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Strengthening Critical Thinking Skills of Prospective Teacher Students through Inquiry Learning in Science Learning: An Explanatory Mixed Methods Study

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Abstract: This study aims to explore the effectiveness of Inquiry-Based Learning (IBL) integrated with the local culture of Hem Re Yegokhe in improving the critical thinking skills of elementary school teacher candidates in a multicultural area. Using an explanatory sequential mixed methods design, this study began with a quantitative pretest–posttest measurement using an instrument based on the five dimensions of the California Critical Thinking Skills Test (CCTST), and continued with qualitative exploration through interviews and observations. A total of 173 students were divided into experimental and control groups. The results showed that the integration of the IBL approach and local cultural practices significantly improved critical thinking skills, especially in the dimensions of interpretation, analysis, and inference. The dimensions of evaluation and explanation experienced a more moderate increase, which was associated with the limited time of the intervention. Thematic analysis supported the quantitative findings and emphasized the role of cultural context in encouraging deep reflection and contextual awareness. The findings also revealed a gap in achievement between students from 3T and non-3T areas, indicating the need for scaffolding strategies and strengthening intercultural competence and social empathy. This study provides an empirical contribution to the development of a locally relevant and socially inclusive cultural-based pedagogical model. Implications include strengthening teacher education curricula, lecturer training, and policies that support the integration of local knowledge as a learning resource. Further research is recommended to be conducted longitudinally, develop culturally based assessment instruments, and explore other cultural practices as learning contexts.

Keywords: Critical thinking; Culturally responsive learning; Hem re yegokhe; Inquiry-based learning; Intercultural competence

Introduction

Critical thinking skills are an essential component in developing the professional competence of 21st-century teachers. Amidst social change and ever-growing global complexity, prospective teachers are required not only to understand teaching materials, but also to have the ability to analyze information

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objectively, construct arguments logically, and evaluate problems in a reflective and contextual manner (Elder, 2022). In multicultural education, these skills are very important because teachers play a role in forming inclusive perspectives and developing sensitivity to socio-cultural diversity (Szelei et al., 2020). However, previous studies have shown that prospective teacher students, especially those from disadvantaged, outermost, and remote areas (3T), often have low levels of critical thinking skills (Hossain, 2024). The condition of education in 3T or marginalized areas is closely related to limited access to educational resources, low exposure to reflective learning, as well as inequality in learning infrastructure, and gender equality (Agyei et al., 2024; Allotey et al., 2023). This situation is a serious challenge in preparing professional teachers who are able to implement learning that supports diversity and social justice.

As many as 74% of prospective teacher students in this study came from the 3T area in Papua and attended lectures in the multicultural class of the FKIP, Cenderawasih University. They bring a unique socio-cultural background, live in a communal community with strong mutual cooperation values, and rely heavily on local wisdom in building understanding (Kadir et al., 2021). Traditions and culture are maintained even though they face the flow of modernization. This condition demands a learning model that is not only academic, but also contextual and responsive to cultural identity, in order to prevent alienation in the learning process. One pedagogical approach that has been proven effective in developing critical thinking skills is Inquiry-Based Learning (IBL) (Wale & Bishaw, 2020). This approach positions students as active subjects involved in exploring problems, collecting data, and formulating solutions through in-depth analytical and synthetic thinking processes (Kwangmuang et al., 2021). The IBL model allows for contextual learning, because students relate academic material to their life experiences and the social realities they face (Koes Handayanto et al., 2024; Maharani et al., 2023; Sucilestari & Arizona, 2020).

