Teacher Experience with Culturally Responsive Science Teaching Practice: A Qualitative Study

Rif'ati Dina Handayani[1,*], Triyanto[2], and Pramudya Dwi Aristya Putra[3]

[1]Physics Education Deparment, University of Jember, Indonesia
[2]Department of Civic Educatation, Sebelas Maret University. Indonesia
[3]Science Education Department, University of Jember, Indonesia
Email: rifati.fkip@unej.ac.id (R.D.H.); try@staff.uns.ac.id (T.); Pramudya.fkip@unej.ac.id (P.D.A.P.)
[*]Corresponding author

Manuscript received October 29, 2024; revised November 22, 2024; accepted December 25, 2024; published March 12, 2025

***Abstract*—This research aims to investigate teachers' experiences in Culturally Responsive Science Teaching (CRST). This research is a qualitative narrative inquiry study with six teachers who are currently pursuing teacher professional education as participants. Data was collected through open interviews. A thematic analysis is used to process data in stages: data transcription and selection of quotations, selection of keywords, coding, developing themes, conceptualization of coding and themes, and development of conceptual models. The research findings show that teachers gain positive experiences related to culturally responsive science teaching practices of changing teachers' mindsets and restructuring science content. Collaboration between teachers is needed to implement CRST because it is time-consuming and effortful. This research is expected to become a basis for teachers to implement science learning based on students' social cultures and backgrounds to make meaningful learning.**

***Keywords*—culturally responsive pedagogy, culturally responsive teaching, teacher experience, teaching practice**

I. Introduction

Learning should pay close attention to the global context and pluralism of society. Learning should equip students with the competencies needed for their future life. Changes to comprehensive learning designs and strategies need to be made. Cultural issues and their impact on learning are becoming increasingly important for teachers. Barton and Tan emphasize that teachers play an essential role in preparing students to be successful in learning [1]. Teachers must provide various ways for students to succeed in learning [2]. Emphasis on student identity must be placed so that all things related to students are valuable and meaningful [3]. However, the fact indicates that many teachers have little experience in learning that emphasizes students' relevant cultural identities [4]. Gay and Howard posit that teachers learn uniformly without considering students' social culture, ethnicity, experience, and diversity. Therefore, culturally responsive science learning is the key to unleashing identity intellectual potential and activating students' cognitive processes. Culturally responsive is designed to motivate and accelerate the learning of culturally diverse students [5].

Culturally responsive science teaching is a learning approach that uses the culture, personal experiences, and ethnic performance of students so that science learning becomes more effective, efficient, and relevant for them [6]. Culturally responsive teaching allows students to learn about their own culture and also helps them learn about other cultures [3, 7]. It can mitigate enduring gaps in learning achievement between students with diverse cultural backgrounds and identities [8]. Students come to school with thoughts, beliefs, skills, and knowledge constructed from experiences and interactions with the environment [9]. They do not enter lessons with empty minds that can be filled with other or new knowledge; instead, students' minds are full of experience and knowledge that develops through assimilation [10]. That is why incorporating students' cultural backgrounds and experiences into science learning is crucial for a teacher to understand [11]. Teachers become more responsive to culture by critically examining their practices and evaluating and improving learning strategies that suit the actual conditions of students and society [12]. Therefore, this research aims to explore teachers' experiences in practicing culturally responsive science teaching. The question in this research is: what is the teacher's experience in practicing culturally responsive science teaching?

II. Method

Participants in this research were selected using a purposive sampling method. The purposive sampling method deliberately determines participants to gather information on specific topics and issues [13]. This research's participants were six science teachers pursuing professional teacher development programs and teaching practice. A teacher professional development program is a form of formal education in higher education organized by the Indonesian government for one year to improve teachers' professional competence so that they are declared worthy of obtaining teacher certificate competencies [14]. Professional teacher development programs also train teachers to be responsive and ready to build strengths and cultures appropriate to students' future and development in a global society. Detailed information regarding the participants in this study is presented in Table 1.

Table 1. Data of research participants

	Age	Teaching years	Grade
Ms. Liv	Late 20s	3 yrs	7th
Ms. Dwi	Late 20s	3 yrs	7th
Ms. Kanz	Late 20s	3 yrs	7th
Ms. Ing	Middle 20s	1yrs	8th
Ms. Nisa	Late 20s	2 yrs	8th
Ms. Jwita	Middle 20s	1 yrs	8th

This research is a qualitative narrative inquiry. Narrative inquiry is a research method used to understand a phenomenon or topic [15] deeply. This research method was

chosen because it helps researchers capture and obtain clear data regarding science teachers' experiences implementing culturally responsive science teaching. Narrative inquiry allows researchers to understand individual experiences more deeply through collecting, analyzing, and interpreting personal stories [16].

