

The Development of a Local Wisdom-Based RADEC Model to Enhance Elementary School Students' Cultural Literacy and Collaboration Skills

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Abstract: The low levels of cultural literacy and collaboration skills among elementary school students in a multicultural city like Singkawang pose a 21st-century challenge. This challenge can be overcome through innovative learning models, including the TiDayu local-wisdom-based RADEC. The objectives of this study are to determine the validity, practicality, and effectiveness of the local wisdom-based RADEC model in enhancing the cultural literacy and collaboration skills of elementary school students. This study uses the Research and Development (R&D) method with the ADDIE model approach. The subjects of the study were fifth-grade students of SDN 89 Singkawang. Data were collected through questionnaires, tests, and observations, analyzed descriptively, and using N-Gain. The results of this study indicate that the average validation scores from learning model experts, science content experts, cultural experts, and practitioner experts (elementary school teachers) place the local wisdom-based RADEC model in the valid category (84.6%). Based on implementation data and teacher and student responses, the RADEC model was considered practical, with an average score of 83.2%. Furthermore, the implementation of the local wisdom-based RADEC model indicates its potential effectiveness in learning, as evidenced by an increase in student literacy with an N-Gain score of 0.75 (high category). The average students' collaborative skills increased from 56.25% (categorized as moderate collaboration) to 95.99% (categorized as very high collaboration). Therefore, the TiDayu local wisdom-based RADEC model is easy to implement and shows initial potential to enhance students' cultural literacy and collaboration skills, as local wisdom provides a meaningful learning context, enables the interpretation of cultural values (cultural meaning-making), and encourages social interaction among elementary school students.

Keywords: RADEC model, local wisdom, cultural literacy, collaboration skills.

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■ INTRODUCTION

21st-century learning demands that students not only excel in cognitive domains but also possess life skills, including critical thinking, communication, collaboration, and creativity (4Cs). Among these four competencies, collaboration skills and cultural literacy become important in the context of a multicultural society like Indonesia. Unfortunately, various study results show that these two aspects have not yet developed optimally at the elementary education level.

Cultural literacy constitutes a set of values, dispositions, and individual abilities to recognize, interpret, and apply cultural values and concepts in everyday life, developed through dialogue and constructive argumentation with individuals from diverse cultural backgrounds, and serves as an essential skill for twenty-first-century citizens. (Riani et al., 2018; García Ochoa & McDonald, 2019; Rapanta et al., 2021). Cultural literacy encompasses an understanding and appreciation of Indonesian culture as a national identity, while reflecting positive and fundamental attitudes

necessary in daily life (Garcia-Mila et al., 2021; Takiddin et al., 2025).

However, data from a national survey conducted by Puslitjak Kemendikbudristek (2021) show that only 38.5% of elementary school students in Indonesia demonstrate an adequate understanding of local culture and national cultural diversity. Saragih (2021) and Mursalim et al. (2025) revealed that low cultural literacy among elementary school students correlates with a lack of local content and limited learning resources contextualized in the learning process.

These empirical findings are consistent with the results of interviews with teachers at SDN 89 Singkawang, which revealed that students live in a multicultural environment rich in Chinese, Dayak, and Malay (TiDayu) cultures. Nevertheless, these local cultural elements are rarely explicitly incorporated into classroom instruction. Teachers reported that students are generally familiar with traditions such as *Cap Go Meh* or *Naik Dango*; however, they have not yet developed a deep understanding of the cultural meanings underlying these traditions or the ability to relate them to learning content. This condition indicates that the potential of local culture, which could serve as a contextual learning resource, has not been optimally utilized to foster students' cultural literacy.

On the other hand, students' collaborative abilities are still relatively low. Based on the results of the Minimum Competency Assessment (AKM) conducted by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) in 2022, 51% of elementary school students had difficulty completing group tasks or presenting ideas cooperatively during class discussions. Research findings from Atira et al. (2023) also show that only 44% of upper elementary school students in multicultural regions demonstrate good collaborative skills, including the ability to listen,

share tasks, and make decisions together. Findings from interviews with teachers at SDN 89 Singkawang further confirmed that students tend to be passive during group work, are not accustomed to sharing roles, and discussions are often dominated by a few students.

