

Effect of Culturally Relevant Teaching on Scientific Knowledge among Class VI Students

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Submitted: 27/01/2025

Revised: 10/02/2025

Accepted: 07/03/2025

Published: 23/04/2025

Abstract

India is rich in culture, tradition arts, and ethos. For hundreds of years ago, culturally, economically, linguistically, religiously and ethnically different people living in India and the Indian classroom filled with cultural diversified students commonly called multicultural classroom. It was stated by National Policy on Education (1986), and POA (1992) that need for culture based revision of curriculum. The latest document NEP (2020) recommended that the indigenous knowledge and different cultures needs to be incorporated in the curriculum and textbook; it also suggested that preservation and promotion of Indian culture and ethos must be the high priority. It is very essential to consider students cultural background, language, ethnicity during teaching process. Keeping in view of the importance of culture and its role in learning science, a research study was conducted focused on developing scientific knowledge and skills through Culturally Relevant teaching (CRT). The sample for the present study was 45 students of class VI in Amarkantak, Madhya Pradesh selected purposively. The sample comprises of tribal and non-tribal students. The data was collected with the help of questionnaire and opinionnaire. The collected data was analyzed by t test and frequency percentage. The study findings revealed that the implemented Culturally Relevant Teaching was effective and the students enjoyed learning, also they felt that their culture and language was acknowledged and respected.

Keywords

Culturally Relevant teaching, Scientific Knowledge and Skills.



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INTRODUCTION

Culture is encompassed with the way we think and act in daily life. Cultural characteristics are learned, acquired and transmitted. Culture is an integral part everyone life. Culture exist in each and every society. Cultural expressions are the way of expression of our life anywhere and anytime. School, home and culture are interdependent to each other. It was stated by National Policy on Education (1986) that school is a miniature of society. Cultural characteristics and school beliefs, practices, materials and problems are interconnected and interrelated Widen, et.al. (1998). Home culture which greatly influence the learning classroom (Parker, 1998). Research findings revealed that individual cultural characteristics play an important role in moulding the process of thinking (Maheswar, 2020). National Curriculum Framework (2005), and National Curriculum Framework for Teacher Education (2009) stated that learning is perceived as an integral part of physical, cultural, social, context.

Culture acts as a scaffolding mechanism between learners and the learning process. Teacher need to adopt a pedagogy that embrace, celebrate and acknowledge all the culture in the classroom. Culturally relevant teaching (CRT) one such a pedagogy that recognize all the culture and it facilitate students learning. It is inevitable that Teacher must know knowledge of every student's cultural diversity, accordingly the learning experiences to be given. Vygotsky sociocultural theory also asserts that child's cognitive development and learning mediated and guided by their social interaction. Further he stated that their language and culture plays important role in shaping their cognitive development. Philosophy of constructivism also says that children are not empty mind, they come to school with some sorts of concepts about physical and biological world which constructed by their cultural orientation. India is a multicultural nation and the Indian classrooms are culturally diverse in nature; keeping in view of the importance of culture, NEP (2020) recommended to incorporate the indigenous knowledge and to represent the different culture in the curriculum and textbook; it also suggested that preservation and promotion of Indian culture and ethos must be the high priority.

Curriculum and pedagogy from the foundational stage need to be redesigned keeping in view of local context in terms of culture, tradition, customs, language, scientific needs, indigenous and traditional ways of learning. Pedagogy should link the content and students culture. Looking at the nature of classroom diversity, the pedagogy should fulfil the students' expectation and meet the learning needs of all culturally different students. Students also express their voice in the

classroom and feel that learning is joyful by engaging in science experiments and activities that leads development of scientific concepts and skills. Hence practice of Culturally Relevant Teaching (CRT) is most crucial and unavoidable because Indian classroom is pluralistic in nature in terms of culture, religion, and language. Also it is very essential to adopt culturally relevant pedagogy for creating the classroom more equitable and inclusive. It can connects the content and the students. Culturally relevant teaching is not only just for understanding the deep knowledge but also for integration of cultural experiences in the classroom and curriculum. Teaching science by integrating different culture increase students' academic achievement (Richards, et al., 2007) and also promote cultural diversity among students. Hence, the present researcher made an attempt to develop scientific knowledge through culturally relevant teaching among class VI students.

