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The effect of discovery learning with Wamena local content on natural and social sciences learning outcomes and scientific attitudes

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Abstract
This study examines the effect of the Discovery Learning model enriched with Wamena local wisdom on natural and social sciences learning outcomes and students' scientific attitudes in Grade III elementary schools in Wamena. Conventional, non-contextual teaching that is weakly connected to local culture has contributed to low learning outcomes and scientific attitudes, motivating this research. A quantitative approach with a posttest-only quasi-experimental control group design was employed. The sample comprised 35 students in the experimental class, who learned through discovery learning with Wamena local wisdom, and 34 students in the control class, who received conventional instruction. Data was collected using a natural and social sciences achievement test and a scientific attitude questionnaire and analyzed using MANOVA. The results showed that discovery learning with Wamena local wisdom had a significant simultaneous effect on natural and social sciences learning outcomes and scientific attitudes ($p < 0.05$). The experimental group achieved higher mean scores in natural and social sciences (86.67) than the control group (66.67) and the experimental group students' scientific attitude reached a very high category (102) compared to the control group (92). These findings indicate that the model improves cognitive achievement and fosters critical, contextual scientific attitudes while positioning local culture as a core element of elementary school learning.
Keywords: Wamena local wisdom; discovery learning; natural and social science learning outcomes; scientific attitude

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INTRODUCTION

Character education is an effort to prepare students to become better individuals in religious, social, and cultural dimensions, which is realized through words, deeds, thoughts, attitudes, and personality (Utami et al., 2024). In line with this, the development of 21st-century skills does not only focus on shaping students' attitudes or character, knowledge, and skills, but also requires critical and complex thinking skills so that students are able to face the challenges of life in the modern era (Angga et al., 2022). To achieve these objectives, a learning model that places students as active subjects in the learning process is needed, as this approach has been proven to be more effective in encouraging learning engagement and conceptual understanding, one of

which is through the application of the Discovery Learning model. Recent studies have demonstrated that Discovery Learning can significantly improve learning outcomes in science at the elementary level. For example, Sudirama et al. (2021) found that implementing Discovery Learning in primary schools enhanced conceptual understanding through student exploration and discovery activities. Similar findings were reinforced by a meta-analysis by Naibaho and Hoesein (2021), which concluded that Discovery Learning has a positive effect on cognitive aspects, especially when students are directly involved in discovering knowledge. This meta-analytic evidence underscores that the Discovery Learning model yields significant benefits for science learning outcomes, particularly under structured teacher guidance.

Beyond learning outcomes, Discovery Learning has also been shown to develop scientific attitudes such as curiosity, observation skills, critical thinking, and openness to new information. Roheni et al. (2020) reported that this model increases scientific attitudes and science process skills by involving students in learning experiences emphasizing observation, data collection, and drawing conclusions. Similarly, recent research by Indriani et al. (2023) and Salman et al. (2024) confirms that student-centered learning processes can contribute to improving scientific attitudes in the classroom. When learners actively participate in inquiry and discovery, they tend to exhibit greater curiosity and a more positive attitude toward scientific learning. On the other hand, Indonesia's "Kurikulum Merdeka" (Independent Curriculum) provides greater scope for integrating local content as an authentic learning resource. Strengthening local culture and regional potential in instruction is believed to increase the relevance of material and students' psychological connection with the learning context (Alfi & Bakar, 2021). In Jayawijaya Regency (Wamena area), the local government has developed and distributed local wisdom-based teaching materials, including books on local language and culture, to schools (Dinas Pendidikan Jayawijaya, 2021). This situation creates opportunities for teachers to integrate Wamena's cultural context into classroom learning.

Discovery Learning is grounded in constructivist principles, which posit that knowledge is not merely transferred from teacher to student, but actively built by learners through interaction with their learning environment (Indah, 2024). Current research shows that Discovery Learning is effective in increasing conceptual understanding, critical thinking, and learning motivation, especially in science subjects. A meta-analysis by Naibaho and Hoesein (2021) found that using this model had a significant positive influence on elementary science learning outcomes, particularly when accompanied by structured teacher scaffolding. Similarly, an experimental study by Nirmalasari et al. (2024) found that using Discovery Learning in elementary science led to significantly higher post test scores compared to direct instruction.

