



Values, Context, and Culture: The Implementation of Culturally Responsive Teaching (CRT) for Innovation in Elementary School Mathematics Teaching Materials

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Abstract: This community service program aims to improve the competence of elementary school teachers under the Bantul Education Office in implementing Culturally Responsive Teaching (CRT) in mathematics through training, mentoring, and the development of culture-based teaching materials to foster inclusive, engaging, and contextually relevant learning environments. The program was conducted through workshops and hands-on practice, during which teachers were trained to develop teaching modules, lesson plans, instructional media, and assessment instruments that integrate educational values, everyday contexts, and local cultural elements. Program evaluation was conducted using observations, interviews, questionnaires, and documentation, and the data were analyzed through descriptive statistics and thematic analysis to examine participants' engagement, understanding, and feedback. The evaluation results indicated that the integration of educational values received the highest average score (4.71), followed by contextual relevance (4.58) and the incorporation of cultural artifacts (4.22). Although teachers demonstrated a high level of consistency in implementing CRT principles, integrating local culture into mathematics instruction remained a major challenge. The greatest barrier identified was the limited availability of contextual and digital teaching materials, with an average difficulty score of 3.28. Nevertheless, teachers demonstrated a strong awareness of and perceived need for CRT in mathematics education, reflected in a high average score of 5.16. These findings suggest that Culturally Responsive Teaching extends beyond a pedagogical approach by providing a transformative framework that connects mathematics learning with students' lived experiences while preserving local cultural heritage. Continuous mentoring and the development of context-based digital teaching resources are therefore essential to support the sustainable implementation of CRT in elementary schools.

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Introduction

Culturally Responsive Teaching (CRT) is a pedagogical approach that integrates students' cultural contexts into learning to create more inclusive and relevant classrooms. In elementary school mathematics, the application of CRT is expected to enhance student engagement and academic outcomes (Li & Lv, 2022), especially in regions with cultural diversity, such as Bantul, Yogyakarta. Research on the state of the art in CRT indicates that this approach not only improves academic results but also helps students feel more connected to the material being taught. Studies by (Gay, 2002) highlight that CRT can motivate students



by linking learning to their own experiences and cultural backgrounds (Hodgson et al., 2023). Culturally responsive teaching methods can significantly increase student engagement in learning (Agupusi, 2019). One innovation in CRT implementation is the use of technology in teaching. For instance, using digital platforms to deliver content relevant to students' cultural contexts aligns with the development of educational technology, enabling teachers to access resources that support CRT implementation (O'Connor et al., 2024).

In mathematics education, CRT connects concepts to local culture through real-life examples and cultural practices. Teaching with students' cultural contexts can enhance their understanding of mathematical concepts (Feston et al., 2020). However, challenges remain in implementing CRT, notably the lack of understanding and skills among teachers. Many teachers have not been trained in CRT, and thus struggle to integrate students' cultural contexts into their lessons (Nyassi et al., 2023). Ongoing professional development is essential to strengthen teachers' ability to apply CRT in mathematics, making learning more relevant and engaging through cultural contexts and technology.

CRT is a pedagogical approach that integrates students' cultural contexts into the learning process. In elementary school mathematics education, CRT can be implemented in a systematic way. Teachers must understand students' cultural backgrounds, including their values, traditions, and experiences. This can be achieved through surveys or initial discussions with students and parents (Andriani & Wahyudi, 2023). The curriculum should be designed with students' cultural contexts in mind. For example, using real-life examples in teaching mathematics, such as measurements in local handicrafts or patterns in traditional art (Puspitasari & Airlanda, 2021).

The implementation of CRT also incorporates Realistic Mathematics Education (PMR), which links mathematical concepts to real-life situations students encounter. This helps students understand the relevance of mathematics in everyday life (Saleh et al., 2017). Activities are designed to encourage students to work in groups and discuss the mathematical problems they face. This not only enhances problem-solving skills but also strengthens social relationships among students. Integrating cultural values into mathematics transforms abstract content into meaningful learning, making it more inclusive, relevant, and engaging in diverse contexts like Indonesia.

