

Culturally Responsive Teaching Approach to Improve Science Material Mastery in Elementary School Students: A Systematic Literature Review

Fatia Nur Azizah, Sarwanto, Roemintoyo

Universitas Sebelas Maret
fatianur58@student.uns.ac.id

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Abstract

This study aims to explore the culturally responsive teaching (CRT) approach in improving the mastery of science material in elementary school students. The purpose of this study is to analyze how the application of CRT can help overcome the low mastery of science concepts by connecting learning materials with culture, local wisdom, and students' environment. In addition, this study identifies the impact of the application of CRT in increasing students' active involvement and understanding of science materials. This study uses a qualitative method through a systematic literature review with analysis based on Preferred Reporting Items for Systematic Review. Data were collected from various literatures that discuss the application of CRT in science learning. The results of the study indicate that the application of CRT effectively improves the understanding of science concepts by making learning more relevant and contextual for students. The integration of local culture in learning allows students to more easily understand the material and relate it to everyday life. In addition, this approach encourages students' active understanding and participation through recognition of their cultural context. By connecting science concepts with students' cultural contexts, this approach also increases motivation and interest in learning, making learning more meaningful and effective.

Keywords: *Culturally Responsive Teaching; Science Mastery; Students; Elementary School*

Abstrak

Penelitian ini bertujuan untuk mengeksplorasi pendekatan *culturally responsive teaching* (CRT) dalam meningkatkan penguasaan materi sains pada siswa sekolah dasar. Tujuan penelitian ini adalah menganalisis bagaimana penerapan CRT dapat membantu mengatasi rendahnya penguasaan konsep IPA dengan menghubungkan materi pembelajaran dengan budaya, kearifan lokal, dan lingkungan siswa. Selain itu, penelitian ini mengidentifikasi dampak penerapan CRT dalam meningkatkan keterlibatan aktif dan pemahaman siswa terhadap materi sains. Penelitian ini menggunakan metode kualitatif melalui tinjauan literatur sistematis dengan analisis berdasarkan *Preferred Reporting Items for Systematic Review*. Data dikumpulkan dari berbagai literatur yang membahas penerapan CRT dalam pembelajaran IPA. Hasil penelitian menunjukkan bahwa penerapan CRT efektif meningkatkan pemahaman konsep sains dengan menjadikan pembelajaran lebih relevan dan kontekstual bagi siswa. Integrasi budaya lokal dalam pembelajaran memungkinkan siswa lebih mudah memahami materi dan menghubungkannya dengan kehidupan sehari-hari. Selain itu, pendekatan ini mendorong pemahaman dan partisipasi aktif siswa melalui pengakuan terhadap konteks budaya mereka. Dengan menghubungkan konsep sains dengan konteks budaya siswa, pendekatan ini juga meningkatkan motivasi dan minat belajar, sehingga pembelajaran menjadi lebih bermakna dan efektif.

Kata kunci: *Culturally Responsive Teaching, Penguasaan IPA, Siswa, Sekolah Dasar*



INTRODUCTION

The Merdeka Curriculum in Indonesia emerged as a response to the demands of 21st century education which emphasizes the importance of the relevance of teaching materials to student needs. The Merdeka Curriculum is an educational innovation that responds to changing times in the Society 5.0 era by preparing students with 21st century skills (Lestari dkk., 2023). In this context, education focuses not only on mastering academic knowledge, but also on developing the critical skills, creativity and collaboration needed to face global challenges (Wulandah dkk., 2023). With the increasing diversity of cultures and student backgrounds in the classroom, student-centered learning approaches are becoming increasingly important. This aims to overcome the learning loss that occurred during the COVID-19 pandemic while meeting the growing needs of society (Salma & Yuli, 2023).

Culturally responsive education is becoming increasingly important in the current educational context, especially in efforts to increase mastery of science material among elementary school students. A culturally responsive curriculum not only helps students relate course material to their life experiences, but also increases student engagement and motivation to learn (J. . Brown, 2021). Integrating cultural elements into learning is a very effective approach to improving students' understanding of science material. In this way, students not only learn scientific concepts, but can also relate this knowledge to their everyday experiences and cultural context. This is important because the relevance of lesson material to real life can increase student motivation and involvement in the learning process (Kurniawan dkk., 2024).