In practice, Discovery Learning follows a structured procedure comprising stimulation, problem statement, data collection, data processing, verification, and generalization. Each step is designed to facilitate scientific activities such as observing, classifying, analysing, predicting, and drawing conclusions (Dina et al., 2019; Noviyanti et al., 2019). These activities are core skills in integrated natural and social science learning and allow students to construct understanding independently based on their own learning experiences. Because natural and social science takes an interdisciplinary approach, contextual meaningfulness (for example, via local content) strongly affects the depth of student understanding. Research by Nirmalasari et al. (2024) reported a significant increase in science post test scores after students engaged in discovery-based learning.

Scientific attitude plays an important role in natural and social science learning, as it encourages students to think rationally and make data-based decisions. Suwintara et al. (2022) found a significant correlation between scientific attitudes and science learning outcomes in elementary students, suggesting that fostering scientific attitudes can support academic achievement. Discovery Learning encourages the development of scientific attitudes through activities like observation, simple experiments, data analysis, and group discussion. Empirical evidence by Roheni et al. (2020) showed that using Discovery Learning significantly increased students' scientific attitude scores, supporting the idea that active discovery-oriented learning

environments promote positive attitudes toward science.

The reality of learning in remote areas such as Wamena does not yet fully reflect the desired educational ideals because in Cluster 1 YPPK Wamena elementary schools, learning is still dominated by lecture methods and teacher-centered approaches, so students tend to be passive, rarely ask questions, and have few opportunities to explore. This has an impact on low natural and social science achievement and weak scientific attitudes, where students often receive information without deep involvement, resulting in low critical thinking skills and curiosity based on field observations in 2024. in addition, from a cultural perspective, teaching materials have not made much use of local wisdom, which is actually rich in potential as a learning resource, such as the construction of Honai houses, Wamena cultural practices, and folk tales that can be used as relevant scientific contexts but have not been optimally integrated into natural and social science learning, thus revealing a gap between the national education vision that emphasizes active, contextual learning oriented towards the development of scientific thinking and actual classroom practices. Therefore, this gap highlights the urgency of research on the application of Discovery Learning based on Wamena local wisdom to improve natural and social science learning outcomes and students' scientific attitudes.

Multiple studies have consistently shown the effectiveness of culture-based Discovery Learning in enhancing learning quality. For instance, Munafiroh et al., (2024) found that integrating Lampung local wisdom into Discovery Learning significantly improved students' mathematical problem-solving skills and showed no outcome differences by gender. A meta-analysis by Koten and Rohaeti (2024) affirmed that discovery learning based on local wisdom had a very high effect on critical thinking skills in chemistry education. Safitri et al. (2024) demonstrated that electronic worksheets (e-LKPD) based on local "dome house" potentials effectively improved all indicators of junior high students' critical thinking. Additionally, Sayangan (2024) showed that using local media in Discovery Learning increased creativity, engagement, and conceptual understanding in geometry. Maharani et al. (2024) reported that integrating ethnopedagogy into Discovery Learning effectively shaped student character (e.g., responsibility and tolerance). Collectively, these findings indicate that local wisdom-integrated Discovery Learning consistently enhances students' cognitive skills, character, and participation by providing contextual, meaningful learning experiences.

Based on the above discussion, this study aims to examine the impact of a modified Discovery Learning model enriched with Wamena local wisdom on student learning outcomes in Cluster 1 YPPK elementary schools in Wamena. In addition, this study seeks to provide recommendations for the development of culturally responsive teaching models that can be applied in remote areas by utilizing local cultural wealth to improve the quality of the educational process.

METHODS

This study used an experimental approach with a quantitative quasi-experimental design. Experimental research is intended to test the impact of a particular treatment on specific outcomes. A quasi-experimental design was selected because it was not possible to control all variables or to randomly assign individual students to groups in the natural classroom setting. More specifically, the study employed non-equivalent post-test-only control group design. This plan was thought to be the best way to look at how the Discovery Learning model with Wamena local knowledge affected two things: how well third-grade elementary school students learned natural and social sciences and how they felt about science. The classes in Cluster 1 YPPK elementary schools in Wamena would stay the same. Two groups were involved in the study, one experimental group and one control group. The experimental group received instruction using the Discovery Learning model enriched with Wamena local wisdom, whereas the control group received conventional teacher-centered instruction. At the end of the intervention, both groups completed a posttest and a scientific attitude questionnaire.

