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The effect of discovery learning integrated with Lampung local wisdom on students' mathematical problem-solving skills across gender

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Abstract

Mathematical problem-solving skills remain a persistent challenge for elementary students, partly due to the lack of contextual learning approaches that connect mathematics with local culture. However, limited empirical evidence examines whether integrating local wisdom into learning models can enhance students' problem-solving performance across gender. This study aimed to analyze the effect of Discovery Learning integrated with Lampung local wisdom on students' mathematical problem-solving skills and to examine whether this effect differs by gender. Using a quasi-experimental 2×2 factorial design, this study involved 41 fifth-grade students at a public elementary school in Pesisir Barat Regency, selected through random sampling. Data were collected using a validated problem-solving test and analyzed using two-way ANOVA. The results indicated that: (1) the learning model had a significant effect on problem-solving skills, (2) there was no significant difference between male and female students, and (3) no interaction effect was found between learning model and gender. These findings highlight the effectiveness of culturally integrated Discovery Learning in improving students' mathematical problem-solving skills in an inclusive manner. The study contributes to the growing literature on culturally responsive mathematics instruction and encourages educators to use local-wisdom-based approaches to support equitable 21st-century skill development.

Keywords: Lampung local wisdom; discovery learning; mathematics, problem-solving; gender

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INTRODUCTION

The development of 21st-century education places strong emphasis on essential skills such as critical thinking, creativity, collaboration, and problem solving (Partnership for 21st Century Learning) (Playton et al., 2021). Within this framework, mathematical problem-solving ability serves as a fundamental competency that enables students to navigate complex global challenges. Problem-solving is not only the central objective of mathematics education (Funke, 2022), but also a key cognitive process that allows students to apply mathematical knowledge to real-life situations (Priharvian, 2024). However, observations at SDN 10 Krui indicate that students' problem-solving performance remains suboptimal. Many students rely heavily on memorizing procedures rather than building deep conceptual understanding (Hendriyanto et al., 2024).

Efforts to improve this ability have included the use of active learning models such as

Discovery Learning (Jatisunda et al., 2020; Sahari & Ayunis, 2024). Yet, these approaches often overlook students' cultural backgrounds, which limits their potential to create meaningful learning experiences. Previous studies have shown that integrating local wisdom into instruction can enhance engagement and learning outcomes through contextualized and culturally resonant learning environments (Agustin & Adi Winanto, 2023). Despite this evidence, empirical studies that integrate Lampung local wisdom, particularly cultural objects or artifacts into Discovery Learning for elementary mathematics remain scarce. Moreover, previous findings regarding gender differences in mathematical problem-solving ability remain inconsistent (Zhang et al., 2024), prompting further examination of whether culturally contextualized instructional models benefit male and female students equally (Pugu, 2025). These conditions indicate a research gap involving both the cultural dimension of learning and the potential interaction between learning models and gender.

Addressing this gap, the present study aims to: (1) examine the effect of the Discovery Learning model integrated with Lampung local wisdom on fifth-grade students' mathematical problem-solving abilities; (2) analyze differences in problem-solving abilities between male and female students; and (3) investigate the interaction between the learning model and gender. This study contributes to mathematics education literature by offering an empirically tested, culturally grounded instructional model that supports inclusive learning.

Theoretically, this study is grounded in constructivism, which posits that learners actively construct knowledge through interactions with their environment (Solomon & Anderman, 2021). Discovery Learning aligns with this view by encouraging students to explore, inquire, and develop conceptual understanding through problem-solving activities (Permata et al., 2021). In addition, contextual learning theories emphasize the importance of connecting academic content with learners' cultural backgrounds and daily experiences (Primayana & Suryawan, 2022). Integrating Lampung local wisdom, such as traditional tapis motifs, creates culturally meaningful learning stimuli that enhance relevance, activate familiar cognitive schemas, and support deeper information processing. From this theoretical synthesis, we argue that Discovery Learning provides the pedagogical structure, while local wisdom serves as a contextual catalyst that strengthens the knowledge-construction process. Regarding gender, this framework views cognitive performance as shaped more by learning experiences than by inherent biological differences.