The term Culturally Relevant Teaching was introduced by Gloria Ladson-Billings (1994). It refers to teaching that integrates students' cultural knowledge, background, and previous home and community experiences in the curriculum and the pedagogic process in the classroom. Other theorist Gay (2000) and Villegas and Lucas (2002) used the terms Culturally Responsive Teaching or Culturally Pedagogy. According to them, it is a teaching learning process that recognizes all the culturally diversified students in the classroom to acquire knowledge and skills through their cultural characteristics and background, family structure, language, and social and cultural identity. Gloria Ladson-Billings (1994) identified three tenets centrally underpinning this CRT, they are (i) keeping high expectation for all students (ii) assist the students for their development of cultural competence (iii) guiding the students in order to develop critical consciousness. Kanaiaupuni identified five basic elements of culture based education they are: language, family and community, context (i.e. school and classroom structure,), content (culturally grounded), data and accountability (gathering and maintaining the data pertaining to culture).

Geneva Gay (2000) wrote that culturally responsive teaching connects students' cultural knowledge, prior experiences, and performance styles to academic knowledge and intellectual tools in ways that legitimize what students already know. Principles of Culturally Relevant Teaching According to Shade, Kelly and Oberg (1997), the following are the seven principles of CRT: Students asserted in their cultural connection, personal invite for teachers, learning environment and surrounding invites Physically and culturally different students, students are continuously motivated, encouraged and reinforced for the academic development, pedagogic practices are modified that accommodate all culturally diverse students, classrooms are controlled and managed

with firm, love, consistent, classroom interaction individual as well as collective.

Science can be best learned by performing experiments or learning by doing method. Scientific knowledge to be constructed rather than imparted by teacher. Jean Piaget (1977) suggests that children best learn by personal experience. One of the important objectives of science teaching at schools is to prepare the students to understand the basic scientific concepts around the natural phenomenon, and to develop the scientific skills. These objectives help them to construct and understanding of higher level complex scientific knowledge through which students can develop cognitive and analytical thinking skills. NCF (2000, 2005) suggested that the teaching of science must emphasis process skills and products because these two components are inseparable they are interlinked each other. Science is integral part of culture and Culture is embedded in scientific knowledge. One of the characteristics of nature of science is that science is socially culturally embedded. It imply that the way of knowing science in the classroom should be compatible or match with the way of life that they live. Cultural aspects helpful for learning scientific concepts. Student Cultural knowledge system often used to explain scientific concepts. Amoah, (2018) stated that students previous knowledge, ideas on concepts based on their cultural beliefs.

Culture is critical component in learning science. Hence, Science teacher need to think and act as culturally responsive teachers wherein students' cultural practices and their lives outside the school are to be integrated in the teaching learning process. Similarly, culturally relevant learning environment needs to be provided in the classroom that facilitate the students to participate actively in the learning process. For example: tribal community are unique in agriculture, paintings, indigenous medicines, pot making, food preservation, singing and dancing, festival celebration, animal husbandry, milking, fishing. These cultural practices are to be incorporated in the science classroom and provide opportunity for the students to observe, classify, communicate, measure, predict and infer. Teacher needs to create classroom environments which is responsive to all children. Culturally relevant teaching is not only just for understanding the deep knowledge but also for integration of cultural experiences in the classroom and curriculum.