This problem is exacerbated by learning models dominated by conventional approaches that are less active and collaborative and fail to engage with students' local contexts. Learning that is not relevant to everyday life results in low active student participation and weakens the strengthening of local cultural values (Thomas & Quinlan, 2023; Zickafoose et al., 2024; Sugiyanto et al., 2025). This is a pressing issue, especially in areas such as West Kalimantan, especially the city of Singkawang, which is rich in Chinese, Dayak, and Malay (TiDayu) cultural diversity, but has not been optimally integrated into elementary school learning (Juniardi & Marjito, 2018; Sulistri et al., 2020; Qalam et al., 2024).

The proposed solution is to develop an innovative, dynamic, and context-responsive learning model that is explicitly integrated with local cultural values. One such approach is the RADEC (Read-Answer-Discuss-Explain-Create) learning model. RADEC, characterized by its active, collaborative, and contextual nature, has been shown to effectively enhance students' active participation and deep conceptual understanding (Pratama, 2019; Apriansah, 2024). Further research also confirms the positive impact of this model on various 21st-century skills, such as critical thinking and science literacy, across different educational levels and subjects (Rohani et al., 2025; Uyar & Karamustafaoglu, 2025). RADEC is particularly well-suited to integrating with TiDayu local wisdom because it emphasizes contextualized learning, active exploration, and collaborative knowledge construction, which align closely with TiDayu's cultural characteristics. Its sequential phases (Read-Answer-Discuss-

Explain-Create) enable students to anchor scientific concepts in local cultural experiences from the outset, consistent with Sociocultural Learning Theory (Vygotsky), which posits that knowledge is constructed through cultural mediation and social interaction. Furthermore, RADEC resonates with the Funds of Knowledge framework (Moll et al., 1992), which asserts that learning becomes more meaningful when instructional processes incorporate students' community-based cultural practices. In the Read phase, students observe texts, artifacts, or local practices that serve as scaffolding linking their community experiences (Funds of Knowledge) to academic content, in line with the Zone of Proximal Development (ZPD). During Answer, students respond individually to reflective questions that mediate their understanding of cultural values. Discussing promotes social interaction by comparing Dayak, Chinese, and Malay practices through cultural artifacts, aligning with Vygotsky's cultural mediation theory and facilitating peer scaffolding. In Explain, students present interpretations grounded in community experiences, thereby enhancing meaningful learning. Create enables production of creative outputs, such as culture-based science projects, reinforcing conceptual and collaborative understanding. Collectively, RADEC systematically embodies ZPD, cultural mediation, and *Funds of Knowledge*, strengthening both literacy and collaboration. International studies similarly affirm that culturally grounded pedagogies enhance student engagement, collaboration, and learning identity (Chuanzhu et al., 2025; Yuheng Zeng et al., 2025).

The urgency of this research lies in the need for innovative learning models to address the challenges of low cultural literacy and collaboration skills among elementary school students, as reflected in the results of the 2024 Minimum Competency Assessment (AKM). These results indicate that nearly half of

elementary school students have not demonstrated adequate literacy and collaborative skills in learning, particularly in science. Science learning in elementary schools ideally emphasizes not only conceptual mastery but also the integration of local cultural contexts to strengthen the relevance of learning for students. Cultural integration in science allows students to study scientific phenomena with local cultural practices such as sound patterns or the use of nature, thereby enriching scientific understanding through meaningful experiences. At the same time, exploratory and inquiry-based science activities encourage effective group work, strengthening collaboration skills through discussion, role-sharing, and collaborative problem-solving. International studies also confirm that contextual learning, which combines culture and collaborative activities, enhances students' active participation and social skills in multicultural environments (Hennessy et al., 2020; Lee & Buxton, 2015). However, in areas like Singkawang City, which is rich in cultural diversity, especially among the Chinese, Dayak, and Malay (TiDayu) ethnic groups, this cultural wealth has not been widely leveraged as a resource for contextual learning in elementary schools. This results in students often lacking authentic experiences in understanding and interacting with the surrounding culture. In this situation, the RADEC development model based on local wisdom is very important: not only is it compatible, but it is also, theoretically and empirically, the most synergistic in transforming TiDayu local wisdom into a collaborative, contextual, and meaningful science learning experience.

The RADEC model has been extensively developed to improve learning outcomes and 21st-century skills. Studies by Afandi et al. (2024) and Apriansah et al. (2024) demonstrate the effectiveness of this model in enhancing critical thinking abilities and conceptual understanding.

