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Formative Assessment Practices Using a Culturally Responsive Teaching (CRT) Approach in the Context of Mie Des in Science Learning

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Abstract

This study aims to describe the implementation of formative assessment using the Culturally Responsive Teaching approach by integrating Mie Des as a local cultural context in science learning, and to examine students' responses to this practice. Using a descriptive qualitative design, data were collected through classroom observations, interviews, and documentation during three learning sessions on heat transfer. The results show that formative assessment was implemented through open-ended questions, reflections, group discussions, rapid and constructive feedback, using student worksheet, and the use of digital media. These activities helped students connect scientific ideas with their cultural experiences, increased their engagement, and strengthened their confidence in learning science. Students demonstrated active participation and emotional involvement, although some focused more on cultural aspects than scientific reasoning. The study concludes that integrating local culture into formative assessment can enhance scientific understanding, cultural awareness, and student engagement, while providing valuable feedback for designing responsive and contextually meaningful science learning.

How to Cite

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INTRODUCTION

Science education aims not only to enhance students' cognitive abilities but also to develop their skills and character. All of these competency components need to be developed simultaneously. To optimize competency development, teachers in science learning need to consider the characteristics of students' sociocultural backgrounds, ensuring that learning is contextual and meaningful (Jardim et al., 2021; Lai, 2023; McKoy & Lind, 2022; Sarkingobir & Bello, 2024). The learning approach that correlates lesson topics with local culture is known as the Culturally Responsive Teaching (CRT) approach.

CRT makes learning easier to understand and more meaningful by connecting it with students' life experiences and cultural backgrounds (Abdalla & Moussa, 2024; Hutchison & McAlister-Shields, 2020; Levine & Tamburrino, 2024; Tanase, 2020). CRT principles include recognizing cultural diversity, including cultural content in learning materials, building a caring learning community, and responding to diversity in communication (Abdalla & Moussa, 2024; Hutchison & McAlister-Shields, 2020).

The implementation of CRT is closely linked to the Sustainable Development Goals (SDGs). SDG 4, which focuses on education, emphasizes inclusive, equitable, and quality education. This aligns with CRT, which emphasizes respect for students' diverse sociocultural backgrounds to ensure equal educational opportunities. Through students' sociocultural contexts, teachers can design meaningful learning, thereby enhancing students' collaboration skills, self-confidence, and active participation in learning (Handayani et al., 2018; Rahmawati et al., 2020).

Student performance improvements can be identified through assessments, one of which is formative assessment. Formative assessment is an assessment conducted by teachers during the learning process to improve the quality of learning. It is continuous, responsive, provides constructive feedback, and actively involves students through reflection or peer review (I Dewa Ayu Made Meilani Pramesti, 2024; Prashanti & Ramnarayan, 2019). Formative assessment forms include group discussions, learning reflections, quizzes, presentations, and rapid feedback (I Dewa Ayu Made Meilani Pramesti, 2024; Ningsih et al., 2025; Prashanti & Ramnarayan, 2019; Sanchez-Lopez et al., 2023).

The problem that occurs in practicing formative assessment is that it is still general and not contextual to students' lives and does not reflect students' cultural diversity (Koirala, 2025; Rahman et al., 2021). In addition, teachers do not yet have the ability to develop formative assessments that are contextual and culturally responsive (Berisha et al., 2024; Szelei et al., 2020).

Based on observations at several schools in Bantul Regency, formative assessments have not integrated students' socio-cultural backgrounds and are limited to measuring cognitive abilities. Teachers at these schools have not yet linked local potential, such as Mie Des, a local specialty of Bantul Regency, to science topics. Mie Des's production has the potential to be integrated with heat transfer topics such as convection, radiation, and conduction. (Kotsis, 2024). In accordance with the findings of (Jiang et al., 2025) which states that teachers experience obstacles in providing assessments that take into account students' cultural backgrounds.

The results of previous studies indicate that formative assessments incorporating culture can enhance students' mastery of science, technology, critical thinking skills, inquiry skills, and self-regulated learning (Bellido-García et al., 2024; Lemley & Cho, 2023). Although formative assessment makes a very good contribution to learning, this research has not been widely conducted in Indonesia (Azizah et al., 2025; Silitonga et al., 2024). Existing research has largely examined the dominance of summative assessment, the barriers experienced by teachers, and the lack of training (Halim, 2021; Prastikawati et al., 2024). This gap needs to be resolved through further research to explore how to implement CRT-based formative assessments, such as utilizing Mie Des as a local cultural context in science learning.