However, in the context of a multicultural society, the effectiveness of IBL is often limited if it is not integrated with an approach that respects local values. Learning that focuses only on global science and abstract knowledge has the potential to alienate students from their own socio-cultural background. This is in line with criticism from the perspective of critical pedagogy and inclusive education which emphasizes the importance of paying attention to the cultural background of students in the learning process (Yektiningtyas et al., 2023). This is where the importance of culturally responsive learning or Culturally Responsive Teaching (CRT) lies, which emphasizes the integration of local culture in curriculum design and learning strategies (Hernandez, 2022; Johnson & Elliott, 2020). The integration of a culturally responsive Inquiry-Based Learning (IBL) model has strategic potential in improving local (critical thinking skills of prospective teacher students through strengthening the context of learning based on the wisdom of (Prayogi et al., 2024; Stenberg & Maaranen, 2022). In Papua, the traditional practice of Hem Re Yegokhe—sustainable sago forest management by the Sentani indigenous community—represents the integration of ecological and cultural values that is in line with modern ecological concepts. The use of sago trunks that have entered the generative phase as a breeding medium for sago beetles reflects a form of managed symbiosis, which effectively reduces pest pressure on productive sago trees. This ecological engineering demonstrates an understanding of the principles of energy flow and biodiversity conservation. When used as a context for inquiry learning, this practice encourages students to build scientific reasoning while reflecting on its relevance to local cultural values.

Unfortunately, academic literature still lacks discussion on how concrete integration between IBL and culturally responsive learning can influence the critical thinking skills of student teachers, especially students from 3T areas. Previous studies tend to focus on the effectiveness of IBL in general (Nzomo et al., 2023) or on the importance of local culture-based education (Bektiarso et al., 2024) without considering how both can strengthen each other in the context of multicultural higher education. This indicates a relevant research gap to be explored further. Considering this background, this study is directed to answer the following questions; What is the profile of critical thinking skills of student teachers after participating in Hem Re Yegokhe local culture-based Inquiry-Based Learning?; How effective is the integration of the IBL approach and culturally responsive learning in improving the critical thinking skills of student teachers?; What are the supporting and inhibiting factors in the implementation of local culture-based IBL learning in the context of teacher education in multicultural areas?. To answer this question, this study uses an explanatory sequential mixed methods approach that combines quantitative measurements of changes in critical thinking skills through standardized instruments, and qualitative exploration of learning dynamics through interviews and observations (Busetto et al., 2020; Parsons et al., 2023).

The main hypothesis tested is that the integration of inquiry-based learning and local cultural context can significantly improve the critical thinking skills of prospective teacher students compared to conventional learning. Thus, the main contribution of this study is to offer a learning model that is based on local context but is in line with the demands of high-level thinking skills.

This study broadens the understanding of culture-based pedagogy as a transformative approach in teacher education, while enriching the literature on critical and multicultural education in Indonesia and other regions with high cultural diversity.

Method

The findings of this study are expected to be an empirical and conceptual basis for formulating more equitable, inclusive, and socially relevant education policies. Figure 1 presents the integrative conceptual model developed in this study. This model maps the relationship between local cultural practices as input, stages of the Inquiry-Based Learning process as a pedagogical approach, and learning outcomes in the form of five dimensions of critical thinking skills. The learning process is also mediated by elements of cultural identity, social interaction, and critical reflection, which form a transformative learning experience in a multicultural context.

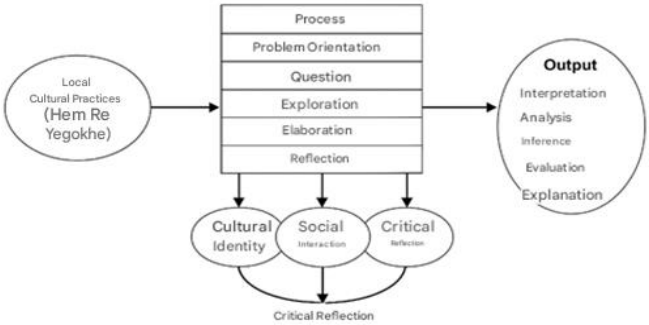

Figure 1. Integrative inquiry-based learning model based on local culture to strengthen critical thinking skills

Research Design

This study used a mixed methods approach with an explanatory sequential design developed by Creswell (2023) and Sugiyono (2023). This design begins with the collection and analysis of quantitative data to test the effectiveness of the experimental intervention, which is then followed by a qualitative phase to explore the quantitative results in depth. The quantitative phase in this study was designed as a quasi-experimental pretest-posttest non-equivalent group design, involving an experimental group and a control group. The experimental group received Inquiry-Based Learning (IBL) learning integrated with the local cultural context of Hem Re Yegokhe, while the control group followed conventional learning without a culturally responsive approach. The qualitative phase aims to explore students' experiences during the intervention, including their perceptions of the learning process and reflections on the critical thinking skills that developed. Figure 2 illustrates the general explanatory sequential design applied in this study.

