

Application of the Radec Model with an Ethnoscience Insight for the Analysis of Seasonal Change in Lampung

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ABSTRACT

This study explores the analytical thinking skills of prospective Madrasah Ibtidaiyah (MI) teacher students in understanding seasonal changes in Lampung through the ethnoscience-based RADEC learning model integrated with the local Ngumbai Sabah tradition. The aim is to bridge scientific concepts with local wisdom through both verbal and visual representations. The research employed a quantitative experimental design with a One-Pretest-Posttest design. The sample consisted of PGMI students from Class H, and the instrument was an open-ended essay test assessing students' abilities to differentiate, organize, connect concepts, and present them visually. Data were analyzed descriptively and inferentially, including a paired-sample t-test to evaluate the effectiveness of RADEC. Results show that the ethnoscience-based RADEC model effectively improves students' ability to differentiate and organize concepts. However, their ability to connect concepts comprehensively remains limited, especially in visual representations. The main hindering factors are misconceptions regarding basic science concepts, particularly seasonal change phenomena, and difficulties in representing the relationships between scientific concepts and Lampung's local wisdom. Most visual outputs remain descriptive and fragmented, highlighting the need to strengthen higher-order analytical thinking skills and visual literacy.

ARTICLE INFORMATION

Keywords:

analytical skills; ngumbai Sabah; RADEC

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INTRODUCTION

Lampung Province, known as *Sang Bumi Ruwa Jurai*, has complex geographical, astronomical, and oceanographic characteristics. Located at the southern tip of Sumatra Island and flanked by two continents (Asia and Australia) and two oceans (the Indian and Pacific), this region lies along a strategic pathway of global atmospheric circulation. These conditions directly influence monsoon wind patterns, including the west monsoon, which brings moist air masses from Asia and the Indian Ocean, resulting in high rainfall, and the east monsoon, which originates from Australia and is characterized by drier air and a longer dry season (Dafri et al., 2021; Yulihastin et al., 2021; Kunarso et al., 2018). The interaction between the global atmospheric circulation and Lampung's coastal geography further intensifies seasonal variability in wind and rainfall patterns. In addition to global atmospheric factors, Lampung's oceanographic conditions play a crucial role in shaping local weather. The province is surrounded by various bodies of water, including seas, oceans, straits, rivers, and lakes, which influence air temperature and rainfall variability through evaporation and convective processes. Anggraini et al. (2024) reported that high evaporation rates in coastal areas of Lampung enhance the formation of cumulonimbus clouds, contributing to high rainfall intensity and frequent

lightning events, particularly in Bandar Lampung and South Lampung. Furthermore, the *cold pool* phenomenon generated by convective systems over the sea has been shown to trigger heavy rainfall and prolong the duration of extreme precipitation in coastal areas of Lampung (Yulihastin et al., 2021). Ocean-atmosphere interactions also affect sea surface temperatures and air circulation patterns, leading to extreme weather events such as high waves and strong winds (Okgareta et al., 2024).

Lampung's diverse topography, consisting of mountains, valleys, and lowlands, further reinforces regional climate dynamics. Orographic processes in mountainous areas lead to increased rainfall, while valleys and lowlands experience greater fluctuations in temperature and humidity (Peng et al., 2020; Jin et al., 2024). The interaction between topography, monsoon winds, and ocean circulation makes tropical coastal regions such as Lampung highly vulnerable to intense convective and orographic rainfall (Chiang et al., 2024; Gnann et al., 2025). These climatic variations directly increase regional vulnerability to hydrometeorological disasters, including floods and droughts, and influence land productivity and vegetation distribution (Guo et al., 2020).

The complex seasonal dynamics described above have a significant impact on the agricultural sector, which serves as the primary source of livelihood for the people of Lampung. As an agrarian region, local communities heavily depend on seasonal accuracy to determine appropriate planting and harvesting periods (Dulbari et al., 2021). However, climate change has led to declining agricultural productivity. Listiana et al. (2022) reported that most pepper farmers in East Lampung Regency believe production has decreased by up to 75.93% due to climate change. Seasonal uncertainty has also led to failures in rice and coffee crops, causing economic losses for farmers (Manik et al., 2016).