However, a big challenge still exists, namely the low mastery of science material among students. Many students from diverse cultural backgrounds have difficulty understanding science concepts due to a lack of connection between the material taught and their cultural context (Bender, 2021). The low level of mastery of scientific material can be seen from the latest data from PISA which shows that scientific literacy in Indonesia is still at a low level. Based on the OECD report, in PISA 2022, Indonesia's average score for scientific literacy was 383, far below the global average of 485. Additionally, around 66% of Indonesian students do not reach a basic level of understanding in science, namely level 2 or lower (OECD, 2024). The report also notes that only 40% of Indonesian students achieve level 2 or higher in science, while the percentage of students achieving level 5 or 6 (which indicates high ability) is very small. This indicates a serious challenge in science education in Indonesia, where many students are unable to apply their science knowledge in real situations (Kemendikbudristek, 2023). Additionally, the impact of the COVID-19 pandemic has exacerbated this situation by causing significant learning loss, necessitating more innovative and inclusive teaching approaches (Education Week, 2022). A culturally responsive teaching approach can provide opportunities for students to be actively involved and develop critical thinking skills and independence in learning.

The Culturally Responsive Teaching (CRT) approach emphasizes the importance of understanding and respecting students' cultural diversity. Teachers need to recognize different cultural values, norms and practices among students, so as to create a learning environment that is inclusive and relevant for all students (Gloria Ladson-Billings, 1995). In addition, the curriculum taught must reflect students' cultural diversity, by linking learning content to their cultural experiences. This allows students to feel more connected to the material being taught, increasing their motivation and engagement in the learning process (Gay, 2018).

Remembering that science is often considered a challenging subject for students. By applying the CRT approach, this research aims to explore the application of a culturally responsive teaching approach as a strategy to improve mastery of science material among elementary school students. This is very important because mastering

science not only has an impact on students' academic achievements, but also on their ability to think critically and solve problems in the real world.

The novelty of this study lies in the systematic approach used to review the existing literature on CRT in the context of science teaching. By collecting and analyzing various previous studies, this research provides deeper insight into the effectiveness of the CRT approach in improving mastery of science material. It also offers practical recommendations for educators to implement culturally responsive teaching strategies, so they can more effectively meet students' diverse learning needs. Thus, this research not only contributes to the academic understanding of CRT but also provides concrete guidance for educators to create more relevant and meaningful learning experiences for students, especially in science subjects that many students often find difficult.

METHODS

This research adopts a systematic literature review approach. The analysis method applied is PRISMA (Preferred Reporting Items for Systematic Review). The PRISMA guidelines aim to support authors in improving the presentation and transparency of systematic reviews and meta-analyses (Vrabel, 2015). The review was carried out by collecting relevant evidence and meeting predetermined eligibility criteria to answer the research question. The systematic literature review process is carried out in an explicit and structured manner, which aims to reduce bias in the identification, selection, synthesis and conclusions of studies. The characteristics of a systematic review include: 1) explanation of the aims and methods used, 2) systematic search by identifying studies that meet eligibility criteria, 3) validity assessment including evaluation of the risk of bias, and 4) systematic presentation (Page dkk., 2021)

2.1 Search Terms

PRISMA was applied to find research sources through the Scopus database with a publication time span from 2019 to 2024. Source searches were carried out using several keywords, namely: "culturally responsive teaching in science learning" and "mastery of science material."

2.2 Criteria

Several criteria are determined to select the most relevant sources for the keywords. The articles used must meet the following criteria:

- a. Published in Scopus and Sinta
- b. Published in a reputable journal
- c. Focus on education
- d. Available on Google Scholar
- e. The journal is open access
- f. Articles published between 2019 and 2024.

2.3 Study Selection

Selection for further studies consists of three steps. First, all articles were selected according to predetermined criteria. Second, the abstracts of all articles were screened again based on these criteria. Next, the researcher examined the entire text of the remaining articles. From the selected articles, information about culturally responsive teaching and mastery of science material was classified. This data classification is part of the article content analysis process. The final step in content analysis is to explain culturally responsive teaching in science learning.

2.4 Analysis

The selected articles are then analyzed to understand the relationship between variables related to culturally responsive teaching in an effort to improve mastery of

science material. The findings from this meta-analysis are then presented and discussed in this research.