It was stated by Brown-Jerry & Cooper, (2011) that the "Cultural uniqueness" of each student should be acknowledged and nurtured for making effective learning condition in the classroom. NEP (2020) also reiterates that student's local culture and their socio-cultural characteristics, values identities, languages need to be addressed and acknowledged through curriculum and pedagogy by providing experiential learning. Delors et.al. (1996) pointed out that there is a linkage between

cultural diversity and education; integrating all students' cultural characteristics in the teaching methods and contents leads to actualize the aim of learn to live together. Ladson-Billings, 1995) asserted that culturally relevant teaching is a learner centred approach to recognize cultural references, cultural background, and cultural experiences in all aspects of learning. According to Gay, (2000), Ladson-Billing, (1995) all the students safe, welcomed, and accepted therefore schools and classroom need to be responsive to culture (Anuragam, 2019). Further asserted that teachers knowledge, competence, attitude, awareness towards culturally relevant teaching are most valuable in bringing culturally inclusive classroom in a way that maximise the learning of culturally different students. Daripa (2017) study reported that in most of the tribal schools, the regional or official language were used in the teaching learning process which leads to poor understanding or not understood by tribal students because they speak in their mother tongue which creates a gap between home language and school language. If the science teaching and learning fails to recognise, welcome, address, acknowledge, and value indigenous and all other students cultural background, cultural identity and cultural characteristics in the classroom that may leads to create negative impact on their learning and academic success. Culturally relevant teaching recognises the differences of culture in terms of language, family structure, cultural background, and social identity. Culturally relevant teaching are most important in Indian classroom that can take care of the educational needs of culturally diversified students that maximise the learning of culturally different students.

METHOD

Methodology

Objectives

1. To study the effectiveness of Culturally Relevant Teaching in terms of development of Scientific Knowledge with regard to Gender, and Tribal and Non-Tribal students.
2. To study the students opinion towards Culturally Relevant teaching for the development of Scientific Knowledge.

Hypothesis

There is no significant difference in the pre-test and post-test scores on the scientific knowledge with regard to tribal and non-tribal students'.

Research Design

Single group pre-test and post-test research design was employed for the present study.

Population: The population for the proposed study is Government schools students of Standard VI in the Anuppur District of Madhya Pradesh.

Sample and Sampling Technique

The sample for the present study was 45 students of class VI from Government Middle School, Amarkantak Block, Anuppur District, Madhya Pradesh. The sampled students belonged to Gond, Panika tribal community and non-tribal students such as Yadav, Banjara, Nayak. The sample comprises of 20 girls and 25 boys (N=45); 19 tribal and 26 non-tribal students (N=45). The purposive sampling technique was adopted due to the following criteria.

- The students in the selected school consists of tribes and non-tribe.
- The school is located in the interior part of the village wherein poor infrastructure facilities such as no science laboratory, library, ICT lab, sports and games materials, unhygienic drinking water, and separate toilet for girls and boys.
- Most of the students were irregular to the school due to agriculture and other house hold work.

Delimitations of the Study

- The study delimited to Basic Process skills and scientific knowledge of class VI students.
- Study was delimited to Government middle school of Amarkantak.

Research tools and Techniques for Data Collection

The below mentioned tools and techniques were constructed and administered by the researcher.

Achievement Test on Scientific Knowledge: After piloting the tool, the constructed closed-ended questionnaire was administered as pre-test and post-test i.e. before and after implementing the culturally relevant teaching. The test was intended to test students' conceptual understanding in science. There were 50 test items in the questionnaire. The items in the questionnaire consists of both physical and biological science.

Opinionnaire for students: The researcher constructed opinionnaire to study students' opinion towards culturally relevant method of teaching and its influence in developing knowledge and skills in science. The Opinionnaire consist of 35 items with four ratings such as Always, sometime, rarely and never. The opinionnaire was administered after implementing the culturally relevant teaching.

Analysis of the Data

The quantitative data collected through close-ended questionnaires (achievement tests) were analyzed by paired t test (single group) and the data collected through Opinionnaire were analyzed by frequency percentage.

Testing of Hypothesis: There is no significant difference in the pre-test and post-test scores on the scientific knowledge with regard to tribal and non-tribal students'. To study the effectiveness of the cultural relevant teaching on scientific knowledge of the students', the Pre-Test and the Post-Test Analysis was computed with regard to tribal and non-tribal students'. The total sample was categorized based on the community of the students'. The above hypothesis was framed and tested to know the significant difference between the tribal and non-tribal students' in Pre-Test and the Post-Test Scores by employing t-test and the results are presented in table.