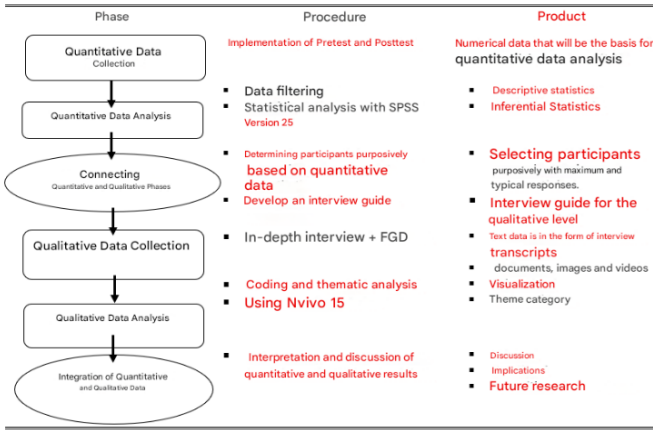

Figure 2. Explanatory sequential mixed methods research design

Figure 2 shows two main phases: Quantitative phase – data collection through pretest and posttest in both groups, and Qualitative phase – interviews and observations with selected participants from the experimental group to explain the quantitative findings.

Participants and Research Context

The participants in this study were 173 student teachers from a teacher education program in Papua, Indonesia. The participants were selected purposively, considering the representation of students from 3T (frontier, outermost, disadvantaged) and non-3T regions. The involvement of students from diverse regional backgrounds was considered important to test the extent to which cultural context influences the effectiveness of the learning intervention. Participants were divided into two groups proportionally: 88 students as the experimental group and 85 students as the control group. The experimental group participated in six sessions of IBL-based ecology learning that integrated the local practice of Hem Re Yegokhe as the learning context. Hem Re Yegokhe is a sustainable sago forest management practice by the Sentani indigenous community, Papua, which is rich in ecological and social values.

Learning Intervention

The intervention was conducted over six two-hour sessions, using a local culture-based Inquiry-Based Learning approach. The learning structure in each session followed the main stages of IBL: problem orientation, question formulation, exploration, concept elaboration, and reflection (Pedaste et al., 2015). Ecological materials were directly linked to the local context of Hem Re Yegokhe, such as the sago ecosystem cycle, conservation values, and local wisdom in disaster

mitigation. Instructors were given initial training to ensure that the implementation of the intervention was consistent and contextual. The control group received the same materials and time allocation, but used an expository approach without local cultural integration. This design allows for a valid comparative analysis of students' critical learning outcomes.

Instruments and Data Collection

The main instrument for quantitative data collection was the translated version of the California Critical Thinking Skills Test (CCTST), which has been tested for validity and reliability internationally. This test covers five main dimensions of critical thinking: interpretation, analysis, inference, evaluation, and explanation. The test was conducted in two stages, namely a pretest before the intervention and a posttest after the last session. Qualitative data were obtained through semi-structured interviews and classroom observations. Interviews were conducted with 6 students in the experimental group who were selected based on the highest and lowest improvement scores in the posttest, to capture the dynamics of differences in experience. The selection of six participants for in-depth interviews was carried out using the maximum variation sampling and typical case sampling approaches, based on the highest and lowest posttest improvement scores in the experimental group. This strategy allows for in-depth exploration of contrasting learning experiences, while reflecting the variety of student responses to the intervention.

In the context of the explanatory sequential mixed methods approach, a limited number of qualitative participants is acceptable as long as data saturation and thematic redundancy have been achieved (Creswell, 2023). Thematic analysis also showed the emergence of recurring narrative patterns, which strengthens the validity of the qualitative data even though the number of participants is not large. Observations focused on students' critical thinking behavior during discussions, problem explorations, and group reflections. Interview data were recorded, transcribed verbatim, and analyzed using a thematic analysis approach. Thematic analysis was conducted using Nvivo 15 software.