Several studies have begun to develop the RADEC model within instructional processes. One of them is Anggia et al. (2025), who utilized the RADEC model assisted by literacy media in the learning process. However, no research has yet to comprehensively develop RADEC as a culturally based learning model systematically designed to enhance cultural literacy and collaborative skills among elementary students in multiethnic contexts. This study seeks to fill that gap by developing a RADEC model integrated with local cultural practices (Chinese, Dayak, and Malay) and implemented through thematic learning in primary schools, particularly in science education. Thus, this research provides both theoretical and practical contributions to the development of culturally based learning models, while offering an innovative solution to the persistent issues of low cultural literacy and collaboration among students living in pluralistic societies. The research questions in this study are as follows: (1) How valid is the developed local wisdom-based RADEC model? (2) How practical is the implementation of the local wisdom-based RADEC model in the elementary school learning process? (3) How effective is the application of the local wisdom-based RADEC model in improving elementary school students' cultural literacy and collaboration skills?

■ METHOD

Participants

This research was conducted in September at SDN 89 Singkawang. The research subjects were 24 fifth-grade students. The sample was determined using a purposive sampling technique, with class VA students at SDN 89 Singkawang designated as the research location and subjects.

Research Design

This research design followed the ADDIE development model, which comprises five stages: Analysis, Design, Development, Implementation,

and Evaluation (Sugiyono, 2017). According to Arkün & Akkoyunlu (2008), the ADDIE model also determines the feedback mechanism and duration of learning activities.

Research Procedure

This study was conducted through five systematic stages. The first stage is the analysis phase, which includes initial analysis, student analysis, task analysis, concept analysis, and goal specification. The second stage is the design phase, which involves formulating the objectives and competencies to be achieved, designing a prototype of the local wisdom-based RADEC model, and developing the learning instruments. The third stage is the development phase, consisting of validation, testing, and revision. The next stage is implementation, during which the local wisdom-based RADEC model that has been designed and developed is applied in the learning process. Finally, the evaluation stage is carried out to determine the effectiveness of the local wisdom-based RADEC model in improving students' cultural literacy.

Instruments

The research instruments employed in this study consisted of test and non-test instruments. The test instrument was used to measure elementary school students' cultural literacy through objective test items administered as a pretest and a posttest, each consisting of 10 items. The cultural literacy indicators assessed included values of diversity, cultural sensitivity, and cultural interaction. The indicators of diversity values and cultural sensitivity were each represented by four items, while the indicator of cultural interaction was represented by two items. The test instrument underwent a content validity assessment by experts in elementary and cultural education. In addition, the empirical validity of the test items was examined using point-biserial correlation analysis. The results indicated that all test items

were classified as valid. Furthermore, the reliability of the test instrument was assessed using the KR-20 reliability coefficient, which yielded 0.84, placing it in the high reliability category and indicating that the instrument is consistent and appropriate for use in this study.

The non-test instruments were used to measure students' responses through questionnaires and to assess students' collaborative skills during the learning process using observation sheets. The questionnaire instrument for teachers' and students' responses was developed using a Likert scale, with both positive and negative statements, to assess their responses to the RADEC model integrated with local wisdom. The measured aspects included the ease of understanding the RADEC syntax, content comprehension, student engagement, and the clarity of instructional materials. The questionnaire underwent content validity testing through expert judgment, and all items were deemed valid. Reliability analysis using Cronbach's Alpha yielded a coefficient of 0.86, which falls into the high reliability category, indicating that the questionnaire is reliable and suitable for use in this study.

On the observation sheet, the collaborative skills assessed included positive interdependence, face-to-face interaction, individual accountability and personal responsibility, communication skills, and teamwork skills. Each indicator was represented by two observational statements. The collaborative skills observation sheet underwent content validity testing through expert judgment and was deemed valid. Inter-rater reliability analysis yielded a reliability coefficient of 0.82, indicating a high level of consistency among raters.