FINDING AND DISCUSSION

Table 1: Mean, S.D, and paired t-values of the Pre-Test and the Post-Test score of Scientific knowledge test with regard to tribal and non-tribal students'

Test Score	Gender	N	Mean	SD	SEM	df	t-Value
Pre-Test Score in Scientific Knowledge	Tribal students'	19	15.84	3.64	0.84	43	0.794
	Non-Tribal Students'	26	16.73	3.76	0.74		
Post-Test Score in Scientific Knowledge	Tribal students'	19	31.11	5.15	1.18	43	2.281
	Non-Tribal Students'	26	34.73	5.35	1.05		

From the above table, it was observed that the computed t-value of the pre-test score in scientific knowledge is 0.794 and is less than table t-value at 0.01 level of significance. It is also observed that the computed t-value of the post-test score in scientific knowledge is 2.281 and is more than table t-value at 0.01 level of significance. Hence, the hypothesis is rejected at 0.01 level of significance. It indicates that there exists a significant difference between the tribal and non-tribal students' in the Post-Test score towards scientific knowledge.

When compared the mean differences among the tribal and non-tribal students', the mean score of the tribal students' in Pre-Test is 15.84 and Post-Test is 31.11 as well as non-tribal students' Pre-Test Score is 16.73 and Post-Test Score is 34.73. It was inferred that the mean scores of tribal and non-tribal students' in the Post-Test were more than the Pre-Test.

It concludes that non-tribal students' having scientific knowledge better in pre-test score than tribal students'. After giving treatment through cultural relevant teaching both tribal and non-tribal students' have achieved more score in the post-test. However, non-tribal students' are slightly more than the tribal students' in the post-test score in understanding the concepts of the scientific knowledge.

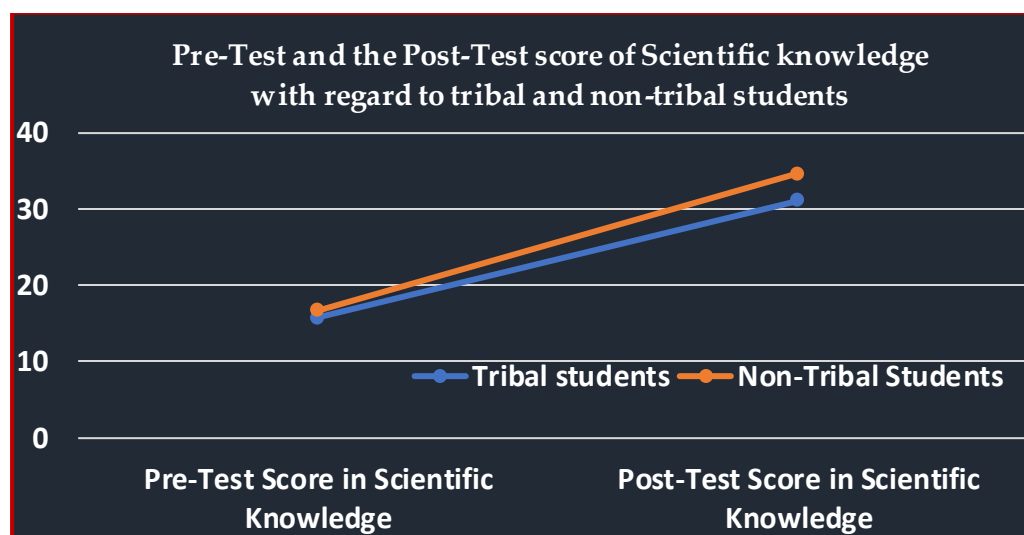


Figure 1. Pre-Test and the Post-Test score of Scientific knowledge with regard to tribal and non-tribal students

Analysis of Opinionnaire

Students opinion towards cultural relevant teaching was analysed and interpreted by using frequency and percentage which is depicted in the table below.