Table 1. Non-Equivalent Posttest Only Control Group Design

Group	Treatment	Posttest
E	X	O_1
K		O_2

Description:
E : Experimental group
K : Control group
X : Treatment in the form of the Discovery Learning model with Wamena local wisdom
O_1 : Posttest for experimental class
O_2 : Posttest for control class

The study was conducted in Cluster 1 YPPK elementary schools in Wamena, located in the Papua Highlands region of Indonesia. The target population consisted of all third-grade students enrolled in Cluster 1 YPPK elementary schools in the 2024/2025 academic year. Cluster random sampling at the class level was used because the intervention was implemented in intact classes rather than in individually assigned students. Four third-grade classes from four elementary schools in Cluster 1 YPPK were selected as the research sample. Based on the random selection procedure, YPPK Bunda Maria Pikhe Elementary School and YPPK Yusuf Wamena Elementary School served as experimental classes, and YPPK James Elementary School and YPPK Santo Stefanus Sinatma Elementary School served as control classes. All students in the selected classes who were present during the study were included as participants, resulting in a final sample of 35 students in the experimental group and 34 students in the control group. The research was following the regular school schedule, and the intervention consisted of eight instructional meetings in each class.

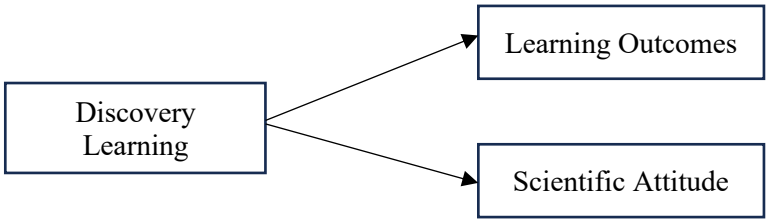

Figure 1. Relationship between Research Variables

The data collected during the study were quantitative. Data collection employed both test and non-test techniques. The test instrument, constructed in multiple-choice format, was used to measure natural and social sciences learning outcomes. The non-test instrument, in the form of a Likert-type questionnaire, was used to measure students' scientific attitudes. Content validity for both instruments was evaluated by two expert judges using Gregory's formula, and the ratings were subsequently converted into a 2×2 cross tabulation to obtain a validity coefficient. Item validity for the test and questionnaire was examined using the Pearson Product Moment correlation, and each item was analyzed using the SPSS software. Instrument reliability was assessed prior to use, with the scientific attitude questionnaire tested for internal consistency using Cronbach's Alpha.

The statistical technique used to test the research hypotheses was Multivariate Analysis of Variance (MANOVA) because the study examined the effect of one independent variable on two dependent variables simultaneously. Hypothesis testing was conducted at a significant level of 5 percent. The analysis went through several stages, starting with a descriptive analysis of the data, then prerequisite testing, and finally hypothesis testing. Three hypotheses were formulated, and each was examined by comparing the null hypothesis (H_0) against the alternative hypothesis (H_1) to determine whether the Discovery Learning model with Wamena local wisdom had a significant effect on natural and social sciences learning outcomes and scientific attitudes.

Hypothesis 1

H_0 : There is no simultaneous effect of the Discovery Learning model with Wamena local wisdom on natural and social sciences learning outcomes and scientific attitudes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

H_1 : There is a simultaneous effect of the Discovery Learning model with Wamena local wisdom on natural and social sciences learning outcomes and scientific attitudes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

Hypothesis 2

H_0 : There is no effect of the Discovery Learning model with Wamena local wisdom on natural and social sciences learning outcomes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

H_1 : There is an effect of the Discovery Learning model with Wamena local wisdom on natural and social sciences learning outcomes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

Hypothesis 3

H_0 : There is no effect of the Discovery Learning model with Wamena local wisdom on the scientific attitudes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

H_1 : There is an effect of the Discovery Learning model with Wamena local wisdom on the scientific attitudes of third-grade students in Cluster 1 YPPK elementary schools in Wamena.