In Kabupaten Bantul, Yogyakarta, a key educational challenge lies in teachers' limited competence in implementing Culturally Responsive Teaching (CRT), particularly in integrating local cultural values into classroom practices. Although the region is culturally diverse, only around 30% of teachers report confidence in embedding local context into their teaching (McKoy et al., 2017). This problem is further compounded by a lack of understanding of how to integrate local cultural values into the curriculum. At the partner school, observations and interviews reveal that teachers face challenges in both lesson planning and instructional media, particularly in applying Culturally Responsive Teaching (CRT). Lesson plans remain standardized with minimal integration of local cultural values, and classroom activities are largely textbook-centered. Instructional media are also limited, relying mostly on basic printed materials without cultural adaptation. Teachers report difficulties in translating CRT into practical teaching components, along with constraints in time, resources, and technical skills.

This gap in teachers' knowledge and skills in implementing CRT creates a learning environment that is less inclusive. Limited teacher competence in CRT and lack of culturally relevant resources create disengaging classrooms, undermining inclusion and negatively impacting students' academic and emotional outcomes. Studies have shown that teachers



often lack access to these essential tools, which are critical in embedding local cultural contexts into their teaching practices (Herman et al., 2023). Despite strong institutional commitment, limited CRT training and resources leave teachers unable to create inclusive classrooms, directly reinforcing educational inequities and disadvantaging students from marginalized cultural backgrounds.

Integrating CRT into elementary mathematics offers a powerful solution to improve engagement, motivation, and achievement. By linking concepts to students' cultural contexts such as through ethnomathematics and local cultural practices learning becomes more meaningful and impactful. This approach allows students to see the practical relevance of mathematics in their own cultural context, bridging the gap between abstract concepts and their lived experiences (Douglas, 2020; Nurhayati & Judijanto, 2025). In this way, CRT not only improves academic outcomes but also fosters inclusivity by validating the diverse cultural experiences of students. However, major barriers persist, particularly limited teacher preparedness and inadequate resources, which hinder effective CRT implementation especially in rural schools. These challenges include limited access to digital tools, professional development programs, and teaching materials that support CRT practices (Fatra et al., 2025; Nisa et al., 2025).

As such, there is an urgent need for targeted professional development programs that focus on building teachers' cultural competence. Many community service programs on Culturally Responsive Teaching (CRT) tend to emphasize conceptual understanding through seminars or short-term training, often with limited follow-up and minimal connection to teachers' real classroom contexts. In contrast, this program is distinguished by its integrated, practice-oriented, and context-specific design. It actively engages teachers in developing and implementing ethnomathematics-based lesson plans rooted in Bantul's local culture, not merely understanding CRT in theory. Furthermore, the program adopts a participatory model where teachers are involved from planning to evaluation and is reinforced through continuous mentoring and classroom implementation support. This ensures that CRT is not only learned but also translated into sustainable teaching practices, making the program more practical, relevant, and impactful than conventional approaches.

In response to these challenges, the goal of this community service initiative is to enhance the competence of teachers in Dinas Pendidikan Bantul in applying CRT within elementary school mathematics (Carlos Torrego-Seijo et al., 2021; Hendriana et al., 2025; Payadnya et al., 2025). This program equips teachers with practical tools and resources to integrate local cultural values into mathematics teaching, fostering more inclusive and engaging classrooms. By applying CRT, it aims to enhance student engagement, improve academic outcomes, and strengthen teacher student relationships. However, its success depends on addressing key challenges such as limited teacher training, resource constraints, and urban-rural disparities. Therefore, sustained professional development, supportive policies, and culturally grounded materials are essential to realizing equitable and high-quality mathematics education in Indonesia.

Method

The method of this community service program adopts the Participatory Training model (Kuzmin, 2012), which is selected for its focus on active participant involvement throughout all stages of the process, including planning, implementation, and evaluation. This approach is designed to enhance teachers' competencies in developing teaching materials by



integrating local cultural values into the learning process. Participatory methods are widely recognized for promoting collaboration, reflection, and the active involvement of participants.