In adapting to seasonal changes, Lampung communities possess rich local wisdom, in the form of ethnoscience, passed down through generations. One example is the Ngumbai Sabah tradition, a customary ritual practiced by farming communities that serves as an indicator of the planting season and an expression of gratitude for agricultural yields. This tradition reflects the local community's ability to interpret natural signs and adapt to environmental dynamics (Ardiman, 2023). Integrating ethnoscience, such as Ngumbai Sabah, into science education is considered effective in bridging abstract scientific concepts with students' real-life experiences.

Although seasonal change is closely related to the daily lives of Lampung communities, science education in schools and universities remains dominated by theoretical, decontextualized approaches. Seasonal change concepts are generally taught through explanations of Earth's rotation and revolution, without connection to local environmental conditions or cultural knowledge. As a result, prospective *Madrasah Ibtidaiyah* (MI) teacher students experience difficulties in understanding these concepts analytically and applicatively.

Preliminary studies indicate that the analytical thinking skills of prospective MI teacher students remain at low to moderate levels, particularly in terms of differentiating, organizing, and connecting information. These findings are consistent with Inayah and Lubab (2023), who emphasized that strengthening analytical thinking skills among prospective teachers remains an urgent need in teacher education. In addition, students' visual representations have not reflected their ability to engage in abstract or integrative thinking, even though visual representation is a critical indicator of conceptual depth (Christenson et al., 2014; Martini et al., 2021). Moreover, most studies on analytical thinking skills still focus primarily on verbal and written assessments. Research integrating visual representations as diagnostic tools for analytical thinking, particularly in ethnoscience-based seasonal change learning using the RADEC model, remains very limited. To address this gap, a learning model that integrates literacy, discussion, analysis, and contextually grounded knowledge creation is required. The RADEC learning model (Read, Answer, Discuss, Explain, and Create), developed by Sopandi (2017), offers a systematic approach that promotes active student

engagement throughout the learning process. Integrating RADEC with an ethnoscience approach, particularly the Ngumbai Sabah tradition, enables students to learn seasonal change concepts through both scientific and local cultural perspectives simultaneously. The RADEC stages provide opportunities for students to construct conceptual understanding, develop analytical thinking skills, and express their understanding through meaningful verbal and visual representations. This approach aligns with studies suggesting that strong seasonal knowledge enhances individuals' and communities' ability to anticipate risks and design appropriate adaptation strategies (Guido et al., 2020; Klemm & McPherson, 2017; Gunda et al., 2017).

The novelty of this study lies in examining the analytical thinking skills of prospective MI teacher students through a combination of verbal explanations and visual representations in learning seasonal change using an ethnoscience-based RADEC model in the Lampung context. This study specifically incorporates the Ngumbai Sabah tradition as an authentic and meaningful context for science learning, a context that has rarely been examined empirically. Furthermore, this research not only measures the level of analytical thinking skills but also categorizes these skills based on analytical indicators and the quality of visual representations. The integration of RADEC, ethnoscience, and visual representation provides both theoretical and practical contributions to the development of contextual and sustainable science education.

Based on the context, gap, solution, and novelty described above, the research questions of this study are as follows: 1) Does the application of the ethnoscience-based RADEC learning model improve the analytical thinking skills of prospective MI teacher students in the topic of seasonal change?; 2) What is the level of analytical thinking skills of prospective MI teacher students, including their ability to present analytical results in visual representations?; 3) What factors hinder the improvement of analytical thinking skills of prospective MI teacher students through the implementation of the ethnoscience-based RADEC model?