RESULTS AND DISCUSSION

Results

The description of the research data was grouped into four categories, namely: (1) natural and social sciences learning outcomes of students taught with the Discovery Learning model, (2) natural and social sciences learning outcomes of students who did not receive instruction through the Discovery Learning model, (3) scientific attitudes of students taught with the Discovery Learning model, and (4) scientific attitudes of students who were taught using conventional methods. The posttest data for natural and social sciences learning outcomes in the experimental group represented the scores obtained by the 35 students who received instruction using the Discovery Learning model. After the post-test was administered, the highest score recorded in the experimental group was 93.33 and the lowest score was 43.33. Based on these results, the categorization of natural and social sciences learning outcomes for the experimental group was calculated as follows.

Table 2. Category of natural and social sciences learning outcomes of experimental group

Interval	Classification
$80.8 \leq \bar{X}$	Very high
$72.5 \leq \bar{X} < 80.8$	high
$64.2 \leq \bar{X} < 72.5$	Medium
$55.8 \leq \bar{X} < 72.5$	Low
$\bar{X} < 55.8$	Very Low

The average natural and social sciences learning outcome score of students who participated in instruction using the Discovery Learning model with Wamena local wisdom was 86.67, which falls within the interval of $80.8 \leq \bar{X}$. Based on this result, it can be concluded that the natural and social sciences learning outcomes of students taught with the Discovery Learning model with Wamena local wisdom were categorized as very high. In contrast, the description of the posttest data for natural and social sciences learning outcomes in the control group, which consisted of 34 students who received conventional instruction, showed a maximum score of 86.67 and a minimum score of 30. Based on these scores, the categorization of natural and social sciences learning outcomes for the control group was established as

follows.

Table 3. Control group natural and social sciences learning outcome categories

Interval	Classification
$72.5 \leq \bar{X}$	Very high
$63.1 \leq \bar{X} < 72.5$	high
$53.6 \leq \bar{X} < 63.1$	Medium
$44.2 \leq \bar{X} < 53.6$	Low
$\bar{X} < 44.2$	Very Low

The average natural and social sciences learning outcome score of students who participated in conventional instruction was 66.67, which falls within the interval of $63.1 \leq \bar{X} < 72.5$. Based on this calculation, it can be concluded that the natural and social sciences learning outcomes of students taught with conventional learning models were categorized as high. The posttest description of scientific attitudes for the group of students taught using the Discovery Learning model is as follows. In the experimental group, which consisted of 35 students, the posttest results showed a maximum scientific attitude score of 118 and a minimum score of 88. Based on these results, the categorization of scientific attitudes for students in the experimental group was determined as follows.

Table 4. Categories of scientific attitude of experimental group

Interval	Classification
$110.5 \leq \bar{X}$	Very high
$105.5 \leq \bar{X} < 110.5$	High
$100.5 \leq \bar{X} < 105.5$	Medium
$95.5 \leq \bar{X} < 100.5$	Low
$\bar{X} < 95.5$	Very Low

The average scientific attitude score of students who participated in learning using the Discovery Learning model with Wamena local wisdom was 102, which falls within the interval of $100.5 \leq \bar{X} < 105.5$. Based on this result, it can be concluded that the scientific attitudes of students taught with the Discovery Learning model with Wamena local wisdom were categorized as moderate. In the control group, the posttest data for scientific attitudes were obtained from 34 students. The highest scientific attitude score recorded in this group was 105, while the lowest score was 78. Based on these values, the categorization of scientific attitudes for students in the control group was arranged as follows.

Table 5. Control group scientific attitude categories

Interval	Classification
$98.25 \leq \bar{X}$	Very high
$93.75 \leq \bar{X} < 98.25$	High
$89.25 \leq \bar{X} < 93.75$	Medium
$84.75 \leq \bar{X} < 89.25$	Low
$\bar{X} < 84.75$	Very Low

The average score of scientific attitudes of students who followed learning with conventional models was 92 in the interval $89.25 \leq \bar{X} < 93.75$. Based on this result, it can be concluded that the scientific attitudes of students who took part in learning with the Discovery Learning model with Wamena local wisdom were in the moderate category.

Before hypothesis testing, prerequisite tests were carried out. These included a normality test of the data distribution, a homogeneity test of variance, a homogeneity test of the variance-covariance matrix, and a correlation test between the dependent variables. For the normality test of the data distribution for natural and social sciences learning outcomes and scientific attitudes of students who followed the Discovery Learning model with Wamena local wisdom and those who followed the conventional learning model, the Sig. value was > 0.05. This indicated that the data were normally distributed. For the homogeneity of variance test using Levene's test, the Sig.

values for both natural and social sciences learning outcomes and scientific attitudes were > 0.05. Specifically, natural and social sciences learning outcomes obtained a Sig. value of 0.429 > 0.05 and scientific attitudes obtained a Sig. value of 0.220 > 0.05, which showed that the data between classes had homogeneous variances. Likewise, the homogeneity test of the variance-covariance matrix produced a significance value of Sig. (0,678) > 0.05, indicating that the variance-covariance matrices of the natural and social sciences learning outcomes and scientific attitudes were homogeneous.