The participants consisted of 29 elementary school teachers representing 29 schools within the Kapanewon Kretek cluster (Teacher Working Group) in Bantul, covering Grades 1 to 6 with a relatively balanced distribution. All teachers held at least a Bachelor's degree (S1) in Primary School Education (PGSD), with several having completed a Master's degree (S2) in the same field. The teachers who participated had an undergraduate degree in Elementary School Teacher Education (S1 PGSD), with teaching experience ranging from 0-5 years to over 15 years. The program was conducted in two main training sessions, followed by intensive mentoring, where experts provided direct assistance in developing culturally responsive teaching products.

The training is structured to combine theory and practice, allocating 30% for theoretical instruction and 70% for practical exercises. Theoretical sessions aim to provide participants with essential knowledge about teaching competencies and material development. These sessions are followed by discussions to deepen understanding, encourage sharing of experiences, and clarify key concepts. The guided practice component allows teachers to use their laptops to develop teaching materials, offering direct support and feedback from the facilitators. This hands-on approach encourages active learning and the immediate application of new knowledge. Throughout the training, question-and-answer sessions are held to ensure clarity and foster a deeper engagement with the material. In addition to the training itself, follow-up mentoring is provided through individual communication or small group discussions to support ongoing development and the application of Culturally Responsive Teaching (CRT) principles in teachers' classrooms.

Evaluation is a critical part of the training methodology. Evaluation techniques include observations, interviews, questionnaires, and documentation to assess the participants' engagement, understanding, and satisfaction. This feedback is essential for refining and improving future training sessions. Data analysis was conducted using a combination of descriptive quantitative and qualitative techniques. Quantitative data from questionnaires were analyzed by calculating mean scores, minimum and maximum values, and response distributions for each indicator (educational values, contextual learning, cultural artifacts, difficulties, and needs/perceptions). The scores were then interpreted using Likert scale criteria to determine the level of teacher responses (e.g., low, moderate, high). In addition, variability in responses was examined to identify disparities in teachers' experiences and capacities. Qualitative data obtained from observations, interviews, and documentation were analyzed using thematic analysis, involving data reduction, coding, categorization, and interpretation to identify recurring patterns related to teacher engagement, challenges, and instructional practices. Triangulation across multiple data sources (questionnaires, observations, and interviews) was employed to enhance the credibility and trustworthiness of the findings. This integrated analysis approach ensures a comprehensive evaluation of both the effectiveness of the training program and its practical impact on teachers' competencies.

Result and Discussion

The implementation of the Culturally Responsive Teaching (CRT)-based Elementary School Mathematics Training Program for teachers at the Bantul Education Office was carried out in several systematic stages. Each stage was designed to equip teachers with knowledge, skills, and tangible outcomes in the form of culturally based teaching modules. The training program received highly positive feedback from the participating teachers. All



participants were classroom teachers with educator certification, making the training relevant to supporting their professional development. From the school context perspective, most teachers stated that their school environments were culturally, ethnically, and religiously diverse, making the CRT approach in mathematics education seen as important.

1) Workshop Activity

The initial phase of the activity was held on May 15, 2025, at the Bantul Education Office Hall. The material was delivered using an interactive approach, where teachers were encouraged to reflect on their teaching practices and discuss how local culture could be used as a source for teaching mathematics. After the lecture, an initial mentoring session took place. Teachers were divided into small groups based on their districts and were guided by the community service team to begin designing the framework for the teaching modules. Each group was asked to select a theme from Bantul's local culture (such as batik, traditional markets, traditional games, and family economic activities) to be used as the context for teaching mathematics.



Figure 1. Workshop Implementation

At this stage, a pre-test was also conducted to measure the teachers' initial understanding of the CRT concepts. The results of the pre-test indicated that most teachers still tended to use conventional approaches, where mathematics instruction was not often linked to local culture. This data then served as a baseline for the subsequent mentoring process.