METHOD

A quantitative approach with a quasi-experimental one pretest-posttest design was employed to empirically examine the effect of the ethnoscience-based RADEC learning model on the analytical thinking skills of prospective MI teacher students. This approach was selected because changes in analytical thinking skills can be measured objectively by comparing pretest scores as indicators of initial ability and posttest scores as outcomes after the instructional intervention (Creswell, 2017). The research design is illustrated in Table 1.

Table 1. Research Design

Class	Pretest	Treatment	Posttest
A	O	X	O

Information:

X: Treatment using the ethnoscience-based RADEC model

O: Pretest and Posttest

The population of this study was all PGMI students who were prospective MI teachers who had taken the Elementary/MI Science Material course, and the sample was Class H. The instrument used in this study was a written test assessing analytical thinking skills, in the form of an open essay containing 5 questions, all related to seasonal changes in ethnoscience studies in the Ngumbai Sabah culture of Lampung. The instrument's blueprint is presented in Table 2.

Table 2. Research Instrument Blueprint

Ability Assessment Analytical Thinking (C4)	Science Material Study on Seasonal Changes	Study of Tradition Ngumbai Sabah	Item Question
Ability to differentiate	Earth's revolution and astronomical position, as well as the equator East & west monsoon winds	Natural landscape conditions (waters, mountains, valleys, and lowlands) in the Lampung area	1,2
Ability to organize	Climate & weather patterns Temperature, pressure, and humidity	Estimated start of planting & harvesting of rice for Lampung farmers	3,4
Ability to connect	A combination of astronomical location, equator, geography, and topography	Rice grows well or stunts, and pests and diseases appear among Lampung farmers.	5

Table 3. Scoring Criteria for Analytical Thinking Skills

Indicator	Information	Score				
		0	1	2	3	4
Differentiate	The ability to identify and separate important from irrelevant information.					
Organize	The ability to organize information logically and systematically					
Connect	The ability to relate different concepts and build coherent relationships between ideas					

The rubric (Table 3) is adapted and modified to reflect the research's characteristics and needs. The collected student responses were then analyzed and evaluated, and subsequently classified into the following categories in Table 4.

Table 4. Percentage Categories of Analytical Thinking Skills

Score Range	Categori	Description
90 – 100	Very Good	Students can analyze problems in depth, distinguish important information, organize data clearly, and connect concepts logically and comprehensively.
80 – 89	Good	Students can analyze the problem well, identified key information, and connected concepts adequately, though there were minor organizational errors.
70 – 79	Enough	Students demonstrate adequate analytical skills and can distinguish relevant information, but there are some errors in organizing and/or connecting concepts.
60 – 69	Poor	Students have limited analytical skills, often have difficulty distinguishing important information, and are less able to organize and connect concepts correctly.
< 60	Very Poor	Students fail to demonstrate analytical skills, are unable to distinguish relevant information, and cannot organize and connect concepts well.

To address the three research questions presented in the introduction in a quantitative, logical manner and in accordance with the *One Pretest–Posttest design*, the research data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to describe the profiles of students' analytical thinking skills and visual representation abilities, including mean, median, mode, standard deviation, skewness, and minimum and maximum scores. Furthermore, inferential statistics were employed to examine the effectiveness of implementing the RADEC learning model in improving students' analytical thinking skills. For this purpose, a paired sample t-test was conducted with a significance level of $\alpha = 0.05$ to analyze the differences between pretest and posttest scores. The factors hindering the improvement of analytical thinking skills were analyzed qualitatively through a theoretical review. This analysis was conducted to gain a deeper understanding of the challenges students face during the implementation of the ethnoscience-based RADEC learning model.

RESULTS AND DISCUSSION

Based on descriptive statistical analysis using measures of central tendency, data on students' analytical thinking skills were collected from the pretest and posttest administered after the implementation of the RADEC learning model. The assessed material focused on seasonal changes in the context of the Lampung Ngumbai Sabah tradition, using five essay questions, and all data analyses were conducted using SPSS version 29.0.