Table 1. Data Collection Instruments and Techniques

Data Type	Instrument	Technique	Objective
Quantitative	CCTST	Pretest–Posttest	Measuring improvements in critical thinking skills
Qualitative	Semi-structured interviews	Audio recording, transcription	Exploring students' experiences of the learning process
Qualitative	Classroom observations	Observation checklist	Detecting indicators of critical thinking during learning

Data Analysis Technique

Quantitative data analysis was carried out using SPSS version 26 software. Given that the results of the normality test (Shapiro-Wilk) showed that the data were not normally distributed ($p < 0.05$), a non-parametric test was used. The Wilcoxon Signed-Rank test was used to measure changes in pretest-posttest scores in each group, while the Mann-Whitney U test was used to compare the posttest results between the experimental and control groups. Qualitative data analysis was carried out through a thematic approach with the following stages: in-depth reading of transcripts, identification of initial codes, grouping of themes, and interpretation of student narratives. This analysis aims to explain why and how the local culture-based learning process can shape students' critical thinking skills, especially in the context of the 3T region. The integration of quantitative and qualitative results was carried out at the final interpretation stage through the joint display analysis technique. This technique allows for comparison and synthesis of findings between numerical and narrative data, strengthening the validity and a more holistic understanding of the research results.

Validity and Research Ethics

To ensure the validity and reliability of the results, several strategies were implemented, including the use of standard instruments, content validity testing by experts, and data triangulation between quantitative and qualitative results. A detailed audit trail was prepared to ensure transparency of the analysis process.

This study obtained approval from the Cenderawasih University Research Ethics Committee. All participants signed an informed consent form and were guaranteed anonymity and confidentiality of their data. The study was conducted with respect for the principles of autonomy, justice, and nonmaleficence in educational research.

Results and Discussion

General Description of Quantitative Data

This study examines the effect of Inquiry-Based Learning (IBL) based on the local culture of Hem Re Yegokhe on the critical thinking skills of prospective teacher students in Papua. The main instrument used was the California Critical Thinking Skills Test (CCTST), which includes five main indicators: interpretation,

analysis, inference, evaluation, and explanation. Data were obtained from 173 participants, consisting of an experimental group (n = 88) and a control group (n = 85), with measurements taken before and after the intervention (pretest and posttest). Descriptive results showed an increase in overall critical thinking scores in both groups, with a more significant increase in the experimental group. The average critical thinking pretest score in the experimental group was 46.42, increasing to 78.35 in the posttest. Meanwhile, the control group experienced an increase from 46.64 to 60.62. In general, the effect size values obtained showed that the intervention had a significant and meaningful effect pedagogically, not only statistically. This strengthens the argument that the integration of local culture deepens the critical learning process in a real way. This finding suggests that the IBL approach contextualized through local cultural practices has a greater impact than the conventional approach.

Significance Test of Intragroup Changes

To test the significance of changes between pretest and posttest in each group, the Wilcoxon Signed-Rank Test was conducted because the data were not normally distributed ($p < 0.05$; Shapiro-Wilk). The results of the analysis showed a significant increase in both groups. Experimental Group: $Z = 5.0$, $p < 0.001$ and Control Group: $Z = 0.0$, $p < 0.001$. These results indicate that both types of learning have an effect on the development of students' critical thinking. However, the statistical value shows that the intervention in the experimental group has a much greater effect.

Intergroup Difference Test

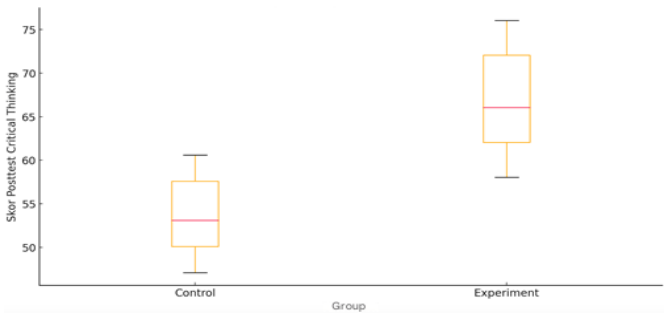

Figure 3. Boxplot Comparison of Critical Thinking Posttest Scores (Experimental vs Control Group) in Hem Re Yegokhe culture-based Ecology learning