Table 2. Analysis of Opinionnaire

No	Statements	Always	Some Time	Rarely	Never
1.	I got the opportunity to participate discuss debate the scientific knowledge in the tribal language during the science teaching-learning process	(36) 78.26%	(6) 13.04%	(4) 8.69%	-
2.	Culturally relevant teaching helps me to understand scientific knowledge deeply.	(36) 78.26%	(7) 15.21%	(3) 6.52%	-
3.	I understand scientific knowledge much easier when it was discussed in my mother tongue.	(40) 86.95%	(3) 6.52%	(3) 6.52%	-
4.	I feel happy when the tribal language and culture and identity were acknowledged in the classroom during teaching-learning process.	(42) 91.30%	(3) 6.52%	(1) 2.17%	-
5.	I got rich learning experiences through culturally relevant teaching for developing scientific knowledge and process skills	(41) 89.13%	(4) 8.69%	(1) 2.17%	-
6.	Cultural based teaching facilitated us to perform hands on experiments and joyful learning which helps us to remember the concepts	(37) 80.43%	(4) 8.69%	(4) 8.69%	(1) 2.17%

7.	Our home language was addressed in the classroom which helps us to understand the concepts much easier	(42) 91.30%	(2) 4.34%	(2) 4.34%	-
8.	I felt that the learning environment in the classroom was physically and culturally invited	(42) 91.30%	(2) 4.34%	(1) 2.17%	(1) 2.17%
9.	Culturally relevant teaching developed our positive attitude towards school	(41) 89.13%	(3) 6.52%	(2) 4.34%	-
10.	Culturally relevant teaching developed positive sense of ethnic identity which increased our self-esteem, academic attitudes and well-being with others.	(42) 91.30%	(2) 4.34%	(2) 4.34%	-
11.	I developed the sense of interest in science by addressing my culture in the classroom	(39) 84.78%	(3) 6.52%	(3) 6.52%	(1) 2.17%
12.	I feel interest in acquiring knowledge and skills when the teacher use local language	(41) 89.13%	(1) 2.17%	(3) 6.52%	(1) 2.17%
13.	Cultural relevant teaching created a link between scientific concepts and the social and cultural experiences i gained at home	(40) 86.95%	(4) 8.69%	(2) 4.34%	-
14.	I observed / noticed the similarities and differences of science diagrams while teaching science	(42) 91.30%	(3) 6.52%	(1) 2.17%	-
15.	I used the hand lens and microscope for observing the fine details in science class	(40) 89.13%	(4) 8.69%	(1) 2.17%	-
16.	I got opportunity to observe the organisms such as earthworm, cockroach etc in science	(43) 93.47%	(2) 4.34%	(1) 2.17%	-
17.	I feel much learning is easier when the teacher provided me the hands on experiences.	(43) 93.47%	(3) 6.52%	-	-
18.	I engaged the sensory organs to observe the smell, texture and other characteristics of some chemicals/ substances in science class to understand the concepts	(42) 91.30%	(2) 4.34%	(2) 4.34%	-
19.	I classified the objects / materials / substances into acids and bases, metals and non- metals based on similarities and differences in science	(43) 93.47%	(2) 4.34%	(1) 2.17%	-
20.	I know to classify the materials into transparent , translucent and opaque	(38) 82.60%	(5) 10.86%	(2) 4.34%	(1) 2.17%
21.	I know to classify the organisms into herbivore, carnivores and omnivores, vertebrates and invertebrates, unicellular and multicellular	(40) 89.13%	(3) 6.52%	(3) 4.34%	-
22.	I posed many questions in tribal language during experimentations	(41) 89.13%	(2) 4.34%	(1) 2.17%	(2) 4.34%
23.	I have presented my observations and inference in tribal language after the experiments	(38) 82.60%	(5) 10.86%	(2) 4.34%	(1) 2.17%
24.	I learned to draw the line graph, bar graph and pie chart in science class	(39) 84.78%	(5) 10.86%	(2) 4.34%	-
25.	I learned to prepare the tables, charts and posters in science class	(41) 89.13%	(3) 6.52%	(2) 4.34%	-
26.	I learned to draw the diagrams and labelled the parts clearly by observing the science models/ charts	(39) 84.78%	(5) 10.86%	(2) 4.34%	-
27.	I was encouraged to ask questions in my own language in science class	(43) 93.47%	(2) 4.34%	(1) 2.17%	-
28.	I learned to represent Food chain, food web and energy flow by picture/ diagrams	(42) 91.30%	(3) 6.52%	(1) 2.17%	-
29.	I learned to measure the temperature of water using the thermometer	(43) 93.47%	(3) 6.52%	-	-