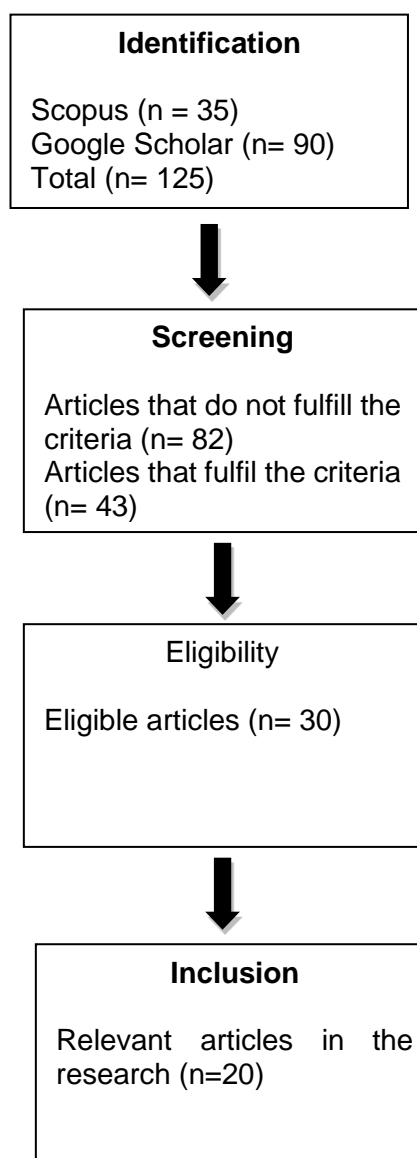


Figure 1. PRISMA Analysis Chart

FINDINGS AND DISCUSSION

A summary of various articles relevant to the PRISMA method taken from the Scopus and Google Scholar databases is as follows.

Table 1. Article Summary with the PRISMA Method

No	Author	Title	Year	Findings	Methodology
1	Steven S. Sexton	Culturally responsive teaching through primary science in Aotearoa New Zealand	2024	Culturally responsive teaching through integrating mainstream	Qualitative

				science curriculum and indigenous knowledge can support all students' learning (Sexton, 2024).	
2	Madalina F. Tanase	Is good teaching culturally responsive?	2020	Culturally responsive teaching strategies in science classrooms can improve student engagement and learning (M. Tanase, 2020).	Qualitative
3	Thelma de Jager	Millennial science student teachers' views on decolonisation and culturally responsive teaching	2019	Culturally responsive teaching in science can improve science learning by integrating cultural values and beliefs into the curriculum (De Jager, 2019).	Action-Research Investigation
4	K. Koirala	Science Teaching in Culturally Diverse Classrooms: Application of Sociocultural Knowledge at a School System in Nepal	2023	Culturally responsive teaching in science can improve learning outcomes for culturally marginalized students (Koirala, 2023).	Qualitative
5	Alfiya R. Masalimova, Marina R. Zheltukhina, Olga V. Sergeeva, Nikolay N. Kosarenko, Dibakhan A. Tsomartova, Lyudmila M. Smirnova.	Science teaching in BRICS: A systematic review of pedagogical approaches and challenges	2024	The need for culturally responsive science teaching in BRICS countries to address systemic inequalities and foster critical thinking (Masalimova dkk., 2024).	Systematic review
6	Jamie Wallace, Elaine V.	Stories That Teachers Tell: Exploring Culturally	2022	Through the experiences and stories shared by	Qualitative Case Study

	Howes, Arthur Funk, Sean Krepski, Maya Pincus, Susan Sylvester, Kin Tsoi, Caity Tully, Raghida Sharif and Samantha Swift (Wallace dkk., 2022)	Responsive Science Teaching		teachers, this group successfully identified themes that help address challenges and support the educational system. By connecting scientific concepts with cultural contexts, teachers were able to develop and analyze more responsive teaching strategies. These findings highlight the importance of storytelling as a rich tool for exploration and learning, and affirm that storytelling is a valuable resource in culturally responsive education, particularly in science instruction (Wallace dkk., 2022).	
7	Madalina F. Tanase	Culturally Responsive Teaching in Urban Secondary Schools Madalina F. Tanase	2021	Culturally responsive teaching strategies in urban secondary science and math classrooms can improve student engagement (M. F. Tanase, 2022).	Qualitative
8	Deeksoon Kim, So Lim Kim, Michael Barnett (Kim dkk., 2021)	"That Makes Sense Now!": Bicultural Middle School Students' Learning in a Culturally Relevant Science Classroom	2021	Culturally relevant pedagogy in a science classroom improved bicultural students' engagement and comprehension (Kim dkk., 2021).	Multiple-Case Study