Table 5. Measures of Central Tendency
for Pretest and Posttest Scores

Central Tendency	Pretest	Posttest
Mean	78.94	84.55
Median	80	85
Modus	85.00	80
Std. Deviation	7.980	6.042
Skewness	-.563	.524
Minimum Score	60	75
Maximum Score	90	100

Based on the descriptive statistical output in [Table 5](#), an overview of students' analytical thinking skills at the pretest and posttest stages was obtained. The posttest mean score for students' analytical thinking skills was 84.55, which is higher than the pretest mean of 78.94. This increase indicates an improvement in students' analytical thinking skills after participating in RADEC-based learning activities. An improvement is also evident in the median value, which increased from 80 in the pretest to 85 in the posttest, indicating that the overall central position of students' achievement shifted toward a higher category.

Although the mode score decreased from 85 in the pretest to 80 in the posttest, this change is relatively small and remains within a good performance category. The decrease in the mode does not necessarily indicate a decline in ability; rather, it suggests that the distribution of posttest scores became more even, with fewer scores concentrated at a single dominant value. In other words, students' achievements were no longer clustered around one score but were more proportionally distributed across a higher range of scores. A positive trend is also reflected in the standard deviation values. In the pretest, the standard deviation was 7.980, which decreased to 6.042 in the posttest. This reduction indicates that the variation in students' posttest scores was smaller than in the pretest. In other words, students' learning outcomes became more homogeneous, with the majority of students scoring around or above the mean. This condition reflects a reduction in the gap

in analytical thinking skills among students following the implementation of the RADEC learning model.

Changes in the minimum and maximum scores further support these findings. In the pretest, the minimum and maximum scores were 60 and 90, respectively, whereas in the posttest, they increased to 75 and 100. The increase in the minimum score indicates that there were no longer any students with very low achievement, while the increase in the maximum score suggests that more students reached optimal performance levels. This result indicates that the learning process not only improved the class average but also raised the achievement of lower-performing students while simultaneously encouraging the highest levels of performance. Based on the skewness value, the pretest data distribution shows a score of -0.563 , indicating a negative skewness (left-skewed distribution). This suggests that most students' scores are above the mean, with a longer tail on the lower-score side. This condition indicates that, at the initial stage of learning, a small number of students still had relatively low analytical thinking skills. This pattern is more clearly observed in Figure 1.

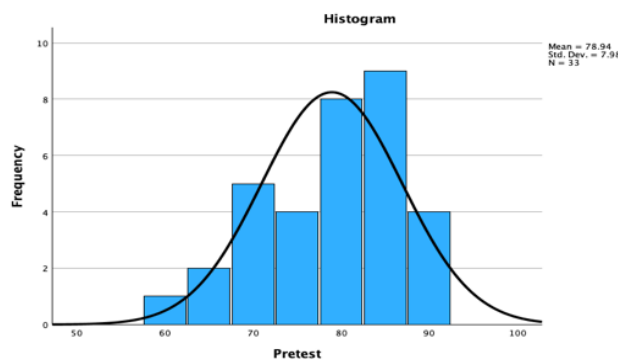


Figure 1. Histogram of Pretest Scores

In contrast, the posttest skewness value is 0.524 , indicating a slight positive skewness (right-skewed distribution). This distribution suggests that students' scores tend to be concentrated in the moderate-to-high categories, with only a small number falling into extreme score ranges. Overall, the posttest score distribution is closer to a symmetric pattern than the pretest distribution, reflecting improvements in both the quality and equity of students' analytical thinking skills. This pattern is consistent with the histogram, which shows a shift in score distribution toward higher values and a more stable spread after the implementation of the RADEC learning model, as presented in Figure 2.