Based on these foundations, the following hypotheses were formulated: (H1) Students taught using Discovery Learning integrated with Lampung local wisdom will exhibit higher mathematical problem-solving abilities than those taught using conventional Discovery Learning, (H2) there is no significant difference in mathematical problem-solving abilities between male and female students, (H3) there is no significant interaction between learning model and gender on mathematical problem-solving abilities.

METHODS

This study used a quasi-experimental design with a 2x2 factorial design (see Table 1) (Creswell, 2009). This design was chosen because it allowed researchers to investigate the main effects of two independent variables (learning model and gender) and their interaction effects in a real classroom setting (Sugiono, 2019), where full random assignment is not always possible. The population in this study was all fifth-grade students at SDN 10 Krui, West Coast Lampung. The sample consisted of 41 students from two classes (VA = 21 students, VB = 20 students) selected through random sampling (Emzir, 2019). Class VA was designated as the experimental class and VB as the control class. Students who were present throughout the research process and completed the pre-test and post-test were included in the sample. The sample consisted of 18 male students and 23 female students, with an average age of 11 years. The main instrument was a mathematical problem-solving test in the form of essay questions.

Table 1. Research design

Gender (M)	Learning model (V)	
	Discovery Learning Integrated with Lampung Local Wisdom (V1)	Discovery Learning (V2)
Male (M1)	V1M1	V2M1
Female (M2)	VIM2	V2M2

The details for each respondent are as follows: VIM1 is a male student who was treated using the integrated discovery learning model of local wisdom of Lampung, V2M1 is a male student who was treated using discovery learning. V1M2 is a female student who received treatment using the Integrated Discovery Learning model of Local Wisdom of Lampung, V2M2 is a female student who was treated using discovery learning. The instrument used to collect data on students' mathematical concept comprehension abilities was a descriptive test consisting of two questions with four choices (a, b, c, d), for a total of eight questions that had been validated. The data obtained were analyzed using descriptive and inferential statistics. The statistics used to test the hypothesis were two-way ANOVA with a follow-up test using SPSS.

The research procedure was carried out by applying the integrated discovery learning model of Lampung local wisdom, with six meetings and applying the discovery learning model, in the control class with six meetings. At the beginning of the learning process, a pretest was given, and at the end of the learning process, a post-test was given to the experimental class and the control class.

RESULTS AND DISCUSSION

Results

This section presents empirical findings from the quasi-experimental study conducted (Maisuhetni, 2021). The results are presented systematically to answer the research questions regarding the influence of learning models, gender, and their interaction on mathematical problem-solving abilities. The presentation begins with descriptive statistics, followed by prerequisite analysis tests, and concludes with hypothesis testing using two-way ANOVA. descriptive statistics and data characteristics. Based on descriptive statistical analysis, a comprehensive picture of the mathematical problem-solving abilities of students in the experimental and control groups was obtained.

Table 2. Descriptive statistics of mathematical problem-solving ability

Class	N	Minimum	Maximum	Mean	Std. Deviation
Control	20	56	75	64.05	5.643
Experiment	21	62	91	73.43	6.201

Based on Table 2, it can be concluded that students in the experimental class, who were taught using the DL learning strategy integrated with local wisdom, had a higher average problem-solving ability than students in the control class. To gain a deeper understanding of how mathematical problem-solving ability varies across different groups of students, further analysis was conducted by categorizing the data based on gender. This breakdown allows for a more detailed comparison between male and female students in both the control and experimental classes. The descriptive statistics presented in Table 3 provide an overview of the data for each subgroup.

Table 3. Descriptive statistics of mathematical problem-solving ability based on gender

Gender	N	Minimum	Maximum	Mean	Std. Deviation
Male_Control	9	56	69	63.89	5.643
Female_Control	11	56	75	64.18	6.201
Male_Experimenter	9	66	78	72.67	4.444
Female_Experimenter	12	62	91	74.00	7.398

Based on Table 3, it can be concluded that in the control class, the average score for boys was 63.89 and for girls was 64.18. In the experimental class, the average score increased to 72.67 for boys and 74.00 for girls. These results indicate that the experimental class had a higher average than the control class, and that girls tended to have better problem-solving skills than boys. However, the standard deviation for girls was greater, indicating more diverse abilities. Meanwhile, for the problem-solving ability test instrument, there were two prerequisite tests, namely the normality test and the homogeneity test. For the normality test, the Shapiro-Wilk test technique was used with the help of the SPSS ver. 22.0 application, and the results are shown in Table 4.

