 1. Comparison of Average Pretest and Posttest Scores

Based on the bar chart above, it can be seen that the average posttest value is higher than the pretest value, where the pretest value is 55.57 and the mean posttest is 82.57. It can be concluded that there was an increase in student learning outcomes in the posttest after being given treatment using the *Problem Based Learning Marharoan Bolon* model in grade IV students with material in Chapter 5 topic A.

The following are the results of the normality test using SPSS 26 with the Shapiro-Wilk formula with the basis for decision making in this test, namely:

Table - 6 Tests of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	**Df**	**Sig.**	**Statistic**	**Df**	**Sig.**
preTest eks	.084	28	.200*	.967	28	.506
posTest eks	.115	28	.200*	.975	28	.716

From the table 6 above, it can be seen that the pretest data is 0.50 > 0.05, so the data is normally distributed, and the posttest data is 0.71 > 0.05, so the data is normally distributed

The N-Gain test is used to measure the extent of the effectiveness of the learning model before treatment (Pretest) to the target learning outcomes after treatment (posttest).

Table - 7 N-Gain Test

	Score
Mean Pretest	55,57
Mean Posttest	82,57
N-Gain Score	0,62

Based on Table 7 , the N-Gain Score = 0.62, interpreted as Moderate, and the N-Gain Percent = 61.83, interpreted as Quite Effective. This means that the learning carried out effectively improved student learning outcomes at a moderate level. These data show that the

Problem Based Learning model based on *Marharoan Bolon* is effective for use in the science subject and can improve the learning outcomes of fourth grade students at UPTD SD Negeri 094155 Rambung Merah.

Data analysis using paired sample test to see the effect of *Problem Based Learning* based on Marharoan *Bolon* in the subject of Science on the learning outcomes of fourth grade students of UPTD SD Negeri 094155 Rambung Merah can be seen in the following table:

Table 8 - t Test Results

Information	Score
r_{count}	15,29
r_{table}	2,052
Significance	0,00

Based on Table 8 , the calculated t-count is 15.29, with a t-table of 2.052, with a 5% margin of error. Thus, t_count > t_table, which means H_0 is rejected and H_a is accepted, indicating that there is an influence of the *Problem Based Learning* model based on *Marharoan Bolon* in the science subject on the learning outcomes of fourth-grade students at UPTD SD Negeri 094155 Rambung Merah.

The significance value shows that the results of the comparison of the pretest and posttest have a sig value (2-tailed) of 0.00 < 0.05, so is H_0 rejected and H_a is accepted. It can be concluded that there is an influence of the *Problem Based Learning Marharoan Bolon* model for the science subject on the learning outcomes of fourth grade students at UPTD SD Negeri 094155 Rambung Merah.

3.2 Discussion

The application of the *Problem Based Learning* model based on *Marharoan Bolon* (Mutual Cooperation) in the Natural Sciences material Chapter 5 Topic A is an effective strategy to improve student learning outcomes. The learning process begins with testing the question instrument to ensure its validity, then a pretest and posttest are carried out on the research sample. Based on the data analysis results, the average pretest score was 55.57, while the average posttest score after applying the learning model increased to 82.57. This finding demonstrates a substantial improvement in learning achievement, with an average gain of 27 points.

This model provides students with greater opportunities to express themselves through problem solving, which simultaneously fosters a sense of togetherness and cooperation between groups in finding solutions. Furthermore, learning becomes more contextual and meaningful because students are directly involved in each stage of *Problem Based Learning*, from identifying the problem, designing a solution strategy, implementing the solution steps, and evaluating the resulting solution. This process aligns with the steps in the Problem-Based Learning model as proposed by Jhon Dewy, (2020).

Through the Problem-Based Learning (PBL) model based on the Marharoan Bolon (Mutual Cooperation) dance, fourth-grade students were proven capable of collaborating and solving problems realistically. This learning approach not only teaches dance movements but

also instills the values of cooperation and local culture through active exploration. Student learning outcomes significantly improved due to direct involvement in the creation and comprehension of culturally-based dances.