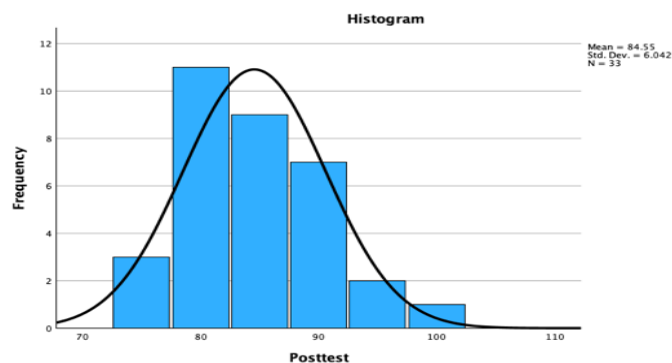


Figure 2. Histogram of Posttest Scores

Based on the descriptive statistical analysis, the subsequent analysis was conducted to determine whether the observed improvement in students' analytical thinking skills was statistically

significant and reflected the effectiveness of the learning process. Therefore, a *Paired Sample t-test* was performed. The results are presented as follows:

Table 6. Paired Samples Correlation

		N	Correlation	Significance One-Sided p	Two-Sided p
Pair 1	Pretest & Posttest	33	.589	<.001	<.001

Based on the *Paired Samples Correlations* output, the *Sig. (Two-Tailed)* value is 0.001, which is lower than 0.05 (α). This result indicates a significant positive correlation between students' pretest and posttest scores of analytical thinking skills. The obtained correlation coefficient is $r = 0.589$, which falls into the strong category. The coefficient of determination (R^2) is 0.3459, indicating that approximately 35% of the variance in posttest scores of students' analytical thinking skills can be explained by the variance in pretest scores. In other words, about 35% of students' analytical thinking performance on the posttest is influenced by their initial abilities, while the remaining variance is affected by other factors, including the instructional treatment applied.

Table 7. Paired Samples Test

		Paired Differences				T	df	Significance	
		Std. Mean	Std. Error	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
		Deviation	Mean	Lower	Upper				
Pair 1	Pretest	--	6.586	1.146	-7.941	-3.271	-	32	<.001
	Posttest	5.606				4.890			<.001

Based on the *Paired Samples Test* output, the **Sig. (Two-Tailed) value is < 0.001**, which is lower than **0.05 (α)**. This result indicates that implementing the ethnoscience-based RADEC learning model integrated with Lampung culture, particularly the Ngumbai Sabah tradition, has a significant effect on improving students' analytical thinking skills.

Table 8. Paired Samples Effect Sizes

		95% Confidence Interval			
		Standardizer ^a	Point Estimate	Lower	Upper
Pair 1	Pretest - Posttest	Cohen's d	6.586	-.851	-1.246
		Hedges' correction	6.745	-.831	-1.216

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Based on the *Paired Samples Effect Sizes* output, the point estimate values obtained are -0.851 and -0.831. These values indicate a large effect size, as their absolute values exceed the 0.8 threshold proposed by Cohen et al. (2018). In addition, the *Sig. (Two-Tailed)* value is < 0.001, which is lower than 0.05 (α). These results confirm that implementing the ethnoscience-based RADEC learning model integrated with Lampung culture, particularly the Ngumbai Sabah tradition, has a significant, high-category effect on improving students' analytical thinking skills.

Based on the previous data, the implementation of the RADEC model has been proven effective in improving students' analytical thinking skills; however, the findings presented were still general. Therefore, this section provides a more detailed analysis to identify the level of improvement in each analytical thinking indicator, including visual representation ability, so that each indicator can be classified into very good, good, sufficient, poor, and very poor categories. The analysis begins with the presentation of descriptive statistics, including measures of central tendency.