Data Analysis

Data analysis in this study was conducted using quantitative descriptive methods. The results of the validation of the model and learning tools were analyzed by a team of experts and then

analyzed using a descriptive percentage test with the validity assessment scores for the teaching module and learning tools according to Riduwan & Akdon (2012), namely Score 4 = Very Appropriate, Score 3 = Appropriate, Score 2 = Less Appropriate and Score 1 = Not Appropriate and then the percentage was calculated using the formula from (Sudijono, 2012)

Table 1. Assessment criteria for the validity of teaching modules and learning devices

Percentage (%)	Validity Criteria
$85 < NV \leq 100$	Highly Valid
$75 < NV \leq 85$	Valid
$55 < NV \leq 75$	Moderately Valid
$0 < NV \leq 55$	Invalid

Source: Sudijono (2012)

The developed RADEC model is considered practical or not based on responses from teachers and students, arranged on a Likert scale. This Likert scale is arranged into positive and negative categories and then analyzed using frequency data analysis techniques, following the formula proposed by Purwanto (2009), as follows.

$$NP = \frac{S}{SM} \times 100\%$$

Note:

NP : Practicality Value

S : Obtained Score

SM : Maximum Score

Table 2. Practicality categories of the local wisdom-based RADEC model

Practicality Value (%)	Category
$85 < NP \leq 100$	Highly Practical
$75 < NP \leq 85$	Practical
$55 < NP \leq 75$	Moderately Practical
$0 < NP \leq 55$	Impractical

Source: (Purwanto, 2009)

In addition to the Questionnaire, learning implementation was analyzed using the average observation results for each meeting, which were categorized as very high, high, sufficient, or low. The category of learning implementation is considered “practical” when the average value for each aspect of observation, as reported by observers at each meeting, falls in the high or very high category.

The effectiveness of the learning model is evaluated by examining the increase in cultural literacy through a comparison of pretest and posttest scores using the N-Gain formula, which is classified as high, medium, or low. In addition, students’ collaboration abilities are analyzed by calculating the percentage of the average score of the observation results and categorized into five levels, namely very high (81-100), high (61-80), medium (41-60), low (21-40), and very low (0-20). The RADEC model, based on local wisdom, is declared valid, practical, and effective if it meets the validity criteria of at least 75%, the minimum practicality criterion is in the practical category, and effectiveness is demonstrated by an increase in cultural literacy and students’ collaborative abilities of at least 75%.

■ RESULT AND DISCUSSION

This study aims to develop a RADEC learning model based on local wisdom from TiDayu (Chinese, Dayak, and Malay) to improve the cultural literacy and collaboration skills of elementary school students.

The development process follows the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) stages. The research results are presented according to three problem formulations: the model’s validity, practicality, and effectiveness.

Results of Needs Analysis

The analysis phase was conducted to identify students’ needs and characteristics, as well as the potential for integrating local wisdom into TiDayu in Singkawang City. The needs analysis identified the following:

1. Material IPAS: Science learning in elementary schools is still dominated by memorization, is less contextual, and has not integrated much local wisdom.
2. Student characteristics: Elementary school students tend to prefer real-life activities, discussions, and stories that are close to everyday life.
3. Local wisdom: TiDayu culture has many practices related to sound, for example, the barongsai drum from the Chinese tribe, the gong from the Dayak tribe, and the tambourine from the Malay tribe.

Based on local wisdom, maintaining the core syntax (Read, Answer, Discuss, Explain, Create). 21st-century competency needs: Learning models that emphasize cultural literacy and collaboration are needed.

Table 3. Results of needs analysis

Aspect	Analysis Result	Implication
IPAS Materials	Lack of context, lack of examples that are close to everyday life	Need to be connected to local culture
Student	Love real practice & stories	Culture-based learning is needed
TiDayu Culture	Rich in sound tradition	Potential to be a source of science learning
21st century competence	Low cultural literacy & collaboration	Need a 4C-based model & local wisdom

Design Stage

Based on the needs analysis, the RADEC learning model was designed by contextualizing it. Further details can be seen in Table 4.

Development Stage

At this stage, learning devices were prepared as teaching modules, TiDayu-culture-based teaching materials, and STUDENT

Table 4. RADEC syntax before and after development

RADEC stage	Before Expansion	After Development (based on TiDayu local wisdom)
Read	Reading material from textbooks	Reading TiDayu cultural texts, such as the story of the Dayak gong or the Malay rebana
Answer	Answering general questions	Answering questions based on cultural phenomena (for example: why does the sound of a gong sound far away?)
Discuss	Science concept discussion	Discussion comparing Dayak, Chinese, and Malay cultural practices
Explain	The teacher explains the concept of science	The teacher explains by linking science phenomena and local culture.
Create	Making general products	Making culture-based products, for example, making TiDayu posters on science material

WORKSHEETS. The development results were obtained from expert validation. Expert validation is the validation stage of the RADEC model based on TiDayu local wisdom (Chinese, Dayak, Malay), conducted by 4 validators: learning model experts, science material experts, cultural experts, and practitioner experts (elementary school teachers). The aspects assessed include: (1) Suitability of learning objectives, (2) Integration of RADEC syntax, (3) Integration of TiDayu local wisdom, (4) Language, and Feasibility of display/presentation.