Classroom projects involve assigning groups of students to explore the movements, music, and philosophy of *Marharoan Bolon* together, enhancing collaboration skills and understanding of traditional. This method also strengthens social bonds and Simalungun community values, which serve as learning resources in a modern classroom context. The results of the study showed an improvement in student learning outcomes after implementing the *Problem Based Learning* model based on the local wisdom of *Marharoan Bolon.* This was evident in the average pretest score of 55.57, which increased to 82.57 in the posttest. Thus, there was a significant increase in student conceptual mastery after participating in the learning process.

This improvement is in line with the theory of constructivism (in Miswarul Abdi Aziz and Teuku Sanwil, (2022), which emphasizes that knowledge will be more meaningful if obtained through direct experience and active involvement of students in solving problems. The *Problem Based Learning* model combined with *Marharoan Bolon* values provides opportunities for students to work together, discuss, and find solutions to problems related to real life. This process not only develops cognitive aspects, but also fosters social attitudes, cooperation, and responsibility.

Furthermore, N-Gain data shows an average value of 0.61, equivalent to 61.83%, which falls into the moderate to high improvement category. This means that the implementation of the local wisdom-based Problem-Based Learning model can significantly improve the effectiveness of science learning. This finding is in line with the results of previous research and the opinion of Robert Sibarani (in F. H. S. Damanik, (2020) which states that *Problem Based Learning* can encourage students to be more critical, creative, and able to link concepts to local contexts. Thus, it can be concluded that the application of the *Problem Based Learning* model based on *Marharoan Bolon* is not only effective in improving learning outcomes, but is also relevant in instilling local cultural values .

4. Conclusions

Based on the research findings and data obtained, the researcher concludes that the implementation of the Problem-Based Learning Model based on Marharoan Bolon in the Science Subject has a significant impact on the Learning Outcomes of Grade IV students at UPTD SD Negeri 094155 Rambung Merah. This is supported by statistical evidence showing a calculated t_{count} = 15.29, which is substantially greater than the table t_{table} = 2.052, with a significant (2-tailed) p-value of 0.00 < 0.05. Therefore, H_0 is rejected and H_a is accepted, confirming the positive influence of the model.

Acknowledgments

I express my gratitude to the presence of God Almighty for all His blessings and presence so that I can complete this article. The completion of this thesis cannot be separated from the help, support, and prayers of various parties. My sincere gratitude goes to Mrs. Emelda Thesalonika, M.Pd., and Mrs. Debby

Yuliana Sinaga, M.Pd., as my supervisors, for all the guidance, direction, and motivation that have been given until the completion of this thesis.

Conflict of Interest

I, the undersigned, hereby declare that in the preparation of this thesis there is no potential conflict of interest, either personal or institutional. All data, analyses, and research results presented are the author's original work and are used solely for academic purposes.

References

Adolph, Ralph. 2021. wahidmurni *PENERAPAN MODEL PROBLEM BASED LEARNING*.

Arifin, Samsul. 2021. "Metode Problem Base Learning (PBL) Dalam Peningkatan Pemahaman Fikih Kontemporer." *TA'LIM : Jurnal Studi Pendidikan Islam* 2(1): 88–106. doi:10.52166/talim.v2i1.1365.

Crowther, C. H. 2021. 162 New Scientist *Seeing and Learning*.

Damanik, France Pepin, and Ramlan Damanik. 2023. "Kearifan Lokal Tradisi Marharoan Bolon Masyarakat Simalungun." *Kompetensi* 16(1): 182–90. doi:10.36277/kompetensi.v16i1.107.

Damanik, Fritz H.S. 2012. "Menata Dan Menguatkan Institusi Pelayanan Publik Bersendikan Kearifan Lokal." (N0. 02): 5.

Fajarini, Ulfah. 2020. "Peran Kearifan Lokal Bagi Pendidikan Karakter." *Sosiodidaktika* 1(2): 123–30.