To compare the differences in posttest scores between groups, the Mann-Whitney U Test was used. The results of the analysis showed that the differences between groups were significant $U = 1826.5$, $p < 0.001$. Based on the Z value = -5.39 and the total number of participants N = 173, the effect size value was calculated using the formula $r = Z/\sqrt{N}$, resulting in $r = 0.41$. According to Cohen's (1988) interpretation, this value is classified as moderate to large, indicating that the local culture-based IBL learning model has a substantive impact on improving students' critical thinking skills. This finding supports the hypothesis that contextual and participatory interventions can provide stronger effects than conventional learning. Comparison of Critical Thinking Posttest Scores (Experimental vs Control Groups can be seen in Figure 3.

Comparison Based on Students' Region of Origin

Further analysis was conducted to determine the impact of the intervention on students from 3T and non-3T regions. The results showed that students from non-3T regions showed greater improvement than 3T students, although both experienced significant improvements.

Table 2. Average Posttest Scores Based on Region

Region	Pretest	Posttest	Δ Score
3T	45.32	64.21	+18.89
Non-3T	47.19	81.42	+34.23

These results indicate that although local culture-based learning can improve critical thinking skills of all students, students from 3T areas need additional guidance and scaffolding.

Distribution of Critical Thinking Ability Categories

Based on the CCTST value classification, student scores are categorized into: very low (≤55), low (56–65), moderate (66–75), high (76–85), and very high (≥86). The distribution of posttest categories shows that 46% of students are in the high and very high categories in the experimental group, while only 18% are in the control group.

Table 3. Distribution of Critical Thinking Posttest Categories

Category	Experiment (%)	Control (%)
Very high	18	2
Tall	28	16
Currently	20	22
Low	24	36
Very Low	10	24

This distribution shows that culture-based interventions are able to push the proportion of students towards a significantly higher category.

Qualitative Findings: Student Reflections on Learning

The analysis of interviews and observations was analyzed using thematic analysis which resulted in revealing five main themes as shown in table 4 below.

Based on these themes, the following is a Qualitative Findings Code Map presented in table 4.

Table 4. Qualitative Findings Code Map

Key Themes	Initial Code (In Vivo Coding)	Thematic Categories	Data Source
Cultural relevance increases learning motivation	'I understand better because this is our culture'	Cultural contextualization and relevance of learning	Experimental Student Interview
Critical reflection increases through real-life experiences	'After seeing it directly, I understand what it means'	Authentic experiential learning	Experimental Student Interview
Students from 3T face challenges in understanding	'I have never seen a sago tree made like that before'	Gaps in understanding based on regional background	Experimental Student Interview
Group discussions help understand context	'My friend helped me understand the concept'	Collaboration and social interaction	Observation and Interview
Desire for integration of home culture in learning	'I want my local culture to also be used as learning material'	Recognition of cultural identity in learning	Experimental Student Interview

Furthermore, the frequency of qualitative themes can be seen in Figure 4.

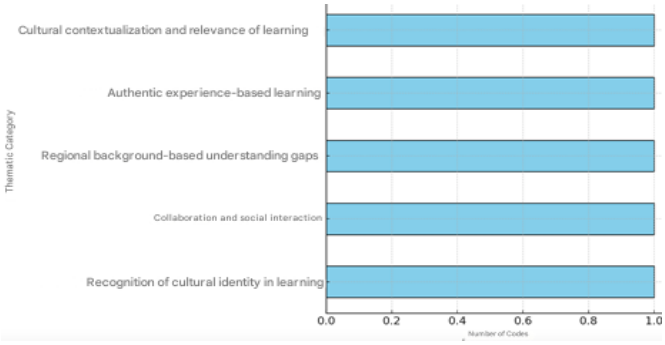

Figure 4. Frequency of students' qualitative themes

Visualization of the frequency of qualitative themes shows that the theme "Cultural contextualization and relevance of learning" is the most dominant category. This finding indicates that the integration of local cultural practices—especially Hem Re Yegokhe—contributes significantly to increasing the relevance of learning for students. Students stated that the connection between academic content and familiar cultural contexts provides a sense of confidence and facilitates understanding, while strengthening intrinsic motivation in the learning process. This is in line with the principles of contextual learning and experiential learning theory that emphasize the importance of meaningful learning through direct involvement with the socio-cultural environment of students.