Based on Table 5, the expert validation recapitulation results indicate that the TiDayu local wisdom-based RADEC model achieved an overall average score of 84.6%, which falls into the valid category. According to the learning model expert's assessment, the RADEC syntax integration aspect received an average score of 86.0%, indicating that the stages of the RADEC learning model were systematically structured and aligned with active learning principles. Meanwhile, the evaluation by the science content expert yielded an average score of 84.2%, suggesting

that the learning objectives and instructional materials developed were consistent with the intended learning outcomes and the science concepts being taught.

Furthermore, the validation results from the cultural expert yielded an average score of 85.6%, indicating that integrating TiDayu local wisdom values (Chinese, Dayak, and Malay) into the learning model was appropriate and relevant to the cultural context of Singkawang City. In addition, the practitioner expert (elementary school teacher) assigned an average score of 83.3% for the aspects of language and presentation feasibility, indicating that the learning materials were generally adequate in readability, language clarity, and visual presentation. However, minor revisions were still required in several sections. Overall, these findings demonstrate that the TiDayu local wisdom-based RADEC model is feasible for implementation in the learning process.

The total achievement average score across aspects is 84.6%, so the validity level falls within the Valid category. This indicates that the local

Table 5. Recapitulation of expert validation results

Validator	Assessed Aspect	Average (%)	Category
Learning Model Expert	RADEC Syntax Integration	86.0	Valid
Science Content Expert	Alignment of Learning Objectives and Instructional Materials	84.2	Valid
Cultural Expert	Integration of TiDayu Local Wisdom	85.6	Valid

Practitioner Expert (Elementary School Teacher)	Language and Presentation Feasibility	83.3	Valid
Overall Average		84.6	Valid

wisdom-based RADEC model has met the standards of pedagogical needs and contextual relevance in Kota Singkawang. Previous research also shows that integrating local culture into learning models increases the relevance of the material and student acceptance. For example, Sukmawati's (2024) research found that RADEC, integrated with Learning models that integrate culture, can improve teacher-student relationships, strengthen students' cultural identity, and increase student engagement through learning materials. Be meaningful and appropriate to their cultural background (Yuheng Zeng et al., 2025; Galenzoga, 2025).

Based on the results of expert validation, the RADEC model grounded in TiDayu local wisdom is declared Valid for implementation but requires minor revisions to linguistic and display presentation aspects. An excerpt from the initial draft before revision and the final excerpt after revision are shown in Table 6 below.

Implementation Stage

The Implementation stage is done to obtain the practicality of the developed RADEC model. Practicality is reviewed from the implementation of the model in the learning process, teacher response, and student response. After the

Table 6. Excerpt of the results of the development of the local wisdom-based RADEC model from the validator

RADEC stage	Initial Draft (Before Revision)	Validator Note	Draft Final (After Revision)
Read	"Students read texts about traditional musical instruments, the Dayak gong and the Malay tambourine, to find the differences, like the sounds they produce."	The language is too academic and lacks illustrations.	"Let's read a short story about the Dayak gong and the Malay tambourine. Look at the following picture, then find the difference in sound produced by these two musical instruments." (with illustrations).
Answer	"What is the difference in sound frequency between a Dayak gong and a Barongsai drum? Explain it based on science concepts."	The term "frequency" is too technical for SD.	"In your opinion, why does the Dayak gong sound deeper than the Barongsai tambourine? What is the difference?"
Create	"Students make a report on the results of the discussion about the comparison of sound properties of the traditional musical instrument TiDayu."	Activities are too focused on reports, less creative.	"Create a simple work, such as a poster or mini-performance, that shows the differences in sound between the Dayak gong, the Malay tambourine, and the Barongsai drum."