Handayani, Anik, and Henny Dewi Koeswanti. 2021. "Meta-Analisis Model Pembelajaran Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Berpikir Kreatif." *Jurnal Basicedu* 5(3): 1349–55. doi:10.31004/basicedu.v5i3.924.

Hardiani, NF. 2022. "Pengaruh Pembelajaran Jarak Jauh Dan Gaya Belajar Terhadap Hasil Belajar Siswa Kelas X IPS SMA Negeri 2 Kota Jambi." : 11–53.

Hasil, Terhadap, Belajar Akuntansi, Siswa Smk, and Negeri Palembang. 2022. "Pengaruh Model Pembelajaran Problem Based Learning (PBL) Dan Gaya Kognitif Terhadap Hasil Belajar Akuntansi Siswa SMK Negeri 5 Palembang." *Liabilities (Jurnal Pendidikan Akuntansi)* 5(2): 30–39. doi:10.30596/liabilities.v5i2.11469.

Kearifan, D A N, and Lokal Antropologis. 2021. "Penguatan Kecerdasan Prespektif Budaya Dan Kearifan Lokal (Antropologis)." *Jurnal Literasiologi* 10: 137–44.

Ma'rifah, Siti. 2020. "'HELPER" Jurnal Bimbingan Dan Konseling FKIP UNIPA." *Jurnal Bimbingan dan Konseling FKIP UNIPA* 35(1): 31–46.

Masniladevi, Nora Melina &. 2020. "Pengaruh Model Problem Based Learning (PBL) Terhadap Hasil Belajar FBB Dan KPK Di Kelas IV SDN Gugus 5." *Jurnal Pendidikan Tambusai* 4(3): 2502–7.

Melindawati, Silfi, Vivi Puspita, Ade Irma Suryani, and Shella Marcelina. 2022. "Analisis Literatur Review Penerapan Model Problem Based Learning (PBL) Pada Pembelajaran IPS Di Sekolah Dasar." *Edukatif : Jurnal Ilmu Pendidikan* 4(5): 7338–46. doi:10.31004/edukatif.v4i5.3919.

Miswarul Abdi Aziz, and Teuku Sanwil. 2022. "Teori Belajar Konstruktivisme Dan Aplikasinya Dalam Pembelajaran Bahasa Arab." *Jurnal Pendidikan dan Pengajaran* 1(1): 76–83. http://pedirresearchinstitute.or.id/index.php/Jurpen.

Pokhrel, Sakinah. 2024. "PENGARUH MODEL PEMBELAJARAN PROBLEM BASED LEARNING TERHADAP KEMAMPUAN BERPIKIR KRITIS SISWA KELAS V PADA MATA PELAJARAN IPAS DI MIMA IV SUKABUMI BANDAR LAMPUNG." *Αγαη* 15(1): 1–80.

Ramadhani, Saravina Putri, Firda Maya Pratiwi, Zefi Hanatul Fajriah, and Bambang Eko Susilo.

2024. "Efektivitas Model Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Terhadap Pembelajaran Matematika." *Prima* 7: 724–30.

Saprudin, Yenny Susanti. 2020. "Pengaruh Intenstasi Mengikuti Pembinaan Kemandirian Terhadap Peningkatan Minat Berwirausaha Pada Warga Binaan Pemasyarakatan Di Lapas Narkotika Klas II A Bandung." : 1–8. http://repository.upi.edu/11162/4/S_KTP_0901265_Chapter1.pdf.

Saragih, Hisarma. 2024. "Dinamika Identitas Etnis Simalungun Dan Pembangunan Di Kota Pematang Siantar." *Etnoshistori: Jurnal Ilmiah Kebudayaan dan Kesejarahan* V(2): 185–96.

Sugiyono. 2019. "Penggunaan E-Learning Berbasis Edmodo Terhadap Hasil Belajar Kelas 4 Sekolah Dasar." *Jurnal PGSD: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar* 15(2): 97–106. doi:10.33369/pgsd.15.2.97-106.