This research data was collected through open interviews. Interviews are the most suitable information-gathering method for narrative inquiry research because they can deeply explore participants' life experiences [17]. Open interviews were chosen because they could be explored more in-depth without being restricted by the researcher's perspective [18, 19]. Interviews were conducted individually for approximately 50 minutes. This aims to capture as detailed and accurate as possible regarding teachers' experiences practicing culturally responsive science teaching in classes.

Furthermore, collected data was analyzed qualitatively through thematic analysis. Thematic analysis is a research method used to identify and interpret patterns or themes in a data set [20]. Thematic analysis is prevalent in analyzing qualitative data [21]. The thematic analysis process was carried out systematically by following a sequential approach to interpreting the data. The stages of thematic analysis in this research refer to Naeem, which involve data transcription and selection of quotations, keywords, coding, developing themes, conceptualization of coding and themes, and development of conceptual models. In the initial stage, the interview data was transcribed into text data. The resulting text data is then read repeatedly and highlighted for selection of quotes and keywords. The keywords are arranged in a table, coded, and connected. The criteria in the coding processes will become the basis for categories, which are then developed further by referring to theory and other research on culturally responsive teaching. As a form of data validity, researchers carried out triangulation. Triangulation is using multiple methods or data sources in qualitative research to understand a phenomenon comprehensively [22].

III. Findings

The research results show that teachers have had positive experiences regarding the implementation of culturally responsive teaching in their classes. CRT practices directly relate to students' diverse social backgrounds and cultural identities. Teachers have two exciting experiences practicing culturally responsive teaching: changing teachers' perspectives and restructuring science content. The details of the codes and themes of the data analysis from teacher experiences are shown in Table 2.

Table 2. Coding and themes of data analysis

Code	Themes	Categories
TP	Change of teachers' mindset	• Self-reflection and evaluation • Role of teachers
SC	Restructuring of science content	• Selection of science content relevant to culture and curriculum • Development of science pedagogical structure • Concerning students identities

A. Changing Teachers' Mindset

The interview results show that culturally responsive science teaching practices encourage teachers to reflect and self-evaluate the implementation of science learning. They look back at their teaching logbook, learning journals, and previous lesson plans to realize whether they follow a culturally responsive teaching approach. The results indicate that most participants have focused on Western science and rarely link local science and students' cultural backgrounds. Teachers teach according to science textbooks. The following is an example of a teacher interview excerpt.

"We carried out a self-reflection and looked back at the science learning material and journals from the previous science learning class. We also read and reviewed the CRT teaching principles we had studied in the previous semester in the teacher development program. We need to do this so that the implementation of CRST in the classroom is truly effective and optimal. "This reflection makes us increasingly aware that all planning that teachers do must not only pursue targets in the curriculum but also students' rights to learn science under their culture" (Ms. Liv).

"Culturally responsive science teaching is not too different from common science learning. I teach science contextually in students' real lives and daily, but we are not yet specific to the cultural, tribal, or ethnic backgrounds of students. The implementation of CRT has improved my view of science learning. There are many things I ask myself, such as whether the science learning I have done is appropriate for students' lives. Is the learning I do useful for students' future lives in society?" (Ms. Ing)

Furthermore, data analysis also indicated that participants believed that learning should not only talk about the development of science in the field of technology or Western science but also native science and the role of science in nature conservation. Teachers feel that the science learning they have carried out so far only describes developments in modern science and ignores local science in the community or native knowledge where students live. Culturally responsive science teaching practices encourage teachers to be able to connect science at school with science outside school.

"I think teaching current scientific knowledge, skills, and local knowledge around students needs to be taught. Teachers must change the perspective that science must be related to Western knowledge; cultural science should be given a chance to be introduced to the students. The essence of science needs to be returned to the nature of science. As teachers, we still need to re-understand the role of teachers in education in Indonesia because Indonesia has a diverse culture and multiple cultures. "This cultural diversity is an important asset that we need to teach students according to their cultural science context and content" (Ms. Jwita)

"Implementing culturally responsive science teaching gave me new knowledge and experience. As a teacher, I have to know many learning strategies. Using a cultural approach is necessary in science learning because the cultural context is generally closely related to social sciences. Culturally responsive teaching has changed my view that local culture in society related to science needs to be introduced to students so that they will become more aware of the existence of their culture and the gap between science in schools and traditional science will become smaller. "In my opinion, that is the role of a teacher, teaching according to the real context of

students' daily lives and bridging the relevance of Western science in schools with traditional science in society" (Ms. Kanz)