development stage, the RADEC model based on local wisdom is then tested on a limited scale. A

limited trial was conducted in the VB class at SD Negeri 89 Singkawang, with a total of 24

students. The material taught is Sound and Its Nature, integrating local wisdom through traditional Dayak gongs and sape' musical instruments, Malay tambourines, and Barongsai tambourines from Chinese culture. The class teacher serves as the executor of learning, while the researcher serves as an observer. An observation of the model's implementation was conducted to assess the extent to which the teacher could apply the RADEC syntax (Read, Answer, Discuss, Explain, Create) in line with the device compiled for the IPAS learning process. During the observation, students' involvement in each RADEC syntax, based on local knowledge, was monitored. A teacher response questionnaire

assessed the practice of the local wisdom-based RADEC model. Because the syntax was easy to understand, the learning materials were clear, and the students were more engaged than usual. However, the teacher suggested providing more visual/audio media to make learning more engaging. Meanwhile, the student questionnaire responses were predominantly positive. Feel happy learning with their own cultural themes, felt proud to know regional musical instruments, and more easily understood concept of sound through real examples. As for the results on the model's practicality, reviewed from the aspects of model implementation, the teacher's response, and the student's response, they are presented in Table 7.

Table 7. Results of the practicality of the model

Aspect	Percentage	Category
Model implementation	83.2%	Practical
Teacher's response	86%	Highly Practical
Student response	84%	Practical
Overall average	83.6%	Practical

Based on Table 7, the practicality results showed that the model implementation aspect obtained 83.2%, categorized as practical, while the teacher's response reached 86%, categorized as very practical, and the student response achieved 84%, categorized as practical. Overall, the model achieved an average practicality score of 83.6%, placing it in the practical category. These quantitative findings were further supported by qualitative data from interviews and field notes collected during implementation.

Based on the interview results, teachers stated that the TiDayu local wisdom-based RADEC learning model was relatively easy to implement in the classroom because it provided clear, systematic learning stages and increased student engagement during the learning process. One teacher stated, *"This learning model is easy to implement because the stages are already clear and systematic. Students also appear*

more active during discussions, and the integration of local culture makes learning more relevant to their daily lives." This statement is consistent with the high teacher response score, which reached the very practical category.

Positive responses were also expressed by students. In a brief discussion, one student stated, *"I enjoy learning this way because we can discuss with friends and also learn about the culture in our region. It makes science lessons more interesting."* Another student commented, *"Learning is more enjoyable because we do not only read, but also discuss and work on tasks together, so it is easier to understand the material."* These statements support the student response results, which were categorized as practical.

In addition, field notes during the implementation showed that most students

actively participated in group discussions, asked questions, and demonstrated enthusiasm when science concepts were linked to examples from TiDayu local culture. These findings reinforce that the TiDayu local wisdom-based RADEC model is not only practical in implementation but also receives positive responses from both teachers and students throughout the learning process.

Minor constraints, such as time and audio/visual media, emerged but did not disrupt the overall implementation. This finding is in line with research by Agil Kurniawati & Mawardi (2023), who combined the CRT approach with the Teams Games Tournament (TGT) model to improve student collaboration in 4th-grade elementary school students. In this study, practicality was well implemented, and student engagement increased.

Evaluation Stage

The evaluation aims to measure the effectiveness of implementing the local wisdom-based RADEC model in improving cultural literacy and collaboration skills among elementary

school students. The evaluation was conducted through pretests, posttests, and observations after the implementation trial.

Student cultural literacy

Students' cultural literacy is measured based on three indicators: diversity values, cultural sensitivity, and interaction with culture. Based on the results of the Wilcoxon Signed Ranks Test, a Z value of -4.215 was obtained with an Asymp. Sig. (2-tailed) value of 0.000. Since the significance value was lower than the significance level of 0.05 ($0.000 < 0.05$), the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_a) was accepted. These findings indicate a significant difference between students' pre- and post-test scores in cultural literacy after the implementation of the local culture-based RADEC model. Furthermore, the results of the Wilcoxon test were strengthened by N-gain analysis to assess improvements in students' cultural literacy. N-Gain scores are shown in Table 8.