The final prerequisite test, the correlation test between the dependent variables, used the Product Moment correlation. The r_{xy} value obtained for the two variables was 0.269 < 0.08 and the Sig. value was 0.026 > 0.05. Based on these results, it was concluded that there was no correlation between the dependent variables. This indicated that the relationship or correlation between the dependent variables was not significant, meaning that the dependent variables were independent of one another and that the MANOVA test was appropriate to use.

In this study, three hypotheses were tested. The first hypothesis examined the simultaneous effect of implementing the Discovery Learning model with Wamena local wisdom on the natural and social sciences learning outcomes and scientific attitudes of third-grade students at Cluster 1 YPPK elementary schools. Hypothesis 1 was tested using MANOVA in IBM SPSS 27.00 for Windows with a significant level of F = 5% (0.05). The decision rule stated that if the sig value ≤ 0.05, H0 would be rejected and H1 would be accepted, whereas if the sig value ≥ 0.05, H0 would be accepted and H1 would be rejected. The MANOVA results showed that the significance values obtained through Pillai Trace, Wilk's Lambda, Hotelling's Trace, and Roy's Largest Root were Sig. (0.000) < 0.05. This meant that the null hypothesis, which stated that there was no simultaneous effect of the Discovery Learning model with Wamena local wisdom on natural and social sciences learning outcomes and scientific attitudes of third-grade students at Cluster 1 YPPK elementary schools Wamena, was rejected, and the alternative hypothesis indicating the presence of a simultaneous effect was accepted.

The second hypothesis tested the effect of the Discovery Learning model with Wamena local wisdom on the natural and social sciences learning outcomes of third-grade students at Cluster 1 YPPK elementary schools Wamena. Hypothesis 2 was tested using one-way analysis of variance (ANOVA A) with F between as the test statistic. Based on the ANOVA results for natural and social sciences learning outcomes, the value of F_{hitung} = 17.445 while F_{tabel} = 3.984. Since Fcount > Ftable and the significance value obtained from the ANOVA calculation was Sig. 0.00, which was less than 0.05, H1 was accepted and H0 was rejected. These results indicated that the discovery learning model with Wamena local wisdom had a significant effect on the natural and social sciences learning outcomes of third-grade students at Cluster 1 YPPK elementary schools Wamena.

The third hypothesis examined the effect of the Discovery Learning model with Wamena local wisdom on the scientific attitudes of third-grade students at Cluster 1 YPPK elementary schools Wamena. Like Hypothesis 2, the test used one-way analysis of variance (ANOVA A) with F between. Based on the ANOVA results for scientific attitudes, the value of F_{hitung} = 33.708 while F_{tabel} = 3.984. Since $F_{hitung} > F_{tabel}$ and the resulting significance value was Sig. 0.00, which was less than 0.05, H1 was accepted and H0 was rejected. These results indicated that the Discovery Learning model with Wamena local wisdom had a significant effect on the scientific attitudes of third-grade students at Cluster 1 YPPK elementary schools Wamena.

Discussion

This study investigated the influence of a culturally enriched discovery learning model (integrating Wamena local wisdom) on two outcomes: (1) natural and social sciences learning achievement and (2) students' scientific attitudes among third graders in Cluster 1 YPPK Wamena. Overall, the results indicate that instruction using Discovery Learning with local content produced substantially higher average learning outcomes in the experimental group compared to the control group. For scientific attitudes, the experimental group had a mean score

of 102 (moderate category) versus 92 (moderate) in the control group, and multivariate analysis (MANOVA) showed a significant simultaneous effect of the treatment on both outcome variables. Separate ANOVA tests also confirmed significant effects on learning outcomes and on scientific attitudes.