9	B. Brown, P. Boda, Kathryn Ribay, Matthew Wilsey, Greses Pérez	A technological bridge to equity: how VR designed through culturally relevant principles impact students appreciation of science	2021	Culturally relevant virtual reality lessons can improve students' attitudes and appreciation of science (B. Brown dkk., 2021).	Quasi-Experimental
10	Daniel Edelen, Sarah B. Bush	Moving Toward Inclusiveness in STEM With Culturally Responsive Teaching	2021	Culturally responsive teaching can improve inclusiveness and meet the needs of every student in STEM education (Edelen, Daniel, 2021)	Not mentioned
11	C. Tzou, Megan Bang, Leah A. Bricker	Commentary: Designing Science Instructional Materials that Contribute to More Just, Equitable, and Culturally Thriving Learning and Teaching in Science Education	2021	Culturally responsive teaching in science learning can improve mastery in science by centering equity and justice-oriented goals (Tzou, Carrie, Megan Bang, 2021).	Not mentioned
12	Tia C. Madkins, Maxine McKinney de Royston	Illuminating political clarity in culturally relevant science instruction	2019	Culturally relevant pedagogy and a teacher's sociopolitical consciousness can empower students in science learning (Madkins, T. C., & McKinney de Royston, 2019).	Qualitative
13	Theila Smith, Lucy Avraamidou, Jennifer D. Adams	Culturally relevant/responsive and sustaining pedagogies in science education: theoretical perspectives and curriculum implications	2022	Culturally relevant/responsive and sustaining pedagogies in science education can improve science learning for historically marginalized	Qualitative

14	Karizza Jane Pejaner, Voltaire Mallari Mistades	Culturally Relevant Science Teaching: A Case Study of Physics Teaching Practices of the Obo Monuvu Tribe	2020	students (De Jager, 2019). Culturally relevant science teaching practices can improve academic success for the Obo Monuvu tribe (Pejaner, K. J., & Mistades, 2020).	Qualitative
15	Alexis D. Riley, F. Mensah	My Curriculum Has No Soul!": A Case Study of the Experiences of Black Women Science Teachers Working at Charter Schools	2023	Culturally relevant teaching in science can help Black and Brown students, but is challenging for Black women science teachers in charter schools (Riley, A. D., & Mensah, 2023).	Qualitative Case Study
16	Julie C. Brown, I. Livstrom	Secondary Science Teachers' Pedagogical Design Capacities for Multicultural Curriculum Design	2020	Culturally responsive teaching in science can improve science learning by integrating cultural and community knowledge into the curriculum (Brown, J. C., & Livstrom, 2020).	Mixed methods
17	Tara Nkrumah	The Inequities Embedded in Measures of Engagement in Science Education for African American Learners from a Culturally Relevant Science Pedagogy Lens	2023	Culturally relevant science pedagogy can improve African American students' engagement and mastery in science (Nkrumah, 2023).	Qualitative
18	Bhaskar Upadhyay, Erin D. Atwood, Baliram Tharu	Actions for sociopolitical consciousness in a high school science class: A case study of ninth grade class with predominantly	2020	Culturally relevant pedagogy helps indigenous students become more sociopolitically aware and reflective about	Ethnographic

		indigenous students		science learning (Bhaskar Upadhyay, Erin D. Atwood, 2020).	
19	Krystle P Cobian, Sylvia Hurtado, Ana L Romero, Justin A. Gutzwa	Enacting inclusive science: Culturally responsive higher education practices in science, technology, engineering, mathematics, and medicine (STEMM)	2024	Culturally responsive teaching practices in STEMM can promote participation and improve outcomes for underrepresented groups (Cobian dkk., 2024).	Multiple case study
20	L. le Grange	Rethinking Learner-Centred Education: Bridging Knowledge Cultures	2019	Culturally responsive teaching that considers learners' cultural frameworks can improve learning of Western science (Grange, 2019).	Not mentioned

3. 1 Application of Culturally Responsive Teaching in Overcoming Low Mastery of Science Concepts

The application of Culturally Responsive Teaching (CRT) in the context of science education in elementary schools aims to overcome the challenge of low mastery of science concepts among students. This approach focuses on integrating students' cultural values into the learning process, so that the material taught becomes more relevant and meaningful for them. By understanding students' cultural backgrounds, teachers can design more inclusive and supportive learning experiences, which in turn can improve students' understanding of science concepts.

The steps for implementing science learning with a culturally responsive teaching approach involve five components in learning, namely self-identification, cultural understanding, collaboration, critical reflection, and transformative construction. Self-identification begins with developing student identity by linking it to cultural background. Cultural understanding is applied by involving students in cultural understanding and knowledge construction through images or real situations. Collaboration is carried out by dividing the class into several groups to discuss material that is connected to cultural concepts and perspectives. Critical Reflection is applied by providing opportunities for students to convey their findings by reflecting their understanding. Transformative Construction involves students in changing their values and understanding by presenting them in an assignment or observation (Rahmawati & Ridwan, 2017).