B. Restructuring Science Content

Science learning carried out in schools is included in the curriculum, where the government has determined the learning outcomes and science topics. However, teachers still have a chance to develop science content according to students' backgrounds, experiences, and school conditions to make it more contextual. The interview results show that teachers need a deep understanding of science content. Participants believed that implementing CRST in the classroom encouraged them to examine and understand the science curriculum more deeply to apply contextual learning according to the students' socio-cultural background. Also, they must be able to connect local knowledge with science content contained in the curriculum. One of the teachers explained in detail that he first looked for local expertise around the students, then searched for and carefully selected the science content that aligned with the science topic in the curriculum. This is undoubtedly uneasy for teachers, but they are trying to implement CRST in the classroom optimally by providing appropriate science content to students.

"The challenging aspect when integrating CRST in the classroom is determining and selecting science concepts in native knowledge relevant to science topics in school. For example, in the topic of biodiversity in seventh grade, I explained much about tobacco and sugar cane plants, the main agricultural commodities in the school area where I teach. I also introduced the sugar cane culture to the students. "I do this so that students can understand that the local culture that is believed and practiced by the community is not just a tradition but a form of a scientific issue as an effort by local people to increase harvest and preserve nature" (Ms. Dwi)

"There is much local knowledge around students. Teachers must select and choose what is relevant to the science topics. I chose the topic of tobacco's drying or curing process when teaching students the concept of temperature and heat. Many parents of students work as tobacco farmers and labor in tobacco warehouses. I obtained information about the tobacco curing process by asking the workers and tobacco farmers directly, then I analyzed it and adjusted it to the science content at school" (Ms. Nisa)

Furthermore, the analysis results also show that selecting appropriate and relevant local science content in schools is insufficient. Teachers still have to think about how to teach the content to students. They argue that choosing the right strategies, methods, and media needs to be conducted so that students also have more understanding and reduce misconceptions. The material's structure, the order of the material, and the learning media are also considerations for teachers before carrying out CRST in class. One of the teachers firmly said that teaching native science must be equipped with appropriate media or illustrations, and the presentation structure must be coherent. This is crucial to avoid partial information and misconceptions among students about science.

"After selecting science material contained in traditional knowledge, I still have to think about the order of the material or concepts that I convey first, whether cultural science or normative science at school. I need to think about this so that the material is easy for students to understand and convey effectively, coherently, and completely. To avoid student confusion, I teach Western science first and then connect it with cultural science and local knowledge. I explain cultural science as examples of phenomena in society simple language" (Ms. Kanz)

"to make students easily understand the science lessons, I teach science in culture at the beginning of learning. I do this to attract students' attention, motivate them to learn, and connect their preconceptions and experiences with the science concepts. "Apart from that, I also use learning media such as videos and photos of appropriate examples of local culture to support the delivery of clear material to students" (Ms. Liv)

IV. Discussion

The research results show positive experiences for teachers when practicing culturally responsive science teaching in the classroom. Implementing CRST means bridging science in the community where students live into the classroom. Culturally responsive teachers view it as their responsibility to help students negotiate their two worlds, at school and outside school. This is under Hatcher et al., which states that it is necessary to understand Two-Eyed Looking in Integrative Science to avoid domination and assimilation of knowledge [23]. Culturally responsive teaching practices change thinking patterns and mindsets about the teacher's role in science learning. Teachers carry out self-evaluation and reflection more often. Evaluation and self-reflection is the process of collecting, recording, and analyzing everything that happens in the class that has been carried out so that learning improvements can be made, including changes to learning strategies [24]. Observing and analyzing the class from various aspects will help the teacher have a new perspective to interpret and understand the science leraning and behavior of students and the class [25]. This will also help teacchers develop attention to the class, identify problems that occur in the class, and find solutions

Apart from changes in views about teachers, another exciting experience was the restructuring of science content. Restructuring science content is critical in CRST implementation. This provides a new experience for them where the science content itself is included in the curriculum. Teachers must select science material in schools based on local knowledge that appropriate science curricula. Local or native knowledge contains quite a lot of science content that can be taught to students. However, it requires challenging efforts due to limited sources of information related to indigenous science. This is in line with Belgarde et al. stated: the biggest challenge in implementing culturally responsive learning is science content or knowledge appropriate to the curriculum [26]. Collaboration between teachers, schools, and communities outside the school is much needed to obtain the validity of the relevant knowledge. This is because scientific knowledge in culture is not always readily available and accessible for teachers to understand [27].