The markedly higher academic scores in the experimental group support the hypothesis that Discovery Learning contextualized with Wamena local wisdom enhances students' conceptual understanding. The most likely mechanisms explaining this finding include: (a) increased material relevance through local context, which facilitates connecting new knowledge with students' daily experiences; (b) active student engagement in the discovery phases (stimulation, problem statement, data collection, verification, generalization), which promotes deeper information processing; and (c) structured teacher guidance (scaffolding) that keeps student exploration productive and oriented toward learning goals. These mechanisms align with constructivist learning theory and are supported by prior empirical evidence documented in the literature (Naibaho & Hoesein, 2021; Nirmalasari et al., 2024; Sudirama et al., 2021). The empirical consistency with Naibaho & Hoesein (2021) meta-analysis – which highlighted the importance of structured guidance in discovery learning – suggests that our implementation effectively balanced exploration with support. This is a crucial point: purely unguided discovery can sometimes lead to student frustration or misconceptions, but guided discovery (as we employed, with teacher scaffolding) tends to yield better outcomes.

Practically, the substantial improvement in posttest scores for the experimental group indicates that integrating local content was not merely symbolic but functioned as a cognitive resource that facilitated the discovery and meaning making of scientific concepts. This outcome aligns with previous research on the effectiveness of context-based and culturally relevant learning. Studies in other regions have shown that embedding local cultural references in teaching materials can improve student engagement and understanding (Alfi & Bakar, 2021). In our context, Wamena local wisdom (such as examples from the local environment or culture) likely made abstract natural and social science concepts more concrete and relatable, thus enhancing understanding. This finding resonates with the notion that culturally contextualized learning adds meaning and motivation, as students see the direct relevance of what they are learning to their lives. It is consistent with prior findings that context-rich learning environments lead to better conceptual grasp in science.

Although the average category of scientific attitude in the experimental group remained at a moderate level, the difference between the experimental and control groups on this affective measure was statistically significant. This indicates that the intervention successfully improved several aspects of scientific attitude, such as openness to evidence, habits of careful observation, and the tendency to engage in data-based reasoning, even though the eight-week intervention period was not sufficient to raise the overall average into a high category. Roheni et al. (2020) also reported significant improvements in students' scientific attitudes through discovery learning, while emphasizing that sustained teacher support played a critical role. Overall, these findings suggest that although a culturally enriched discovery learning approach has a positive effect on scientific attitudes, achieving stronger and more stable outcomes likely requires longer implementation periods and more supportive classroom conditions.

The significant MANOVA result indicates that the treatment had a simultaneous influence on the set of outcome variables, suggesting that cognitive and affective changes moved together in response to the culturally infused intervention. In educational terms, this means that improving students' conceptual learning in natural and social science and stimulating their scientific attitudes were mutually reinforcing processes under the intervention. This has important implications: enhancing cognitive outcomes (e.g., concept mastery) and fostering scientific attitudes likely strengthen each other, because active engagement and context relevance increase both motivation and reflective scientific thinking. When students find content meaningful and are actively involved, they are more motivated and likely to exhibit curiosity and perseverance – components of a scientific attitude (Gormally et al., 2012). Our findings support

this synergy; the culture-based discovery activities not only taught science content effectively but also engaged students in ways that encouraged them to behave more like young scientists (observing, questioning, etc.), thereby building their scientific disposition. This intersection of cognitive and affective gains underscores a core goal of science education: not only to impart knowledge, but also to inculcate the mindset and attitudes of scientific inquiry.

CONCLUSION

The findings of this study demonstrate that the Discovery Learning model enriched with Wamena local wisdom significantly improves both natural and social sciences learning outcomes and scientific attitudes among third-grade students in Cluster 1 YPPK elementary schools in Wamena. Students who received culturally contextualized discovery-based instruction consistently outperformed those in conventional classes, and the statistical analyses confirmed the robustness of these effects. These results highlight the value of integrating local cultural knowledge into inquiry-based learning, showing that connecting instruction to students lived experiences enhances conceptual understanding, curiosity, and critical thinking.

The study's contributions extend beyond empirical confirmation of the model's effectiveness by reinforcing the importance of culturally responsive pedagogy in elementary education. By embedding Wamena cultural practices into the Discovery Learning framework, this approach strengthens both academic and attitudinal development while preserving cultural identity. Future research should explore the long-term impact of this model across different regions and grade levels to further validate its potential as an innovative strategy for improving learning quality in culturally diverse school settings.

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