2) Implementation in Schools

As a follow-up to the workshop, the implementation of Culturally Responsive Teaching (CRT)-based teaching materials was carried out at several partner elementary schools from August 10–25, 2025. This implementation was done in three stages: planning, classroom execution, and evaluation and reflection. In the planning stage, teachers who participated in the training developed their Lesson Plans by integrating local culture into the mathematics content. For example, the concept of fractions was practiced using the context of dividing traditional Bantul food, while the concept of flat shapes was explained using local batik patterns. This approach not only made the material more contextual but also fostered students' pride in their regional culture.

Next, during the classroom implementation stage, teachers began to use the teaching materials they had developed in their mathematics lessons. The community service team was present at the schools to observe and aid. The observation results showed that students appeared more engaged in the learning process. They found it easier to understand the material because it was linked to their everyday experiences and showed high enthusiasm when local culture was used as an example. At times, students even shared personal experiences related to the local culture used as a learning medium. This demonstrated that CRT could provide more meaningful and enjoyable learning experiences.



3) Review and Mentoring of Modules

The second stage took place on June 16, 2025, with a focus on reviewing and strengthening the teaching module products. During this stage, each teacher group presented the teaching module they had developed since the first meeting. These modules included Lesson Plans, teaching materials, and examples of contextual problems based on local culture. The review process was conducted in a collaborative atmosphere. The community service team provided feedback in turn. The aspects reviewed included: 1) the connection between cultural context and mathematics content; 2) the clarity of teaching steps; 3) the creativity of culture-based questions; 4) the potential for implementation in real classroom settings.



Figure 2. Review and Mentoring

The teachers appeared enthusiastic about receiving feedback and made immediate improvements to the modules they had developed. This process showed an increase in the teachers' skills in linking abstract mathematical concepts with students' real-life experiences in their environment. Teachers were given the opportunity to explain their ideas, strategies, and examples of how they applied the modules they had developed. Presentations were made in turn, followed by a Q&A session from other participants, creating a collaborative learning forum. The community service team then assessed the presented modules based on the following criteria: 1) Alignment with the principles of Culturally Responsive Teaching; 2) Creativity in utilizing local culture as a learning resource; 3) Clarity of the teaching material structure; 4) Feasibility of implementation in classroom teaching.

The evaluation results showed that most groups were able to produce innovative modules, although some groups still needed to deepen the cultural-based question variations. Teachers stated that this process provided valuable learning experiences, as they not only gained knowledge but also produced tangible outcomes that were ready for implementation. Based on the results from the survey conducted among the respondents, teachers generally showed a positive tendency toward implementing culturally based mathematics teaching. A detailed breakdown of the teacher survey results is presented in the table below:

Table 1. Teacher Survey Results

Indicator	Number of Items	Average Score	Min	Max	N Respondents
Educational Values	7	4.71	1	6	29
Contextual	7	4.58	3	6	29
Cultural Artifacts	6	4.22	3	6	29



Difficulties	4	3.28	1	6	29
Needs/Perceptions	8	5.16	3	6	29

The findings show that teachers are relatively consistent in integrating educational values into their mathematics teaching, with an average score of 4.71. This reflects a positive trend that educational values are being considered in the development of modules, lesson plans, media, and even evaluations, although a small number of respondents (evidenced by the minimum score of 1) have not yet fully integrated these values. The contextual indicator, with an average score of 4.58, shows that teachers recognize the importance of connecting mathematics content with students' everyday lives. However, the variation in minimum scores (3) suggests that the application of contextual learning is not yet evenly distributed among teachers.