Practicing CRST allows teachers to learn according to students' cultural backgrounds. Teachers should be

maximally involved in students' social and cultural background and native knowledge in science learning [28]. All teachers agree that their socio-cultural conditions greatly influence students' learning. This is because the social environment influences students' thinking, experiences, skills, and attitudes, automatically impacting classroom learning activities [29]. CRST helps teachers alleviate conceptual discrepancies in students' perceptions inside and outside the classroom [30]. Therefore, teachers are significant in preparing their students to succeed in science. Success in science can be achieved by allowing students to access and/or explain science at home or in the environment where the students come from [31].

V. Conclusion

The implementation of science learning provides an exciting experience for teachers. There is a change in teachers' perspectives about science learning and a deeper understanding of students. The experience of restructuring and selecting science materials that are appropriate to students' cultures is also challenging for teachers. Practicing Culturally responsive science teaching trains teachers to connect science at school with science outside school according to students' cultural background conditions. It is necessary to select and simplify the material so that students understand it quickly and do not give rise to misconceptions. Apart from that, collaboration between teachers, schools, and the student community needs to be considered in culturally responsive science teaching so that learning becomes more meaningful and cultural sustainability in education can be achieved.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Rif'ati Dina Handayani served as the lead researcher. She coordinated the research's implementation. The main task is to compose research articles. Triyanto played a role in data collection, data validation, and data analysis. He assisted the principal investigator in completing the article. Pramudya Dwi Aristya Putra contributed to data collection and validation. He helped complete the research administration. all authors had approved the final version.

Funding

This research was funded by Ministry of Education, Culture, Research, and Technology.

References

[1] A. C. Barton and E. Tan, "Funds of knowledge and discourses and hybrid space," *J. Res. Sci. Teach.*, vol. 46, no. 1, pp. 50–73, Jan. 2009. doi: 10.1002/TEA.20269

[2] W. Kanauan and N. Inprasitha, "Collaboration between inservice teachers and student intern in Thai lesson study," *Procedia - Soc. Behav. Sci.*, vol. 116, pp. 28–32, 2014. doi: 10.1016/j.sbspro.2014.01.163

[3] K. Eppley, "Seven Traps of the common core state standards," *J. Adolesc. Adult Lit.*, vol. 59, no. 2, pp. 207–216, Sep. 2015. doi: 10.1002/JAAL.431

[4] J. M. George, "'Do you have to pack?'—preparing for culturally relevant science teaching in the Caribbean," *Int. J. Sci. Educ.*, vol. 35, no. 12, pp. 2114–2131, Aug. 2013. doi: 10.1080/09500693.2012.760138

[5] L. Darling-Hammond, L. Flook, C. Cook-Harvey, B. Barron, and D. Osher, "Implications for educational practice of the science of learning and development," *Appl. Dev. Sci.*, vol. 24, no. 2, pp. 97–140, Apr. 2020. doi: 10.1080/10888691.2018.1537791

[6] G. Gay, *Culturally Responsive Teaching: Theory, Research, and Practice*, Third. Colombus, Ohio: Teachers College Press, 2018.

[7] C. Mathis, S. A. Southerland, and T. Burgess, "Physics teachers' dispositions related to culturally relevant pedagogy," *Int. J. Sci. Educ.*, vol. 45, no. 14, pp. 1162–1181, 2023. doi: 10.1080/09500693.2023.2190850

[8] E. Abrams *et al.*, "Culturally relevant schooling in science for indigenous learners worldwide : Stressing the all in science literacy for all," *Handb. Res. Sci. Educ.*, vol. II, pp. 671–696, Jul. 2014. doi: 10.4324/9780203097267-38

[9] J. C. A. Sandoval-Rivera, "Environmental education and indigenous knowledge: Towards the connection of local wisdom with international agendas in the framework of the Sustainable Development Goals (SDGs)," *Diaspora, Indig. Minor. Educ.*, vol. 14, no. 1, pp. 14–24, Jan. 2020. doi: 10.1080/15595692.2019.1652588

[10] S. N. Belleau, M. J. Ross, V. K. Otero, N. S. Rebello, P. V. Engelhardt, and C. Singh, "Implementation of physics and everyday thinking in a high school classroom: Concepts and argumentation," *AIP Conference Proceedings*, Feb. 2012, vol. 1413, no. 1, pp. 127–130. doi: 10.1063/1.3680010

[11] H. S. Sobel, N. J. Cepeda, and I. V. Kapler, "Spacing effects in real-world classroom vocabulary learning," *Appl. Cogn. Psychol.*, vol. 25, no. 5, pp. 763–767, Sep. 2011. doi: 10.1002/ACP.1747

[12] J. C. Brown and K. J. Crippen, "Designing for culturally responsive science education through professional development," *Int. J. Sci. Educ.*, vol. 38, no. 3, pp. 470–492, Feb. 2016. doi: 10.1080/09500693.2015.1136756

[13] J. W. Creswell, *Educational Research: Planning, Conducting, and evaluating Quantitative and Qualitative Research*, 4th ed., Boston: Pearson Education, Inc., 2012.