Table 8. Students' cultural literacy N-Gain scores

	Mean	Max Score	N-Gain Score	N-Gain Score 100%
Pretest	50.42	100	0.75	75%
Posttest	87.92			
Information			High	Quite Effective

The average pretest score for students was 50.42, while the average posttest score increased to 87.92. The N-Gain score was calculated at 0.75, indicating that students' cultural literacy improved to the high category. A more detailed analysis of each cultural literacy indicator also showed consistent improvement across all measured aspects. As shown in Figure 1, the diversity values indicator showed an increase in the average score from 20.3 on the pretest to 37.2 on the posttest, with an N-Gain score of 0.79, which is categorized as high. Similarly, the *cultural sensitivity* indicator improved from an average pretest score of 19.6 to 35.1 in the

posttest, with an N-Gain score of 0.72, also in the high category. Meanwhile, the *interaction with culture* indicator increased from 10.5 in the pretest to 15.6 in the posttest, with an N-Gain score of 0.74, indicating a high level of improvement. These findings suggest that implementing the local culture-based RADEC model effectively enhanced students' cultural literacy across all measured indicators, with the greatest improvement observed in the *diversity values* aspect.

These findings indicate that the TiDayu-based RADEC model developed in Singkawang City is sufficiently effective in strengthening

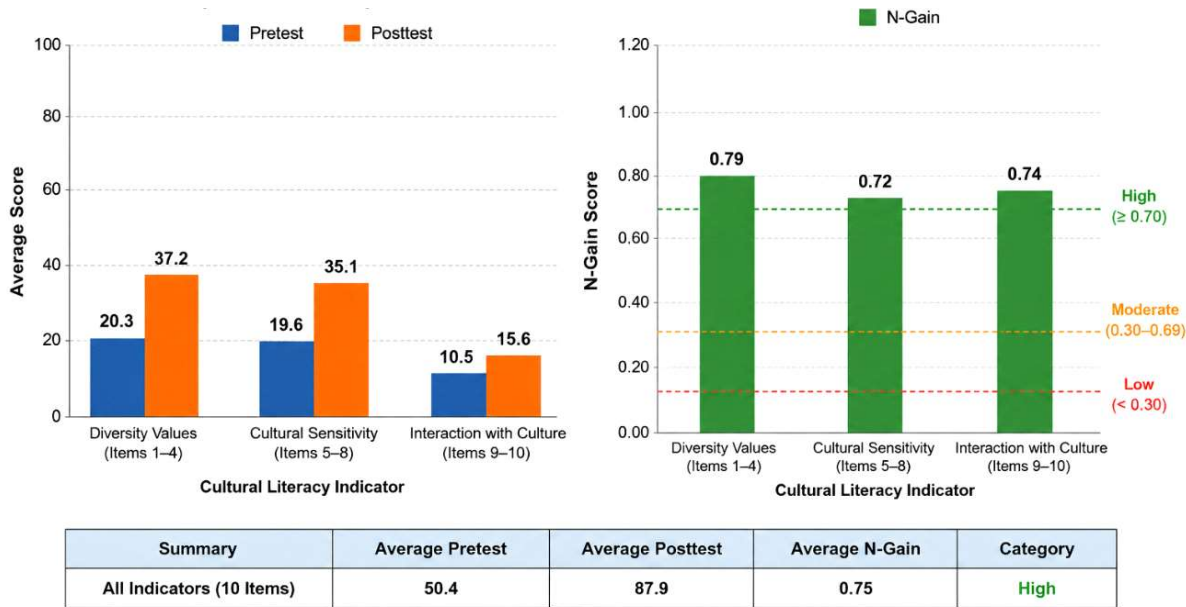


Figure 1. Comparison of pretest, posttest, and N-Gain scores for each cultural literacy indicator (n = 24 students)

students' understanding of cultural values within the IPAS subject, particularly on the topic of sound and its properties. This suggests that the success of implementing the RADEC model, integrated with local wisdom, lies not merely in introducing local culture but also in enabling students to meaningfully connect cultural practices with scientific concepts such as sound, natural phenomena, and traditional musical instruments. These findings are consistent with previous studies suggesting that the integration of local wisdom into science learning can create more contextualized and meaningful learning experiences, while also enhancing students' scientific literacy by facilitating connections between cultural knowledge and modern scientific concepts (Verawati & Wahyudi, 2024; Hikmah et al., 2024; Suwono et al., 2026). Furthermore, the ethnoscience approach in science education has been shown to strengthen cultural literacy, critical thinking, and student engagement by integrating local cultural contexts with scientific phenomena encountered in everyday life (Atmojo et al., 2025). These results

are consistent with the study "*Peningkatan Budaya Literasi Siswa melalui Implementasi Model Pembelajaran RADEC*" by Suryana and Sopandi (2022), which demonstrated that the RADEC model enhances students' literacy culture in elementary schools. Furthermore, international studies have confirmed the effectiveness of the RADEC model in fostering various 21st-century skills across diverse educational contexts. Firmansyah et al. (2023) found that the reading activities within the RADEC model significantly influenced elementary school students' comprehension skills, with 75% of students who engaged in reading activities achieving an average score of 80. In addition, Maspiroh et al. (2025) demonstrated that the RADEC learning model is significantly more effective at improving pre-service teachers' literacy than traditional instructional methods.