30.	I learned to measure the length of the pendulum by operating simple pendulum experiments	(42) 91.30%	(2) 4.34%	(2) 4.34%	-
31.	I learned to measure the weigh the object with the help of pointer balance / spring balance	(41) 89.13%	(3) 6.52%	(2) 4.34%	-
32.	I learned to measure the exact quantity of water by using measuring cylinder and beaker, pipette and burette	(40) 86.95%	(3) 6.52%	(3) 6.52%	-
33.	I know to predict the future occurrences while doing science demonstration/ experiment based on the observation.	(39) 84.78%	(3) 6.52%	(3) 6.52%	(1) 2.17%
34.	I have no misconception in science because the concepts were taught in tribal language.	(43) 93.47%	(3) 6.52%	-	-
35.	I learned to predict the forecasting events when other students' performing the experiments	(37) 80.43%	(4) 8.69%	(3) 6.52%	(2) 4.34%
36.	I acquired the skill of prediction in science and its uses in daily life	(36) 78.26%	(5) 10.86%	(4) 8.69%	(1) 2.17%
37.	I got more opportunities in science class to develop the skill of prediction	(38) 82.60%	(4) 8.69%	(2) 4.34%	(2) 4.34%
38.	I learned to write inferences after the completion of experiments and observations	(37) 80.43%	(4) 8.69%	(3) 6.52%	(2) 4.34%
39.	I made an attempt to write inferences about the experiment	(36) 76.08%	(6) 13.04%	(3) 6.52%	(1) 2.17%
40.	The acquired process skills in the classroom use to practice at home also	(36) 78.26%	(5) 10.86%	(3) 6.52%	(2) 4.34%
Average		87.04%	7.39%	4.39%	1.13%

It can be observed from the above table that 87.04 % of tribal students' opinion was favour to implemented culturally relevant teaching. They responded that they always got opportunity to perform hands on experiences which facilitated to develop scientific knowledge and process skills. Further, responded that they actively participated in discussion in tribal language during and after completion of each experiments which helps them to construct concepts and acquire process skills. It was inferred from their opinion that they felt happier when their language and cultural characteristics addressed and integrated in the science classroom teaching. It was observed that most of the time students' were excited to perform hands on experiments. They understand the basic science concepts when it was explained in their mother tongue. Students' opined that their attitude and interest towards science was developed by doing scientific experiments. Most of the students' expressed their views that by integrating culture and tribal language in science classroom, their sense of ethnic identity developed which increased their self-esteem and academic attitudes. Also, they expressed that the adopted teaching learning process (i.e.CRT) in science classroom connected the tribal language, culture and the concepts and process skills. The felt that the tribal language used in classroom connects between home and school. Tribal cultural based learning experiences

provided in the classroom was more enjoyable and valued the cultural beliefs. Culturally relevant teaching connects the daily lived experiences with the concepts in the classroom which enable the students' to represent their knowledge.