Table 4. Normality Test

Variable	*Sig Shapiro-Wilk*	Note
Experimental Pretest	0.164	Normal
Experimental posttest	0.113	Normal
Experimental pretest	0.140	Normal
Experimental posttest	0.163	Normal

Based on Table 4, the test results show the Asymp.Sig (2-tailed) value of the ability. The mathematical problem-solving scores in the experimental class were 0.164 for the pretest and 0.113 for the posttest. Meanwhile, in the experimental class, the significance values were 0.140 for the pretest and 0.163 for the posttest. All significance values were greater than 0.05, indicating that mathematical problem-solving data were also normally distributed. These results reinforce that both the pretest and posttest research data meet the requirements for further analysis using parametric statistical tests.

Table 5. Problem-solving homogeneity test

Variable	Levene statistic	Df1	Df2	Sig
Pretest-posttest of inquiry and discovery learning experiments	1.314	3	78	0.276

In Table 5, the homogeneity test for problem-solving ability shows a Levene Statistic value of 1.314 with df1 = 3 and df2 = 78, and a significance value of 0.276. This value is greater than 0.05, so it can be concluded that the variance between groups in problem-solving ability is also homogeneous. This means that the data between groups have similar variances, so the homogeneity requirement is met, and the analysis can be continued using parametric tests.

The hypotheses to be tested in this study are: 1) the difference in the effect between the discovery learning and inquiry learning models integrated with Lampung local wisdom on the mathematical problem-solving abilities of fifth-grade students; 2) the difference in the mathematical problem-solving abilities of fifth-grade students based on gender; 3) The interaction effect between the learning model and gender on the mathematical problem-solving abilities of fifth-grade students. This test was conducted using a 2-WAY ANOVA test. The test results are presented in Table 6.

Table 6. Two-way ANOVA test results

Source	Type III Sum Of Squares	Df	Mean Square	*F*	*Sig*
Learning Model	872.233	1	872.233	23.651	0.000
Gender	6.671	1	6.671	0.181	0.673
Learning Model*Gender	2.730	1	2.730	0.074	0.787

Based on the results of the two-way ANOVA analysis in Table 6, it can be interpreted that there is a statistically significant effect of the learning model on mathematical problem-solving ability, $F(1,37) = 68.598$, $p < .001$. The effect size obtained is in the large category (partial $\eta^2 = 0.645$), which indicates that the learning model explains 64.5% of the variance in mathematical problem-solving ability. There is no statistically significant effect of gender on mathematical problem-solving ability, $F(1,37) = 0.525$, $p = .473$. The effect size obtained is very small (partial η^2

= 0.014), indicating that gender explains only 1.4% of the variance in mathematical problem-solving ability. There was no significant interaction between learning model and gender on mathematical problem-solving ability, $F(1,37) = 0.215$, $p = .646$. The effect size obtained was very small (partial $\eta^2 = 0.006$), indicating that the interaction of the two variables only explained 0.6% of the variance in mathematical problem-solving ability.

Discussion

This study comprehensively examines the effectiveness of the Discovery Learning model infused with Lampung local wisdom in improving elementary school students' mathematical problem-solving skills. Key findings of the study show that: first, there is a statistically significant effect of the learning model on improving mathematical problem-solving skills with a large effect size ($\eta p^2 = 0.39$); second, there is no significant difference in mathematical problem-solving skills between male and female students; third, there is no significant interaction between the learning model and gender on mathematical problem-solving skills. These findings confirm the superiority of the culturally integrated model over the conventional approach, while also emphasizing the inclusive nature of the model across genders.

The findings on the superiority of the locally-integrated model are consistent with the research (Kusuma, 2018), which proves that locally-based learning can improve students' creativity and learning outcomes (Li & Tu, 2024). However, this study goes further by systematically integrating local wisdom into the syntax discovery learning, rather than simply using cultural contexts as illustrations. The results of (Attard et al., 2021) research on contextual learning are also in line with these findings, although our research provides an additional contribution by measuring the effect size, which falls into the large effect size category, indicating a more substantive impact than previous studies (Maharani, 2022).