Furthermore, the theme "Authentic experiential learning" also occupies a high frequency. Students who are actively involved in observing and exploring cultural practices demonstrate higher abilities in critical reflection and constructing scientific understanding. Direct interaction with the cultural context encourages the process of synthesis and inference, two main dimensions in the development of critical thinking.

The theme "Gaps in understanding based on regional background" emerged in the group of students from the 3T region. Students from this region reported challenges in understanding unfamiliar cultural practices, such as Hem Re Yegokhe from the Sentani indigenous community. This finding reinforces the urgency of implementing scaffolding strategies and learning differentiation approaches that take into account the diversity of students' cultural backgrounds.

Meanwhile, the theme of "Collaboration and social interaction" shows that group discussions play an important role in building critical understanding. Students use peer interactions to clarify concepts, compare perspectives, and construct logical arguments. This finding is in line with the interpersonal-affiliative approach in education that places social cooperation as the foundation for developing higher-order thinking skills.

Finally, the theme of "Recognition of cultural identity in learning" reflects students' aspirations to present their home culture as part of the learning resources. Students expressed a desire for the learning approach to not only present local culture in general, but also be inclusive of their respective cultural representations. This reflects the importance of a curriculum that is responsive to cultural diversity and encourages the formation of a strong academic identity. Overall, these findings confirm that the integration of the Inquiry-Based Learning approach based on local culture has a positive impact on improving critical thinking skills, and strengthening the dimensions of students' social affiliation and cultural identity. Thus, this learning model is relevant to be applied in teacher education in multicultural contexts, especially in areas with high cultural diversity. This finding is consistent with the theories of Dai et al. (2024), which emphasize that learning that is contextualized with students' cultures can strengthen critical reflection and academic identity. This approach fosters a deeper understanding of personal and collective experiences (List et al., 2024; Esteban-Guitart et al., 2020) allowing students to engage

more meaningfully with academic content (Ungar & Liebenberg, 2013; Sabon & Telussa, 2024).

Data integration was carried out through a joint display approach that brought together statistical results with student narratives of experience.

Integration of Quantitative and Qualitative Findings

Table 5. Joint Display: Integration of Quantitative and Qualitative Findings

Quantitative Findings	Qualitative Findings	Interpretation
Posttest scores increased significantly ($Z = 5.0$, $p < 0.001$)	Students find it easier to understand because of the local context	Culture-based learning increases learning relevance
Gap between 3T and non-3T students still exists	3T students who are not familiar with Hem Re Yegokhe culture have less understanding of Sentani culture	Need scaffolding for less familiar cultural settings
Critical thinking category increased (46% high)	Students stated that learning encourages critical reflection	Authentic experiences strengthen evaluation and inference dimensions

Hypothesis Proof and Discussion of Results

The main hypothesis of this study, that the integration of local culture-based IBL significantly improves critical thinking skills, was proven true. The improvement shown by the experimental group was much higher than the control group, both statistically and in categorical distribution. These results strengthen previous findings from (Nahar & Machado, 2025; Attard et al., 2021), that IBL significantly improves critical thinking. In addition, this study provides a new contribution by adding a local cultural dimension to IBL, in line with the culturally responsive learning framework. Limitations in this study include: the relatively short duration of the intervention (6 sessions), the limited cultural focus on Hem Re Yegokhe, which may not represent all students, and potential bias from self-selection in interview participation. Further studies are recommended to use a longitudinal approach and other local cultural explorations for broader generalization of the results.

Discussion

Strengthening Critical Thinking Skills through Local Culture-Based Learning

The results of this study indicate that Inquiry-Based Learning (IBL)-based learning integrated with the local cultural context of Hem Re Yegokhe significantly improves the critical thinking skills of prospective teacher students. This finding supports the literature emphasizing that IBL is an effective approach in developing higher-order thinking skills (Sulistiyo & Wijaya, 2020; Sam, 2024). The inquiry process encourages students to be actively involved in exploration (Gillies, 2023), question formulation, and reflection, thus enabling the activation of critical thinking dimensions comprehensively (Franco-Mariscal et al., 2024; Gómez & Suárez, 2020), integration of local culture into learning creates a relevant and meaningful context, allowing students to build connections between their academic knowledge and life experiences. This is in line with Facione's (2000) opinion and that critical thinking does not develop in a vacuum, but rather through interaction with social and cultural contexts (Green et al., 2024; November et al., 2020; Nuritdinov, 2024). In line with this, learning that involves local practices, such as the management of the sago ecosystem by the Sentani indigenous community, provides space for students to interpret the social, ecological, and ethical meanings of scientific knowledge.