There are three operational aspects in learning that implement CRT, namely cultural knowledge, connection to the lesson topic, and objective assessment (Gay, 2018; Nortvedt et al., 2020). These three aspects are demonstrated through formative assessment in learning activities such as discussions, observations, and reflections that connect local culture with science concepts. This means that culture-based formative assessments not only measure student abilities but also serve as instructional tools for teachers to be more reflective and responsive to student needs (Koirala, 2025; Nortvedt et al., 2020; Parmiti et al., 2021). So that with the existence of formative assessment, it can provide feedback to teachers and encourage students to reflect critically.

This study aims to describe how formative assessment is implemented using Mie Des as a

cultural context in science learning and to determine students' responses to this practice. This study is expected to develop knowledge about the contextualization of science through the local potential of Mie Des from Bantul and provide input in designing formative assessments in science learning that are relevant and culturally based.

METHOD

Descriptive qualitative research was used in this research design. Descriptive qualitative research details phenomena occurring in the field and asks individuals or groups of individuals to describe their lives and experiences (Zabrina et al., 2023). This research design is very appropriate, considering that not many people have researched it, so a deeper contextual understanding is needed (Kim et al., 2017; Zabrina et al., 2023). This descriptive qualitative research describes in detail the implementation of formative assessment and student responses within a culturally responsive learning context.

This study describes the practice of using CRT-based formative assessment in science learning and describes the results of interviews with people who agreed to be informants, consisting of two pre-service science teachers who teach the same science topic, one science teacher as a companion teacher, and ten students who functioned as triangulation sources. Qualitative research prioritizes depth and richness of data over the number of participants, so the sample size is considered adequate. Participants were selected through purposive sampling in the research.

Informants from the pre-service teachers were selected because they were currently practicing science learning and were obliged to implement formative assessments, and were directly involved in preparing the planning and implementation of learning using Mie Des as a cultural context. The companion teachers in this study were partners in learning activities who understood the characteristics of students, understood the Independent Curriculum, and conducted direct observations of the implementation of learning that integrated Mie Des as a science learning context. Student selection was based on the willingness and recommendations of teachers, reflects the diverse backgrounds of the students, facilitates analysis of the research material, ensures sufficient data diversity, and achieves data saturation.

This research was conducted at a school in Bantul Regency that implemented science instruction using Mi Des as its cultural context. To ensure a comprehensive understanding of the formative assessment process, the study was conducted over three science lessons on the topic of heat transfer. This research goes through the research implementation procedures described in Figure 1.

Figure 1. Research Implementation Procedure

During the preparation stage, the researcher identified and formulated the research focus based on the empirical problem, reviewed the literature, and developed a qualitative research design. The preparation stage also purposively determined the school locations and informants based on the research objectives. At this stage, coordination with the schools was conducted to convey the research objectives and procedures and to ensure the informants' willingness to participate in the study.

The next research procedure is that the researcher has determined the techniques and development of research instruments. The data collection techniques used included classroom observation, interviews with informants, and documentation to understand the events that occurred and demonstrate the informants' perspectives (Villamin et al., 2025; Zabrina et al., 2023). The use of different data collection techniques serves as technical triangulation. Using multiple data collection techniques, the results obtained will be more reliable. The instruments used were observation sheets to understand the implementation of formative assessment in science classes using the CRT approach, and interview sheets to describe informants' implementation of the assessment. Documentation was used to supplement the data, including lesson planning documents, assessment sheets, and student learning outcomes (Adlini et al., 2022). The research instruments that have been developed have been used in subsequent research procedures for data collection.

The next step was data analysis by redu-

cing, presenting, drawing conclusions, and verifying the data according to the Miles and Huberman model (Hisbullah Huda & Hanifah, 2023). Data collection and analysis were carried out simultaneously and interactively throughout the research process (Mezmir, 2020; Monaro et al., 2022). Data reduction is carried out to select and determine relevant data by coding, grouping, and focusing on data that aligns with the objectives (Anggraeni & Sole, 2022; Rijali, 2019).