Majority of students' opined that the culturally relevant teaching was a student centred teaching learning approach for understanding scientific knowledge and acquiring process skills because it provided ample opportunity to develop the skill of observation classification communication measurement prediction and inferences by integrating their culture in terms of food, indigenous knowledge on medicines, agriculture practices, preservation of food, costumes and ornaments, tattoos etc. Such learning experiences not only helped to understand knowledge and acquire process skills but also to recognise the importance of tribal cultural background and cultural experiences. They opined that by demonstrating the process skills such as observing and classifying the cereals and wheat; protein rich and carbohydrate rich food; herbivores and omnivores students' recognise their culture of food. Also the process skill acquired in the classroom was used by the students' in the home as well. Hence it can be inferred that the cultural based science teaching engaged the students' in hands on experiences both physically and cognitively which promote diversity of culture and academic achievements by developing process skills and knowledge in science.

The computed t-value of the pre-test score in scientific knowledge is 0.794 and is less than table t-value at 0.01 level of significance. Also the computed t-value of the post-test score in scientific knowledge is 2.281 and is more than table t-value at 0.01 level of significance. Hence, the proposed null hypothesis is rejected at 0.01 level of significance. It indicates that there exists a significant difference between the tribal and non-tribal students' in the Post-Test score towards scientific knowledge. The difference was that non-tribal students' having scientific knowledge better in pre-test score than tribal students'. After giving treatment through cultural relevant teaching both tribal and non-tribal students' have achieved more score in the post-test. However, non-tribal students' are slightly more than the tribal students' in the post-test score in understanding the concepts of the scientific knowledge.

The students expressed that the adopted teaching learning process (i.e.CRT) in science classroom connected the tribal language, culture and the concepts and process skills. The felt that the tribal language used in classroom connects between home and school. Tribal cultural based learning experiences provided in the classroom was more enjoyable and valued the cultural beliefs.

Culturally relevant teaching connects the daily lived experiences with the concepts in the classroom which enable the students' to represent their knowledge.

CONCLUSION

Teachers are the most accountable agent for the students' learning and their educational outcome. In order to teach culturally diverse students' more effectively, it is necessary for the teacher to understand the interactive relationship among individuals and group in the areas of culture. Culturally relevant teaching deals with personal, moral, social, cultural, and academic knowledge and skills that are taught at the same time. Several research findings also revealed that the culturally relevant teaching improved students' knowledge and skills. Present study results also witnessed that the culturally relevant teaching significantly improved students' scientific knowledge and skills.

REFERENCES

- Abubakar, Tanjung, Y. I., Sani, R. A., Nasution, B., Yohandri, & Festiyed. (2024). Science Teachers' Understanding of Culturally Responsive Teaching on Independent Learning Curriculum. *Jurnal Penelitian Pendidikan IPA*, 10(1), 156–164.
- Atwater, M. M. (2001). Culturally Relevant Science Teaching. *International Journal of Science Education*, 23(8), 803–820. <https://doi.org/10.1080/09500690110055549>
- Barton, A. C., & Tan, E. (2010). "Funds of Knowledge" for Science Education: Theorizing Practices in and out of School. *Studies in Science Education*, 46(2), 1–21. <https://doi.org/10.1080/03057267.2010.516339>
- Brown-Jeffy, S., & Cooper, J. E. (2011). Toward a Conceptual Framework of Culturally Relevant Pedagogy: An Overview of the Conceptual and Theoretical Literature. *Teacher Education Quarterly*, 38(1), 65–84.
- Frimpong, R. A., Amoah, C. A., & Owusu, M. (2018). The effect of culture on the teaching and learning of science at the basic schools in Ghana. *Journal of Education and Practice*, 9(20), 121–127. Retrieved from https://www.researchgate.net/publication/327733420_The_Effect_of_Culture_on_the_Teaching_and_Learning_of_Science_at_the_Basic_Schools_in_Ghana
- Gay, G. (2000). *Culturally Responsive Teaching: Theory, Practice, & Research*. Teachers College Press.
- Gay, G. (2010). *Culturally Responsive Teaching: Theory, Research, and Practice*. Teachers College Press. Retrieved from <https://www.tcpress.com/culturally-responsive-teaching-9780807751155>
- Halim, L., Ramli, M., & Ali, M. N. (2023). *Culturally Responsive Science Pedagogy in Asia: Status and Challenges for Malaysia, Indonesia and Japan*. Routledge.
- Ladson-Billings, G. (1994). *The Dreamkeepers: Successful Teachers of African American Children*. Jossey-Bass. Retrieved from <https://www.wiley.com/en-us/The+Dreamkeepers%3A+Successful+Teachers+of+African+American+Children-p-9780787905265>
- Ladson-Billings, G. (1994). *The dreamkeepers: Successful teaching for African-American students*. Jossey-

Bass.