Table 9. Analytical Thinking Skill Levels for Each Indicator

Statistical Measure Of Central Tendency	Analytical Thinking Skills			Visual Representation
	Differentiate	Organize	Connect	
Mean	86.48	77.42	68.18	63.18
Median	87.00	75.00	75.00	75.00
Modus	87	75	75	50 ^a
Std. Deviation	9.875	10.180	15.653	17.889
Skewness	-.243	-.453	.262	-.350

Based on the descriptive statistical analysis, an overview of students' analytical thinking skill levels across each indicator was obtained. For the differentiating indicator, the mean score was 86.48, which falls into the good category. The median and mode, both at 87, indicate that most students consistently differentiated the concepts. The standard deviation of 9.875 suggests relatively moderate variation in scores and a fairly homogeneous distribution. A skewness value of -0.243 indicates a distribution close to symmetry, with a slight left skew, suggesting that the majority of students achieved middle- to high-scoring levels.

For the organizing indicator, the mean score was 77.42, which falls within the Enough range. The median and mode of 75 indicate that students' ability to structure and organize concepts systematically was not yet evenly distributed. The standard deviation of 10.180 reflects a relatively large variation in students' abilities. A skewness value of -0.453 indicates a left-skewed distribution, suggesting that although most students were in the moderate category, some still performed at low levels. Meanwhile, the Poor indicator showed the lowest mean score, at 68.18, which falls into the low category. The relatively high standard deviation (15.653) indicates a wide range of student abilities. A skewness value of 0.262 indicates slight positive skew, meaning that a large proportion of students obtained low scores, while only a small proportion achieved high scores. These findings indicate that students' ability to integrate and connect concepts comprehensively remains a major area of weakness.

For the visual representation indicator, the mean score was 63.18, which falls into the low category. The median score of 75 is higher than the mean, while the mode of 50 indicates that the most frequently occurring score is relatively low. This combination suggests that although a few students achieved high scores, the majority were clustered at lower performance levels, pulling the mean down. The standard deviation of 17.889 reflects significant variation in students' abilities to represent concepts visually, suggesting inconsistency within the group. A skewness value of -0.350 indicates a slight left skew, meaning that while most students scored moderately, a small number achieved particularly high scores. These results highlight that students' visual representation skills remain a significant area needing improvement, as performance is generally low and unevenly distributed.

Overall, the descriptive statistical analysis shows a clear gradient across each indicator of students' analytical thinking skills. The increasing variability and declining mean scores on higher-order indicators indicate that students experience greater difficulty with analytical tasks that require conceptual integration and visual communication. To clarify these patterns, the distribution and

comparison of students' performance across all indicators are further presented in comparative tables and histograms.

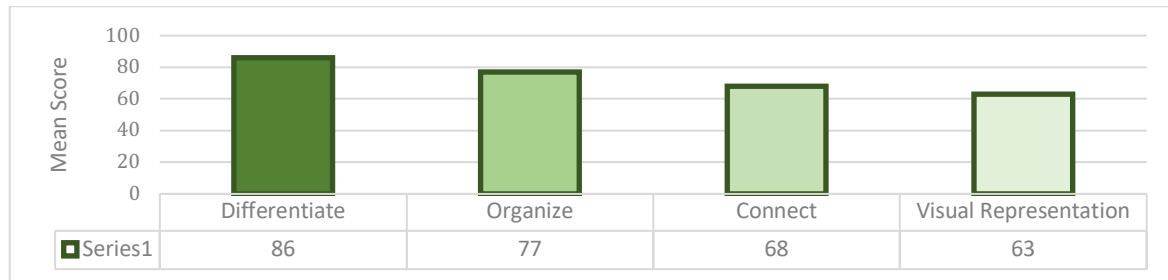


Figure 3. Students' Analytical Thinking Scores for Each Indicator

Figure 3 compares students' analytical thinking skill indicators based on mean scores, showing a declining trend from *differentiate* to *organize* and *connect*. The *differentiate* indicator records the highest mean, followed by *organize* at a moderate level, while *connect* is the lowest, indicating limited conceptual integration. The mean score for *visual representation* is lower than that of *connect*, reflecting difficulties in visually communicating analytical understanding. Overall, the findings highlight the need to strengthen higher-order analytical processes and visual communication of analytical outcomes. To strengthen these findings, examples of students' visual representations are presented to illustrate the relationship between the apparent annual movement of the Sun, monsoon wind directions, and seasonal changes in Indonesia, as well as their impacts on weather, rainfall, humidity, and agricultural activities in Lampung Province that underlie the emergence of the Ngumbai Sabah tradition.