Prior to coding, the data were transcribed into text form. All interviews with pre-service teachers, mentor teachers, and students were transcribed. Furthermore, observations during the lesson were written down in narrative form. During the coding stage, the researcher read all the data transcripts and coded words or sentences relevant to the research. The codes that emerged were open-ended questions, prompt feedback, constructive feedback, student reflections, and emotional engagement, conceptual understanding, use of digital media, integration and connection of local culture with coding examples in Table 1.

Table 1. Example of Coding Results

No	Example of interview data results	Coding
1	"Saya paham cara perpindahan kalor setelah melihat vidio pembuatan Mi Des"	Use of digital media, understanding concepts
2	"Saya memberikan umpan balik langsung setelah siswa merespon"	Quick feedback, constructive feedback
3	"Siswa lebih bisa berekspresi dan percaya diri ketika bercerita pengalamannya tentang Mie Des"	Increased self-confidence, connection to local culture

From several codes that emerged, they were then grouped into several themes and focused on the theme of culturally responsive formative assessment practices and student responses, as in Table 2. Data presentation is done by displaying data in the form of descriptive narratives or other visualizations to identify data patterns so that they are easy to interpret (Greene, 1989; Hayati et al., 2022). Meanwhile, analysis of the patterns of findings related to the theories related to formative assessment and CRT, and verification of the results were carried out in the conclusion-drawing and verification steps.

Table 2. Theme Grouping

Category	Coding	Category Meaning
Formative assessment practices	Open questions, group discussions, less in-depth reflection, quick feedback, responsive feedback, student worksheets as assessment	Formative assessment in the form of question-and-answer discussions, reflection and feedback
Student response	Conceptual understanding, increased self-confidence, emotional engagement	Student responses to learning are shown cognitively and non-cognitively

Conclusions were drawn based on the patterns and interpretation of the data obtained, not only at the end but also gradually through comparisons between informants and the consistency of interview and observation results. Verification was carried out by requesting clarification from pre-service teachers and accompanying teachers and re-checking the correspondence between quotations and the themes obtained.

RESULT AND DISCUSSION

The research results are written based on data analysis from interviews and observations, and documentation during the research. Starting from the learning planning tool in the form of a teaching module, it has been prepared with a complete structure including at least learning objectives, stages of learning activities, assessments, and learning media. The teaching module includes the CRT approach, as the approach used in learning. Writing the approach in the module becomes the basis for implementing learning that is visible in the learning stages. The CRT approach not only appears in the learning stages, but also appears in the learning objectives by mentioning Mi Des as the learning context for analyzing heat transfer events, as shown in Figure 2.

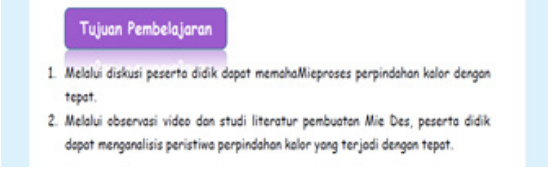

Figure 2. Research Objectives

Formative assessments that integrate the CRT approach are implemented through learning activities demonstrated in several ways, such as open-ended questions, individual student reflection, and group discussions. Open-ended questions serve to explore students' levels of understanding, encourage them to express their opinions, and analyze misconceptions about the material (Albertina Ayilimba et al., 2025; Dini et al., 2020; Furtak et al., 2016). Each student's reflection helps to determine the development of the student's ability level and increases the student's self-confidence (Granberg et al., 2021; Slingerland et al., 2024; Wilkinson, 2024). Discussion groups are used to exchange opinions between students, provide feedback between teachers and students and between students, and build students' collective abilities so that collaboration and communication skills can improve (Albertina Ayilimba et al., 2025; Dini et al., 2020; Slingerland et al., 2024).

When conducting formative assessments, teachers use student worksheets. Formative assessments and student worksheets are closely related. Simultaneous formative assessments allow teachers to track student progress and provide constructive reflection. Student worksheets can be used as a formative assessment instrument because they include assignments, practice tests, and activities to measure students' cognitive, psychomotor, and affective development (Berlian et al., 2023; Gusyanti & Sujarwo, 2021; Sinuraya & Frisnoiry, 2023). Through student worksheets, learning difficulties experienced by students can be identified so that teachers can provide guidance to students and design appropriate learning strategies (Ghaisani & Setyasto, 2023; Marlina et al., 2025; Rahmayani & Atmazaki, 2025).