- Ladson-Billings, G. (1995a). But that's just good teaching! The case for culturally relevant pedagogy. *Theory into Practice*, 34(3), 159-165. <https://doi.org/10.1080/00405849509543675>
- Ladson-Billings, G. (1995b). Toward a theory of culturally relevant pedagogy, *American Educational Research Journal*, 32(3), 465-491. <https://doi.org/10.3102%2F00028312032003465>
- Ministry of Human Resource Development. (2020a). *National Education Policy 2020 Ministry of Human Resource Development Government of India*. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- National Council for Teacher Education. (2009). National Curriculum Framework for Teacher Education. National Council for Teacher Education.. New Delhi. Retrieved from [http://www.teindia.nic.in/files/national curriculum for teacher education-2009.pdf](http://www.teindia.nic.in/files/national%20curriculum%20for%20teacher%20education-2009.pdf).
- National Policy on Education. (1986). Programme of Action (1992). Department of Education, Ministry of Human Resource Development. Government of India: New Delhi, India.
- NCERT. (2000). National Curriculum Framework of School Education. New Delhi: National Council of Educational Research and Training.
- NCERT. (2005). National Curriculum Framework, New Delhi: National Council of Educational Research and Training.
- Parker, S. K. (1998). Enhancing role breadth self-efficacy: The roles of job enrichment and other organizational interventions. *Journal of Applied Psychology*, 83(6), 835–852. <https://doi.org/10.1037/0021-9010.83.6.835>
- Piaget, J (1977). Problems in Equilibration: Theory, Research and application (pp.3-130) New York: Plenum.
- Rahayu, B. N., Muchlis, M., & Mumpuni, A. W. (2023). The Implementation of Culturally Responsive Teaching to Improve Students' Learning Outcomes and Activity. *Jurnal Pendidikan IPA Indonesia*, 5(2), 97–106.
- Rahmawati, Y., Mardiah, A., Taylor, E., Taylor, P. C., & Ridwan, A. (2023). Chemistry Learning through Culturally Responsive Transformative Teaching (CRTT): Educating Indonesian High School Students for Cultural Sustainability. *Sustainability*, 15(8), 6925
- Richards, H. V., Brown, A. F., & Forde, T. B. (2007). Addressing Diversity in Schools: Culturally Responsive Pedagogy. *TEACHING Exceptional Children*, 39(3), 64-68. <https://doi.org/10.1177/004005990703900310>
- Shade, B. J., Kelly, C. A., & Oberg, M. (1997). *Creating culturally responsive classrooms*. American Psychological Association. <https://doi.org/10.1037/10268-000>
- Suhendi, S., Yufiarti, Y., & Zulela, M. S. (2023). Exploring the Effect of Cultural Responsive Teaching and Brain-Based Learning to Improve Critical Thinking Skills in Different Learning Styles. Syekh Nurjati International Conference on Elementary Education.
- Venville, G. J., & Dawson, V. M. (2010). The Role of Culturally Responsive Pedagogy in Science Education. *Studies in Science Education*, 46(2), 121–146. <https://doi.org/10.1080/03057267.2010.516334>
- Villegas, A. M., & Lucas, T. (2002). Preparing culturally responsive teachers: Rethinking the curriculum. *Journal of Teacher Education*, 53(1), 20–32. <https://doi.org/10.1177/0022487102053001003>
- Yoon, J., & Martin, L. A. (2019). Infusing Culturally Responsive Science Curriculum into Early Childhood Teacher Preparation. *Research in Science Education*, 49(3), 697–710.