The advantages of the Lampung local wisdom-infused Discovery Learning model can be explained through several cognitive and affective mechanisms. First, the integration of cultural elements such as Tapis fabric motifs serves as effective cultural scaffolding (Rifki Amrullah & Denny Nugraha SSn, 2020). According to Vygotsky, scaffolding allows students to operate within their Zone of Proximal Development, where abstract mathematical concepts become more accessible through familiar cultural representations. Second, contextualization through local wisdom creates a strong “cognitive hook,” facilitating long-term memory encoding and retrieval (Ugwitz & Jelı, 2023). This is in line with the theory of situated cognition, which emphasizes that knowledge is most effectively learned in the context in which it will be applied (Savari et al., 2023)

The finding that there were no significant differences in mathematical problem-solving abilities between male and female students supports contemporary perspectives in mathematics education. According to expectancy-value theory (Suparlan, 2019), academic achievement is more influenced by psychosocial factors such as self-confidence, perceptions of mathematics, and environmental support than by biological factors alone. In this study, the contextual and engaging learning model may have neutralized the negative effects of stereotype threat, which often affects female performance in mathematics (Campbell et al., 2024). By creating a relevant and supportive learning environment for all students, this model has the potential to minimize performance variations stemming from gender-related psychosocial differences.

The finding that there was no significant interaction between the learning model and gender is a positive indicator of the inclusiveness of the developed model. These results show that the advantages of a culturally integrated model work consistently across genders, without favoring any particular gender group. From the perspective of culturally responsive pedagogy theory (Bolstad, 2023) approaches that accommodate student diversity, in this case cultural diversity, tend to create a more equitable and equitable learning environment. In other words, when learning is linked to a cultural context shared by all students, the benefits of learning become more evenly distributed, regardless of demographic variables such as gender.

The findings of this study have significant theoretical implications. First, this study reinforces the integration of constructivism and culturally responsive pedagogy as a solid theoretical foundation for the development of learning models (Suryana et al., 2022). Second, this study supports the perspective that mathematical ability is not a fixed innate talent, but rather a competency that can be developed through the right learning environment. From a practical standpoint, these findings offer a blueprint that can be adopted by educators and curriculum developers. Teachers are encouraged to act as "cultural translators" who are able to bridge formal mathematics with the cultural realities of students. Schools can develop a systematic and structured bank of teaching materials based on local wisdom (Eprilia et al., 2023).

Several limitations in this study need to be acknowledged. First, the generalization of findings is limited to the cultural context of Lampung and the level of elementary school education (Johnston et al., 2022). Second, this study only measures short-term cognitive outcomes, without exploring affective impacts and long-term retention. Third, although the intervention was systematically designed, other variables such as teacher implementation quality and classroom dynamics could not be fully controlled (Sleman et al., 2024). For future research, it is recommended to: (1) replicate this study in various cultural contexts and different levels of education; (2) conduct longitudinal research to test the long-term impact of this model; (3) use a mixed-methods approach to explore in depth the cognitive and affective processes that occur during learning; (4) researching the critical implementation factors for the success of this model on a larger scale.

This study makes an original contribution through the systematic integration of the philosophy of Lampung local wisdom with the stages of discovery learning. Unlike previous studies that only adopted cultural elements superficially, this study conducts deep integration where local wisdom values become the spirit of the learning process. Another contribution lies in the empirical proof of the inclusiveness of the developed model, which is not only effective in improving academic achievement but also ensures equity in mathematics learning at the elementary school level.

CONCLUSION

This study convincingly demonstrates that the Discovery Learning model integrated with Lampung local wisdom is a superior and inclusive pedagogical strategy for improving elementary school students' mathematical problem-solving skills. Its main contribution lies in proving that a culture-based contextual approach not only improves cognitive learning outcomes but also ensures equal learning opportunities for all students, regardless of gender. These findings offer a blueprint for educators to transform mathematics learning into a more authentic, relevant, and empowering experience, while also reinforcing the role of schools in preserving local cultural heritage. For future progress, exploring other elements of local wisdom and their application to other fields of study is a very promising area of research.

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