One of the main strategies in implementing CRT is curriculum integration. This involves combining the mainstream science curriculum with students' local or cultural knowledge. For example, (Sexton, 2024) suggests that linking science concepts to traditional knowledge or local cultural practices can help students feel more connected to the material being taught. This not only makes learning more interesting but also increases students' sense of ownership of their learning process.

In addition, the use of relevant learning media is very important in the CRT approach. Media that is appropriate to students' cultural context can help them understand science concepts better. For example, using videos, images, or visual aids that reflect a student's culture can make the material easier to understand and remember. This way, students not only learn about science theoretically but also see real applications of the concepts in their daily lives.

Creating contextual connections between science concepts and students' everyday experiences is also an important step in implementing CRT. Relating science material to situations familiar to students allows them to see the relevance of science in their lives. For example, when teaching about ecosystems, teachers can ask students to share their experiences about the environment around them, thereby creating rich and meaningful discussions. This approach helps students feel valued and heard, which in turn increases their motivation to learn.

Ultimately, research findings suggest that implementing CRT can help all students, including those who are culturally marginalized, to better understand science material. (Koirala, 2023) noted that culturally responsive teaching strategies are proven to improve student engagement and learning outcomes. Thus, the application of CRT not only serves to improve mastery of science concepts but also to create a more equitable and inclusive learning environment for all students.

3.2 The Impact of Culturally Responsive Teaching in Increasing Students' Active Involvement and Understanding of Science Material

The impact of implementing Culturally Responsive Teaching (CRT) is very significant in increasing students' active involvement in the science learning process. This approach encourages students to participate actively through introducing their cultural context in teaching materials. (Wallace dkk., 2022) revealed that the use of stories and personal experiences in teaching not only makes the material more interesting but also creates a sense of connection between students and the science concepts being taught. In this way, students feel more appreciated and motivated to be actively involved in class discussions.

Furthermore, this increased active involvement contributes to increasing students' conceptual understanding of science material. Research by Kim shows that culturally relevant pedagogy can improve bicultural students' understanding of science concepts. When students can relate new knowledge to their own life experiences, they tend to develop a deeper and more lasting understanding of the material (Kim dkk., 2021).

In the context of learning outcomes, the application of CRT has been proven to provide significant results. For example, research at SDN Jajartunggal 3 showed an increase in learning outcomes from 57% in the first cycle to 82% in the second cycle after implementing this approach (Sulastri, 2024). These improvements suggest that when teaching is adapted to students' needs and cultural backgrounds, they can achieve a better understanding of scientific concepts. Furthermore, the culturally responsive teaching (CRT) approach positively influences students' active participation and learning outcomes in science (Sya'bana dkk., 2024).

Apart from that, CRT also plays an important role in creating an inclusive learning environment in the STEM fields (Science, Technology, Engineering and Mathematics). This approach helps meet the needs of all students in STEM classes in a more effective way. By paying attention to students' cultural differences and life experiences, teachers can design learning activities that are not only interesting but also relevant to each individual in the class (Edelen, Daniel, 2021). Impact of implementing a culturally responsive teaching (CRT) approach in science learning can increase students' learning motivation and outcomes (Fadillah & Listiawan, 2024).

Overall, the impact of Culturally Responsive Teaching is very positive in increasing students' active involvement and understanding of science material. By integrating cultural values into the learning process, teachers can create more meaningful and effective learning experiences for all students. This not only improves academic results but also builds self-confidence and motivation to learn among students from various cultural backgrounds.

CONCLUSION

The application of the Culturally Responsive Teaching (CRT) approach in science education in elementary schools shows a significant impact in increasing understanding of science concepts among students. By integrating students' cultural values into the learning process, this approach makes science material more relevant and meaningful, thereby increasing students' active involvement and conceptual understanding. The main strategies of CRT, such as curriculum integration that includes local cultural knowledge, the use of culturally relevant learning media, and the creation of contextual connections between science concepts and students' daily experiences, have proven effective in making science learning more inclusive and comprehensive.

Research shows that students who learn in an environment that respects their cultural background tend to be more motivated and active in the learning process. The results of this approach are seen in significantly improved academic outcomes, as found in related studies. In addition, CRT also helps create a more inclusive and supportive learning environment for all students, especially in STEM fields, by considering each individual's needs and cultural differences. In conclusion, the application of CRT in science learning not only has the potential to increase mastery of science concepts but can also build a sense of self-confidence, a sense of belonging, and motivation to learn in students, especially those from diverse cultural backgrounds.

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