At the beginning of the learning process, a picture of processed Mie Des on a plate was shown, and the pre-service teacher opened the questions with reflection questions.

"Apa yang kamu ketahui tentang Mie Des? Bagaimana cara memasaknya?".

Based on observations, students actively answered questions and shared their experiences in consuming and preparing Mi Des. These results are consistent with the following observation excerpt.

"sebagian besar siswa mengangkat tangannya dan menceritakan pengalamannya di dapur atau saat membeli Mi Des".

The findings indicate that open-ended questions are effective as an initial formative assessment strategy to help students identify their prior knowledge by correlating it with their culture. To confirm the correlation between culture and scientific concepts, pre-service teachers stated the following.

"Proses memasak Mie Des adalah contoh nyata perpindahan kalor, apakah kalian bisa menjelaskan mana bagian konduksi dan mana yang konveksi."

The next step is to show a documentary video of the Mie Des cooking process and online news from the Radar Jogja newspaper about the local culinary dish, Mie Des. This serves as a contextual learning medium, even without direct practice. Video and online media help make abstract concepts more tangible by depicting real-world situations, allowing students to better understand the process and cultural values of local culinary arts. (Ibnu Fitrianto & Muhammad Farisi, 2025; Noviana et al., 2023; Surgenor et al., 2021). Providing images, documentary videos, and online media about making Mie Des as a means of stimulating students. Showing videos during lessons can help students understand the material and make the learning process more enjoyable (Abdulrahaman et al., 2020; Mashudi et al., 2021).

The use of online media is essential for improving digital and scientific literacy. This is evident in students' ability to access digital tools to understand, acquire new knowledge, explain, and summarize science material in their lessons. Digital media integration can enhance students' ability to access, evaluate, and critically use information, which are competencies in the Merdeka curriculum (Andi Setiawan, 2024; Megawati & Sofiroh, 2025; Nurlaela, 2025).

After watching videos and reading online media that show the boiling process, steam formation, and heat transfer in cooking utensils, students can relate these concepts to the concept of heat transfer. Students discuss in groups to analyze the parts of the steps in cooking Mie Des that are related to heat through open-ended questions from the pre-service teacher, as seen in Figure 3.

Figure 3. Open Questions

In the next learning step, students collaboratively in their respective groups also discuss to find important words from the concept of heat transfer through puzzle media (Figure 4), define heat transfer, how heat moves, and describe the

part of how heat moves from the Mie Des processing process. After students have finished discussing, they take turns presenting the results of their group discussions in front of the class.

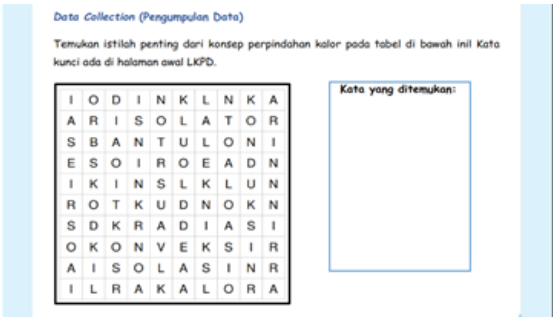

Figure 4. Heat Transfer Concept Puzzle

During the learning process, teachers provide direct feedback and constructive correction as part of formative assessment. Feedback is implemented effectively by asking students questions.

"Bagus, Kamu sudah bisa membedakan konduksi dan konveksi, tapi Apa yang terjadi pada udara di atas wajan?".

This feedback aligns with the characteristics of effective feedback: timely, specific, and process-oriented. Timely feedback encourages students to quickly correct errors and improve their understanding. Prompt and high-quality feedback is highly valued (Haughney et al., 2020; Morris et al., 2021). Specific feedback is not a general assessment but focuses on a particular aspect, providing concrete suggestions for improvement (Alkhiyami et al., 2024; Kutasi, 2023). Process-oriented rather than end result-oriented, with a focus on the strategies used by students during the learning process (Carless, 2022; Fuentes-Cimma et al., 2024; Yang et al., 2021).