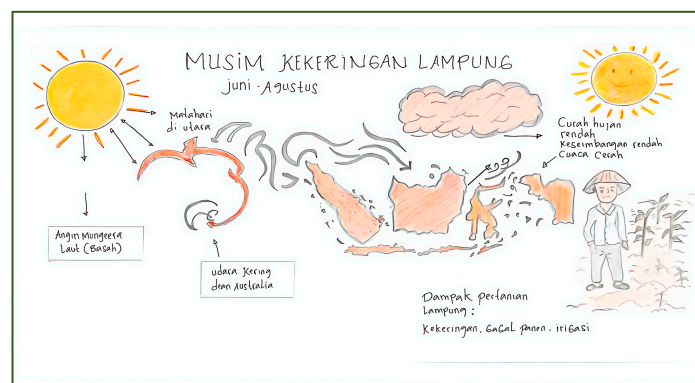


Figure 4. Outputs 1 of Students' Visual Presentation

Based on Figure 4, students explain that during the June–August period, the Sun appears to be positioned in the Northern Hemisphere, triggering easterly monsoon winds from the Australian continent, which are dry. This condition results in the dry season in Indonesia, including Lampung Province, leading to low rainfall, reduced humidity, and an increased risk of drought and crop failure. However, artifacts or artistic elements representing the Ngumbai Sabah tradition are not clearly evident in most visual outputs, and only a small proportion of students can fully integrate this phenomenon into a coherent cultural narrative.

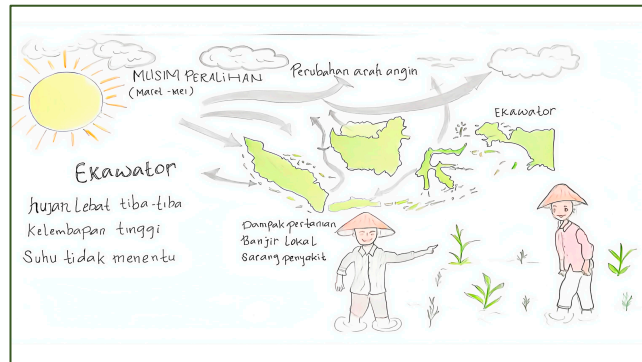


Figure 5. Outputs 2 of Students' Visual Presentation

Based on Figure 5, students attempt to explain the phenomenon of seasonal change during the March–June period, which represents the transitional season (pancaroba). However, the analysis presented remains conceptually inaccurate. During this period, the Sun is located near the equator, so wind patterns are not yet dominated by a particular monsoon, resulting in unstable weather characterized by sudden rainfall, high humidity, and fluctuating temperatures. These conditions increase the risk of local flooding, disrupt agricultural activities, and contribute to the emergence of disease-prone environments. In addition, cultural elements representing the Ngumbai Sabah tradition are not clearly evident in the visual representations. This finding is concerning, as such misconceptions are commonly encountered by students when asked to present their understanding in visual form. Figure 6 is presented for further consideration.