Dimensions of Critical Thinking That Have Increased

Analysis based on the five dimensions of the CCTST revealed that the highest increase occurred in interpretation, analysis, and inference. Interpretation and analysis are basic to intermediate critical thinking dimensions. This increase reflects students' ability to understand information, categorize phenomena, and identify relationships between concepts. The process of observing cultural practices and group discussions significantly encouraged the development of these two dimensions. The inference dimension, which reflects the ability to draw logical conclusions from available information, also showed significant improvement. Students are able to construct generalizations from observations of Hem Re Yegokhe practices, linking them to modern ecological principles such as material cycles, conservation, and sustainability. This is in accordance with the findings of Abrami et al. (2015) which showed that real-world contextual learning improves inferential skills because it encourages decision-making in complex situations. In contrast, the evaluation and explanation dimensions showed lower levels of improvement compared to other critical thinking dimensions.

The evaluation dimension refers to the ability to assess the quality of arguments, evidence, or assumptions by referring to intellectual standards such as relevance, accuracy, logic, and depth. Meanwhile, explanation reflects the ability to construct logical justifications for an idea or phenomenon through internalization of concepts, use of one's own language, and association with real-world contexts. The low improvement in these two dimensions can be attributed

to two main factors, namely the limited duration of the intervention and the lack of student experience in constructing scientific arguments explicitly. This condition is reinforced by the background of students who mostly come from marginalized areas in the 3T region and limited learning sessions (6 sessions). Evaluation and explanation require intensive reflective thinking exercises, where students not only test the validity of their own thinking, but also construct understanding independently and meaningfully. These two dimensions represent aspects of high-level critical thinking that require time, guidance, and habituation in a continuous learning process. This is as stated by Elder et al. (2010) that these two dimensions require deep and repeated reflective exercises.

Learning Reinforcement Strategy Based on Dimensional Profile

The results of the study provide a basis for developing learning reinforcement strategies that are tailored to the characteristics of each critical thinking dimension. The dimensions of interpretation and analysis can be strengthened through cultural observation and discussion. To improve inference, experience synthesis and logical proof activities can be utilized. Meanwhile, evaluation and explanation require an explicit approach through reflective writing, argument assessment, and in-depth discussion. The critical thinking dimension reinforcement strategy is shown in Table 6.

Table 6. Critical Thinking Dimension Reinforcement Strategy

CCTST Dimensions	Average Increase	Difficulty Level	Strengthening Strategy
Interpretation	High	Basic	Cultural observation, discussion
Analysis	High	Intermediate	Case analysis, mind mapping
Inference	Medium–High	Intermediate	Experience synthesis, proof
Evaluation	Low–Medium	High	Argument assessment, critical reflection
Explanation	Low	High	Reflective writing, discussion

Integration of Quantitative and Qualitative Findings

The qualitative results support the quantitative findings, especially in the dimensions of interpretation and inference. Students were able to link their understanding of the sago ecosystem with personal experiences and cultural reflections. Student narratives showed that involvement in the local context strengthened their reasoning and ability to draw conclusions. However, only a few students demonstrated explicit evaluative and explanatory skills, indicating the need for further assistance in developing these dimensions. These findings are in line with studies that state the importance of critical consciousness in Dao culture-based education (Brown & George, 2023).