Students' collaborative skills

Data on students' collaborative skills were obtained using the Student Collaborative Skills Observation Sheet, which was administered

during the learning process. The instrument was developed based on five aspects of collaborative skills, namely positive interdependence, face-to-face interaction, personal accountability and responsibility, communication skills, and group working skills. The observation instrument consisted of 10 statement items using a four-point rating scale, namely 4 (very good) when the behavior was consistently demonstrated without reminders, 3 (good) when the behavior was frequently demonstrated but occasionally required reminders, 2 (fair) when the behavior was sometimes demonstrated but inconsistently, and 1 (poor) when the behavior was rarely or not demonstrated. Thus, the minimum possible score was 10, while the maximum possible score was 40.

Based on the observation results, before the implementation of the TiDayu local wisdom-based RADEC learning model, students' average collaborative skills were 56.25% (average score of 22.5), categorized as moderate collaboration. After implementing the TiDayu local wisdom-based RADEC learning model, the average collaborative skills increased to 95.99% (average score of 38.4), categorized as very high collaboration.

This improvement was evident from observations conducted during the discuss and create stages of the learning process. At these stages, students demonstrated more active participation in group discussions, were willing to ask questions and listen to their peers' opinions, exchanged ideas, shared responsibilities in completing tasks, distributed roles among group members, and completed the tasks in the Student Worksheet collaboratively. They were also able to communicate and work effectively with their group members throughout the learning activities. These findings indicate that implementing the TiDayu local-wisdom-based RADEC learning model significantly enhanced students' collaborative skills throughout the learning process.

Previous research that supports that RADEC or culturally responsive learning models can improve collaboration is research by Rambe et al. (2025); this study reported that RADEC was able to improve students' collaborative skills in the context of Islamic religious education with an increase in N-Gain of around 0.74 (H' 74%) (Rambe et al., 2025). Wulandari et al. (2025), in a study on English language learning, found that the RADEC model oriented toward the 6Cs—particularly the collaboration competency—demonstrated a large effect size among sixth-grade elementary school students. Furthermore, a systematic literature review conducted by Salim et al. (2026), synthesizing findings from 25 articles published between 2019 and 2025, confirmed that the Explain phase significantly supports the development of students' collaborative skills in primary education. Other support by Hikmawati et al. (2021) shows that learning that incorporates local culture is easier for students to internalize and helps them build cultural literacy and social skills, including collaboration (Hikmawati et al., 2021).

Although the RADEC Model for local wisdom in TiDayu, Singkawang city, is valid, practical, and effective, several aspects need revision, such as the language and terminology in some materials, which are still too technical and should be simplified to make them easier for elementary school students to understand. Furthermore, the supporting media (especially visual and audio content about local culture) need to be expanded to make the learning experience more realistic and engaging. Furthermore, more time should be allocated for the Create phase so students can produce more mature work.

■ CONCLUSION

The average validation results by learning model experts, science material experts, cultural experts, and practitioner experts (elementary school teachers) showed that the local wisdom-based RADEC model was in the Valid category

(84.6%). This means the developed model is suitable for use with minor revisions, particularly to improve syntax (language) and to provide supporting displays (audio/visual media).

A limited implementation trial showed that the RADEC (Read, Answer, Discuss, Explain, Create) syntax was well implemented, with an average implementation score of 83.2% (Practical category). The teacher response questionnaire showed 86% (Very Practical), and the student response was 82% (Practical), both supporting this, with an average practicality score of 83.6% (Practical category). This means that the local wisdom-based RADEC model is easy to understand and implement and is appropriate for the learning context in elementary schools, especially in science.

Evaluation through pretest-posttest activities on cultural literacy and observation of students' collaboration skills showed a significant increase in students' cultural literacy with an N-Gain score of 75%, and the students' collaborative skills increased from 56.25% (categorized as moderate collaboration) to 95.99% (categorized as very high collaboration). Thus, the implementation of the local wisdom-based RADEC model demonstrates its potential to improve students' science learning.

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