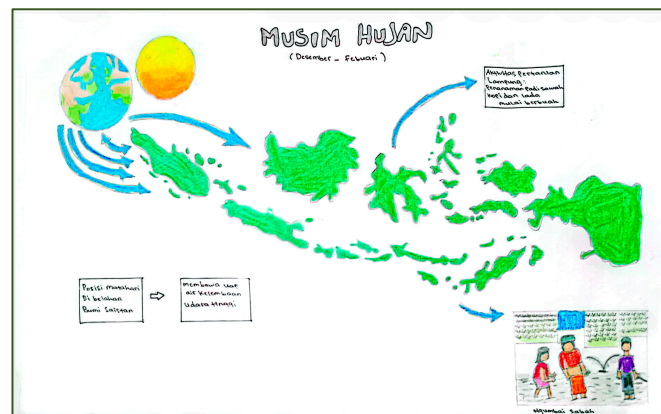


Figure 6. Outputs 3 of Students' Visual Presentation

Based on Figure 6 in Output 3, students attempt to explain the phenomenon of seasonal change; however, they do not clearly relate it to the specific periods of each season associated with the apparent annual position of the Sun in the Northern and Southern Hemispheres. The impacts of seasonal changes on weather conditions and the environment are also insufficiently explained, resulting in a limited analysis and weak visual representations. In addition, cultural elements representing the Ngumbai Sabah tradition are not clearly evident in the visual outputs. This finding is a significant concern, as students commonly experience similar difficulties.

The analysis results indicate that improving the analytical thinking skills of prospective MI teacher students through the implementation of the ethnoscience-based RADEC model still faces several fundamental challenges. The main hindering factor stems from conceptual errors (misconceptions) in understanding basic science concepts, particularly regarding seasonal changes in Indonesia. Many students do not fully grasp that seasonal changes are influenced by the Sun's

apparent annual motion, which drives the monsoon wind system. When the Sun is positioned in the Southern Hemisphere, the west monsoon blows from the Indian Ocean toward Indonesia, carrying moist air masses and triggering the rainy season. Conversely, when the Sun is in the Northern Hemisphere, the east monsoon blows from the Australian continent, which is dry, causing a dry season across most of Indonesia. Misunderstanding these basic mechanisms leads students to struggle with scientifically analyzing cause-and-effect relationships.

These misconceptions become more evident when students are asked to connect the seasonal phenomenon with Lampung's local wisdom, particularly the *Ngumbai Sabah* tradition. *Ngumbai Sabah* is a cultural practice that emerged from local communities' long experience of reading natural signs and adjusting agricultural activities to seasonal cycles. This tradition reflects a harmonious relationship between humans and nature, not only in a spiritual dimension but also as an adaptive strategy to environmental and climatic conditions. However, most students are unable to explain the connection between this tradition and Lampung's complex geographical, astronomical, and oceanographic characteristics. Lampung's location at the southern tip of Sumatra, flanked by two continents and two oceans, and situated along global atmospheric circulation pathways, directly influences monsoon wind patterns and rainfall. In addition, the province's diverse topography, consisting of mountains, valleys, and lowlands, further reinforces regional climate dynamics. Inadequate understanding of these natural contexts prevents students from analytically linking scientific phenomena with local wisdom.

Another hindering factor relates to weaknesses in scientific visualization. Students struggle when asked to visually represent the connection between scientific concepts and Lampung's local wisdom. Visualization requires spatial reasoning, establishing cause-and-effect sequences, selecting appropriate symbols, and integrating scientific elements (Sun position, monsoon wind directions, seasonal changes) with cultural elements (*Ngumbai Sabah* practices). However, most visual outputs remain descriptive and fragmented, failing to show coherent relationships among variables. This condition indicates that although the ethnoscience-based RADEC model provides opportunities for students to read, discuss, and explore phenomena, higher-order analytical skills—particularly in conceptual integration and visual representation—still require strengthening through visual literacy exercises and practice in contextual analysis grounded in local culture.

CONCLUSION

The practical recommendations proposed include strengthening the role of the digital science module to comprehensively instill fundamental science concepts, providing more project-based exercises to enhance students' ability to visually represent scientific concepts, and intensifying hands-on learning practices focused on observing weather, seasonal patterns, and their impacts on agriculture in Lampung Province. Meanwhile, the limitations of this study include a sample restricted to a single class, the focus on only one science topic, limited and less varied quantitative and qualitative research instruments, and a short research duration of only 3–4 sessions, which may not fully reflect the overall analytical abilities of the students.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

CONFLICTING INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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