[14] A. Daud and U. Riau, *Guru Profesional dan Pendidikan Profesi Guru (PPG)*, Riau: UR Press, 2022.

[15] D. J. Clandinin, *Handbook of Narrative Inquiry Mapping a Methodology*, 2007.

[16] L. A. Pino Gavidia and J. Adu, "Critical Narrative inquiry: An Examination of a methodological approach," *Int. J. Qual. Methods*, vol. 21, Feb. 2022. doi: 10.1177/16094069221081594/ASSET/IMAGES/LARGE/10.1177_16094069221081594-FIG2.JPEG

[17] N. King, C. Horrocks, and J. M. Brooks, *Interviews in Qualitative Research*, Thousand Oaks, California: SAGE, 2019.

[18] J. W. Creswell, *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, vol. 4. 2012. doi: 10.1017/CBO9781107415324.004

[19] R. B. Johnson and L. B. Christensen, *Educational Research: Quantitative, Qualitative, and Mixed Approaches*, 5 edition, Thousand Oaks, Calif: SAGE Publications, Inc, 2013.

[20] M. Rogers, "Coding qualitative data," *Varieties of Qualitative Research Methods*, Springer, Cham, 2023, pp. 73–78. doi: 10.1007/978-3-031-04394-9_12

[21] M. Forbes, *Thematic Analysis: A Practical Guide*, vol. 22, no. 2, pp. 132–135, Dec. 2021. doi: 10.1177/1035719X211058251

[22] N. Carter, D. Bryant-Lukosius, A. Dicenso, J. Blythe, and A. J. Neville, "The use of triangulation in qualitative research," *Oncol. Nurs. Forum*, vol. 41, no. 5, pp. 545–547, Sep. 2014. doi: 10.1188/14.ONF.545-547

[23] A. Hatcher, C. Bartlett, A. Marshall, M. Marshall, and A. L. Hatcher, "Two-eyed seeing in the classroom environment: Concepts, approaches, and challenges," *Can. J. Sci. Math. Technol. Educ.*, vol. 9, no. 3, pp. 141–153, 2009. doi: 10.1080/14926150903118342

[24] E. Zaffini, "Teaching and mentoring toward culturally responsive practices," *Music Educ. J.*, vol. 108, no. 4, pp. 37–44, Jul. 2022. doi: 10.1177/00274321221107610

[25] A. K. Alghamdi, "Pre-service teachers' reflections on teaching images in Saudi media," *Teach. Dev.*, vol. 25, no. 2, pp. 155–177, Mar. 2021. doi: 10.1080/13664530.2021.1876160

[26] M. J. Belgarde, R. D. Mitchell, and A. Arquero, "What do we have to do to create culturally responsive programs?: The challenge of transforming american Indian teacher education," *Action Teach. Educ.*, vol. 24, no. 2, pp. 42–54, Jun. 2002. doi: 10.1080/01626620.2002.10734418

[27] S. Stephens, *Handbook for Culturally Responve Science Curriculum*, Fairbanks, Alaska: Alaska Native Knowledge Network, 2000.
[28] K. Shin, "Examining Korean teachers' experiences teaching the centrally developed integrated curriculum," *Asia-Pacific Educ. Res.*, vol. 31, no. 1, pp. 49–60, Feb. 2022. doi: 10.1007/S40299-020-00537-7/METRICS
[29] T. Rutledge, T. Fulton, A. Schmidt, S. B. Bush, and J. K. Dixon, "Equitable mathematics through social–emotional learning and culturally responsive teaching," *Kappa Delta Pi Rec.*, vol. 58, no. S1, pp. 55–61, 2023. doi: 10.1080/00228958.2022.2147608
[30] R. J. Sternberg, "Who are the bright children? The cultural context of being and acting intelligent," *Educ. Res.*, vol. 36, no. 3, pp. 148–155, Apr. 2007. doi: 10.3102/0013189X07299881
[31] R. Hill *et al.*, "Working with indigenous, local and scientific knowledge in assessments of nature and nature's linkages with people," *Current Opinion in Environmental Sustainability*, vol. 43. Elsevier B.V., pp. 8–20, Apr. 01, 2020. doi: 10.1016/j.cosust.2019.12.006