The cultural artifacts indicator had an average score of 4.22, the lowest among the three implementation indicators, indicating that the integration of mathematics with local cultural artifacts is still not widespread. In practice, teachers struggle not because cultural resources are absent, but because they lack concrete pedagogical models, ready-to-use materials, and sufficient training to transform cultural practices such as batik patterns or traditional markets into structured mathematical concepts aligned with the curriculum. Teachers do not lack access to local culture, rather they lack the instructional infrastructure to convert it into curriculum-aligned mathematical tasks. This challenge is compounded by a strong reliance on textbook-driven teaching and limited institutional support for innovative approaches. As highlighted in recent studies (Hasmalawati et al., 2026; Kapile et al., 2026), teachers often find it difficult to identify and operationalize the mathematical value embedded in cultural contexts without sustained mentoring and collaborative support, leading to uneven implementation despite high awareness of its importance. Taken together, these findings suggest that the issue is not conceptual acceptance of CRT, but the lack of sustained, practice-oriented support systems that enable teachers to operationalize cultural artifacts into rigorous and teachable mathematics.

Teachers seem to need support in the form of teaching materials and concrete examples to facilitate the integration of cultural aspects into the lessons. The difficulties indicator, with an average score of 3.28, further highlights that teachers face significant challenges, especially in finding culturally based, contextual teaching materials. The wide range of scores from 1 to 6 reflects differences in experience, creativity, and school support, suggesting the need for systematic training and the sharing of best practices among teachers to minimize these obstacles (Saadah et al., 2026).

The most noteworthy finding is the needs or perceptions indicator, which received the highest average score. This indicates that teachers have a strong awareness of the importance of linking mathematics teaching with local culture, students' life contexts, and its role in shaping character and preserving culture. Furthermore, teachers highlighted the importance of digital learning resources, e-books, and culturally based materials to support inclusive teaching. This suggests that teachers are ready to adapt to technological advancements while preserving the cultural relevance of their teaching.

Integrating educational values into mathematics teaching has gained significant attention in recent research, particularly through frameworks such as (Prahmana, 2022; Wildfeuer, 2022) ethnomathematics, as well as the use of cultural artifacts. Studies have emphasized that teacher competency in applying these approaches requires continuous professional development. For example, NCTM guidelines suggest that effective teaching practices must be actively implemented to improve teachers' skills, with professional



development programs focusing on equity and high expectations for all students (Awaji et al., 2025). In the context of ethnomathematics, teachers in developing countries face challenges due to the lack of structured guidance on how to integrate local cultural elements into their lessons. However, frameworks like ADDIE can help teachers strategically incorporate cultural artifacts, enhancing their teaching practices (Kabuye Batiibwe, 2024).

Additionally, research has highlighted the need for tools to assess teachers' understanding of values like equity, relevance, and creativity in their teaching practices, leading to the development of the Values Assessment in Mathematics Education (VAME) (Govindaraj & Pa, 2014). Regarding student engagement, studies have shown that using cultural artifacts such as Javanese Batik in lessons connects mathematical concepts to students' cultural values like discipline and harmony, which enhances both student engagement and the relevance of mathematics (Khasanah et al., 2025). The Ethno-Realistic Mathematics Education (E-RME) approach, which combines D'Ambrosio's ethnomathematics and Freudenthal's Realistic Mathematics Education (RME), also fosters student engagement by integrating socio-cultural values into learning, while also improving students' character and ethical understanding (Prahmana, 2022). Moreover, culturally responsive pedagogy that incorporates ethnomathematics and culturally relevant teaching methods has been found to reduce math anxiety and improve student achievement by making mathematics more meaningful (Wildfeuer, 2022).

In terms of curriculum development, embedding values like social justice, equity, and cultural relevance into the curriculum is crucial. For instance, socio-critical modeling tasks have been used to emphasize values such as altruism and social welfare, guiding the design of inclusive and meaningful curricula (Dede et al., 2021). The integration of cultural elements such as traditional textiles and games in the curriculum also enhances the relatability of mathematics, particularly in developing nations (Kabuye Batiibwe, 2024). The NCTM's emphasis on high expectations and equity aligns with the need for curricula that address diverse cultural and educational values, ultimately making mathematics education more inclusive for all students. Collectively, these findings underscore the transformative potential of integrating educational values into mathematics teaching, benefiting both teachers and students while shaping a culturally responsive and inclusive curriculum.