Differences Based on Region and Contextual Challenges

The study also revealed differences in critical thinking achievements between students from 3T and non-3T regions. Students from non-3T regions showed a more significant increase. This suggests that the cultural context of Hem Re Yegokhe is more easily understood by students who have broader access and background experiences. In contrast, students from 3T areas require additional assistance, including scaffolding, strengthening reflective literacy, and facilitating intercultural dialogue. O'Toole et al. (2024), and Luter et al. (2017) emphasized that cultural responsiveness in education does not stop at presenting local content, but also includes adapting learning strategies to the social and cultural diversity of students. The implication of this finding is the need for a differentiated approach in culture-based learning, including the use of homogeneous discussion groups, peer mentoring, and a more inclusive narrative approach (Nur'aini et al., 2023; Dalila et al., 2022).

Hypothesis Confirmation and Theoretical Contribution

Based on the results of statistical tests and narrative analysis, the research hypothesis is proven that local culture-based IBL can improve critical thinking skills. This finding strengthens the Culturally Responsive Pedagogy (CRP) framework and combines it with cognitive strategies from IBL. This study offers a theoretical contribution by proposing a pedagogical model that integrates the inquiry process and cultural context as a simultaneous approach in building critical thinking skills in a multicultural society. In addition to strengthening the Culturally Responsive Pedagogy (CRP) framework, this study also provides significant theoretical contributions to the global multicultural education landscape (Franco et al., 2024; Vedpathak & Prashant Mithari, 2024). Learning models that integrate inquiry-based learning with local cultural practices such as Hem Re Yegokhe offer a transformative approach that can be adapted in the context of indigenous communities or minority groups in various parts of the world. For example, in the context of Māori education in New Zealand, First Nations communities in Canada, or Aboriginal communities in Australia, similar approaches can be used to strengthen cultural identity while enhancing students' critical thinking capacity. Thus, this model is not only locally relevant but also has

the potential for cross-cultural application and supports the global agenda for inclusive, reflective, and context-based education. 4.7 Practical and Policy Implications.

The practical implications of these findings are very relevant for teacher education institutions. First, the curriculum needs to be designed to explicitly accommodate local culturally-based learning approaches. Second, lecturer training needs to include competencies in facilitating culturally responsive learning that supports the development of critical thinking skills. Third, local governments and higher education institutions need to work together in documenting, developing, and disseminating local practices as learning resources.

Limitations

This study has several limitations that need to be considered in interpreting the findings. The main limitation lies in the relatively short duration of the intervention, which does not provide enough space for the optimal development of high-level critical thinking dimensions, especially evaluation and explanation. Both of these dimensions require a deep and continuous reflective thinking process, which cannot be fully facilitated in a limited intervention time. In addition, the limited focus of the study on one local cultural context also affects the external validity of the results. Therefore, a longitudinal study with a longer period of time is needed to examine the effectiveness of the intervention more comprehensively, as well as comparative research across local cultures to expand the generalization of the findings. In addition, the instrument used in this study still has limitations in capturing the dimensions of critical thinking that are integrated with the cultural context of the participants. For this reason, the development of an instrument that is more sensitive to cultural variations is highly recommended. An educational ethnography approach can be used to explore more deeply the dynamics of students' cognitive and affective transformation in learning that is responsive to cultural diversity.

Conclusion

This study proves that the Inquiry-Based Learning model integrated with the local cultural context of Hem Re Yegokhe significantly improves the critical thinking skills of elementary school student teachers, especially in the dimensions of interpretation, analysis, and inference. Although the improvement in the dimensions of evaluation and explanation is relatively moderate, it shows that contextual and participatory learning forms a strong foundation for the development of higher-order thinking skills. The main contribution of this study lies in the empirical validation of the effectiveness of the integration of culturally based pedagogical approaches and inquiry strategies in encouraging students' cognitive transformation in multicultural areas. These findings enrich the Culturally Responsive Pedagogy literature by showing that engagement in local cultural practices facilitates critical reflection and strengthens conceptual understanding. Practical implications of this study include the need to design teacher education curricula that are responsive to local wisdom, organize lecturer training in facilitating reflective culturally based learning, and support institutional policies that recognize local knowledge as a learning resource. Limitations on the duration of the intervention and a single cultural context indicate the importance of longitudinal and cross-cultural research to expand the utility and external validity of this model. Overall, this study contributes to the development of local context-based transformational pedagogy that places critical thinking skills as the foundation of future teacher professionalism.

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Author Contributions

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Conflict of Interest

The author declares no conflict of interest.

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