Pre-service teachers responded positively by showing appreciation for each student's response regarding their experiences and family traditions in consuming and preparing Mie Des, regardless of their social background. Respect for students' backgrounds has both cognitive and non-cognitive impacts. Respecting students' cultural backgrounds increases motivation, engagement in learning, and academic achievement (Caingcoy, 2023; Kabylov et al., 2024). In learning that integrates culture, it will foster social awareness, a sense of nationalism, and greater pride in local identity (Caingcoy, 2023; Kabylov et al., 2024) and foster solidarity among students, psychological protection, and resilience to challenges (Guan et al., 2023).

During the learning process, students showed excellent responses. They enthusiastically watched the videos, actively participated in group discussions, and shared their experiences related to Mie Des. Students also enthusiastically responded to feedback provided by the teacher. These observations indicate that students were emotionally engaged. This emotional and cognitive engagement is one indicator that the CRT approach has been successfully implemented in learning. CRT not only improves cognitive abilities but also emotional feelings such as motivation, belonging, and student comfort (Anyichie et al., 2023; Kong et al., 2022; Yeh et al., 2021; Zhou & Hassan, 2024). Teachers who are able to implement CRT comprehensively will improve the social, emotional, cognitive, motivational, and participation development of students (Zhou & Hassan, 2024). The engagement between cognitive and emotional is very important in cross-cultural learning and is the foundation of positive relationships between teachers and students, and between students (Abacioglu et al., 2020; Ragoonaden & Mueller, 2017).

The accompanying teacher stated that students' self-confidence increased because the science material they were learning was closely related to their lives. Not only did this increase in confidence, but so did their higher-order abilities. Students' abilities to analyze, evaluate, and solve problems improved because the material they were learning connected to their own experiences (Haryanto & Arty, 2019; Semilarski et al., 2019). Personally meaningful learning design is a key support in increasing self-confidence in implementing science in everyday life (Haryanto & Arty, 2019).

In the final learning step, students are asked to draw conclusions based on the previous activities. Summarizing activities in learning are part of formative assessment. In this process, the accompanying teacher expressed the opinion that drawing scientific conclusions should be prioritized over simply recounting the process, thereby improving students' ability to evaluate learning. Effective formative assessment not only measures narratives but also the ability to analyze data, connect concepts, and draw conclusions (Ganajová et al., 2021; Zulyusri et al., 2023).

Implementing formative assessment using the Mie Des context faced challenges. These challenges included limited learning time, which prevented everyone from reflecting deeply on their experiences, as exemplified by the following teacher's statement.

"Refleksi sudah dilaksanakan, namun karena keterbatasan waktu, tidak dibahas satu persatu".

Furthermore, students tend to focus on cultural narratives rather than scientific ones. While the formative assessment rubric has received input from the supervising teacher, the lack of empirical validation also presents a challenge. The pre-service teacher plans to discuss follow-up plans with the supervising teacher to help students develop more critical and systematic scientific thinking.

In general, the practice of formative assessment using the CRT approach through digital media has developed culturally based scientific literacy, increased students' reflection on their identity, and supported collaboration between pre-service teachers and accompanying teachers. This study shows that the application of formative assessment using Culturally esponsive Teaching (CRT) methods can optimize the potential of regions such as Mie Des, make learning more meaningful, and better tailor teaching materials to students' needs (Anyichie et al., 2023; Mustafa et al., 2025). By integrating elements of local culture into formative assessment, teachers can better understand student learning progress while encouraging active student participation (Mentari & Rosdianah, 2025; Saputri & Desstya, 2023). This indicates that formative assessment should not rely solely on standard measures, but rather be adapted to local strengths in order to meet contemporary educational demands that promote comprehensive and culturally sensitive learning.

CONCLUSION

The practice of formative assessment based on the CRT approach, with Mie Des as a local context, through several methods, namely the use of open-ended questions, reflection, collaborative student discussions in groups using student worksheets, and rapid and constructive feedback. Learning is assisted by documentary media and online mass media. This method can explore students' initial abilities, monitor the development of student understanding, and help students correct student misconceptions directly. Despite the challenges of time constraints and students' tendencies towards cultural narratives, the results of the study effectively increased students' understanding of heat transfer, student engagement in learning, self-confidence, and high-level skills. Future research can explore empirically validated formative assessment rubrics so that scientific reasoning will be more critical and systematic in the context of a culturally appropriate learning environment.

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