Meanwhile, the difficulties indicator, with an average score of 3.28, highlights that teachers face real challenges in implementation. These difficulties are not only related to a lack of culturally based learning resources but also stem from differences in experience, creativity, and school support. The wide range of scores, from 1 to 6, reflects these variations. This condition suggests that systematic training and sharing of best practices among teachers are necessary to minimize obstacles.

The most interesting finding is the needs or perceptions indicator, which received the highest average score of 5.16. This emphasizes that teachers are highly aware of the importance of integrating mathematics with real-life contexts and local culture. The need for digital learning resources, e-books, and culturally based teaching materials indicates that teachers are ready to adapt to technological advances while maintaining cultural relevance in their teaching. Therefore, the development of digital ethnomathematics-based teaching materials could be a strategic solution to meet teachers' needs and improve the quality of teaching (Zhiyenbayeva et al., 2026).

The implementation of this community service activity can generally be considered successful and aligned with the initial plan. The activity began with careful planning, including identifying the participants' needs, preparing materials, and mapping the necessary



resources. During implementation, participants showed high enthusiasm, which was reflected in near-full attendance, active participation in Q&A sessions, and involvement in practice sessions for developing teaching materials. Observations and group reflections showed that participants not only understood the theory but were also able to apply it in the form of contextual teaching material designs. For example, most teachers successfully integrated local culture into mathematics materials, either in contextual problems or relevant learning media (Nurhayati & Judijanto, 2025; Payadnya et al., 2025). This is in line with the survey results, which showed that more than 80% of participants found the activity very beneficial and immediately applicable in their classrooms.

Additionally, another indicator of success was the improvement in teachers' skills in developing creative teaching materials that align with students' characteristics. Before the activity, many teachers expressed difficulty finding local culture-based teaching materials, but after the training, most were able to produce teaching materials that connected mathematical concepts with students' everyday lives and surrounding environments. From the perspective of sustainability, participants also showed a commitment to applying the results of the training in their respective schools. Some teachers even suggested forming working groups or learning communities as a platform for sharing experiences after the activity. This shows that the community service activity not only provided short-term benefits but also has the potential to create a long-term impact on the improvement of teaching quality in schools.

Conclusion

The community service program was successfully implemented and achieved its planned objectives, as reflected in both qualitative observations and quantitative findings. The participating elementary school teachers demonstrated high enthusiasm and active engagement throughout all stages of the program. Survey results show that teachers had a very positive perception of culturally responsive mathematics teaching (average score 5.16), supported by strong integration of educational values (4.71) and contextual approaches (4.58). Participants reported that the training was highly beneficial, relevant to their professional needs, and directly applicable in classroom practice. These outcomes indicate that the program effectively enhanced teachers' knowledge and skills in designing contextual and culturally based mathematics teaching materials.

However, the findings also reveal several challenges that need to be addressed. The relatively lower score on the cultural artifact's indicator (4.22) and the moderate level of difficulties (3.28) suggest that teachers still face constraints in translating local culture into structured mathematical learning. These challenges are further compounded by limited time, variations in teachers' competencies, and restricted access to technology for developing digital teaching materials. Therefore, while the program can be considered successful in improving teacher competencies and readiness, future initiatives should focus on providing sustained mentoring, practical resources, and technological support to ensure more effective and consistent implementation of culturally responsive teaching in schools.

Recommendation

Based on the empirical findings and reflections from this program, several key recommendations can strengthen its sustainability and impact. The CRT-based training should be expanded and adapted to local contexts, while prioritizing the development of culturally responsive teaching materials through collaboration with experts and local communities. Stronger partnerships between schools, parents, and communities are also



essential to support meaningful implementation. In addition, adequate facilities and digital resources need to be provided to enhance training and instructional practices. Finally, the program should be systematically documented, replicated in similar contexts, and supported by continuous monitoring and evaluation to ensure its effectiveness and long-term improvement.

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