Summary of ERIC Projects

Exploration of Culturally Relevant Teaching to Develop Science Process Skills and Knowledge among Tribal School Students of Class VI in the State of Madhya Pradesh

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Introduction

The National Education Policy (NEP) 2020 emphasises on the developing 'process' and the 'product' of science to adopt learner-centred pedagogy. The policy recommends the incorporation of local and indigenous knowledge, culture and cultural ethos in the curriculum and pedagogy. Indian society is multicultural and the classrooms are culturally diverse in nature. Therefore, a science teacher should be aware about students' cultural background, knowledge, attitude and cultural responsiveness. The pedagogy should be adopted according to the nature of classroom diversity to meet the learning needs of students with culturally different backgrounds. Children can actively participate in learning science by conducting experiments and activities to develop scientific knowledge and skills.

Status of Science Teaching in Tribal Region

India has fifteen lakhs schools, both government and privately funded, and only 15 per cent are located in urban areas, and rest of the schools are located in rural areas. The nation is attempting

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to enhance the quality of education through different programmes and schemes, such as Sarva Shiksha Abhiyan, Mahila Samakhya, Kasturba Gandhi Balika Vidyalaya, Mid-day Meal Scheme (now PM-POSHAN), Mahila Smakiya, National Programme for Education for Girls at Elementary Level (NPEGEL), Rashtriya Madhyamik Skiksha Abhiyan (RMSA), Inclusive Education of the Disabled at Secondary Stage (IEDSS), Scheme of Information and Communication Technology (ICT) at school, Vidyanjali, Ashram schools, residential schools, scholarship facilities, Atal Tinkering Lab, Virtual lab and several other measures. There is a shortage of teachers in schools located in tribal regions. This situation distracts the tribal students to continue their study. Such problems are also quite predominant in rural schools. The report of Learning without Burden, 1992-93; PROBE Report, 1996 and 2006; Hoshangabad Science Teaching Programme, 1972–2002; Homi Bhabha Centre for Science Education (HBCSE), 2004; NCF, 2000 and 2005; NKC, 2008 revealed that majority of schools follow the lecture method, and students memorise the concepts with no practical experiments. As a result, students perform poorly in process skills and scientific knowledge.

Science as both Process and Product

The process and product of science are the inherent aspects of the nature of science. Science process skills include the integration of all skills—procedural, experimental, investigational, manipulative, scientific inquiry, communication, reflective, predictive and inference. Whereas, the products of science are facts, principles, formulae, methods, theories, generalisation and their applications to understand and natural phenomena. Both are inseparable in the practice of teaching-learning of science.

Culturally Relevant Teaching

Culture influences the cognitive functions of students. The students are more eager to learn when the teachers are caring towards them and use pedagogical approaches based on knowledge linked to their own culture. Hence, culture is a critical component in science learning. Culturally relevant teaching is based on the ideas of critical pedagogues. It refers to a teaching style that integrates students' knowledge of their cultural background, previous community experiences in the curriculum and the pedagogical process in the classroom. According to them, it is a teaching-learning process

that recognises that all the students acquire knowledge and skills differently.

Objectives

1. To develop science process skills and scientific knowledge through culturally relevant teaching among the students of Class VI.
2. To study the effectiveness of culturally relevant teaching in terms of the development of science process skills and scientific knowledge with regard to gender, and tribal and non-tribal students.
3. To study the student's opinion towards culturally relevant teaching for the development of science process skills and scientific knowledge.

Sample

The population for the proposed project study is government school's students of Class VI in the state of Madhya Pradesh. The sample for the present study was 45 students of Class VI, from Pondki High School located in Lalpur village, Amarkantak, Anuppur District, Madhya Pradesh. The sampled students belonged to Gond, Panika tribal community and non-tribal students, such as Yadav, Banjara and Nayak. The sample comprises of 22 girls and 23 boys.

Data Analysis

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

Findings on process skills before implementation of culturally relevant teaching

Observation Skill

- The 74.99 per cent of the students' observation skill were in the beginning stage. It means that students were unable to observe the qualitative and quantitative information or any fine details of the given specimens and pictures. They did not notice the similarities and differences between two pictures of animals. Though the hand-lens was provided, they were

still unable to notice any details. The sensory organs were not used effectively to observe the information.

Classification Skill

- The 75.71 per cent of students' classification skills were in the beginning stage, wherein the students were unable to classify or categorise the materials, substances, organisms based on their common characteristics, or properties or attributes. For example, students were unable to classify animals into carnivores, herbivores, omnivores, vertebrates and invertebrates; materials and substances into transparent, translucent and opaque; metals and non-metals; acids and bases.

Communication Skill

- The 80.06 per cent of students' communication skills were in the beginning stage. It means that they were unable to draw a table and a diagram, plot the line graph, bar diagram, and pie chart for the given data. They did not know how to put an arrow mark between animals to show the food web and its relationship.

Measurement Skill

- The 80.42 per cent of the students were in the beginning stage, it means that the students did not know how to measure the length, breadth and height. They incorrectly measured the weight of an object (stone) with the help of a pointer or a spring balance, and also incorrectly measured the temperature of water with the help of a thermometer. They were unable to measure the volume of water by using beaker, pipette and burette correctly. They had committed an instrumental, observational and procedural error. They also did not mention the correct measurement unit.

Prediction Skill

- The 85.21 per cent of students were in the beginning stage of prediction. It means that students were unable to predict the floating and sinking of ice cubes experiments based on the observations. They incorrectly predicted the simple pendulum experiment, angle between two mirrors, and evaporation of liquids experiment. Students did not write any reasons or explanations for their predictions.

Inference Skill

- The 79.56 per cent of students' inference skill were in the beginning stage. It means that students were unable to derive inferences based on the observations of pictures and experiments. Students wrote a few observations instead of inferences. They were unable to distinguish between observations and inferences.

Findings on process skills after implementation of culturally relevant teaching

Observation Skill

- The 78.26 per cent of students' observation skill was in the exemplary stage, wherein the students observed the qualitative and quantitative information, and fine details of specimens. They observed the similarities and differences from the pictures of animals. Also, the steps and materials used for carbohydrate test, protein test and fat test were observed. It indicates that the students effectively engaged their sense of organs for observations.

Classification Skill

- The 80.43 per cent of students' classification skill was in the exemplary stage, wherein the given materials, substances, organisms, food items were classified according to common properties and characteristics. Students skilfully grouped things based on common attributes.

Communication Skill

- The 78.25 per cent of students' communication skill was in the exemplary stage, wherein the students correctly drew tables, diagrams and pie chart, and correctly plotted the line graph, bar graph, and pie chart for the given numerical data. Students drew correct arrow marks to show the interrelationship of animals in the food web.

Measurement Skill

- The 86.71 per cent of students were in the exemplary stage. It means that the students very accurately and precisely measured the length, breadth and height of the table; accurately measured the weight of the object by using a

pointer balance, accurately measured the volume of water by using a measuring cylinder and beaker; and 20 ml of water pipetted out by using pipette. No upper or lower meniscus error was found. The temperature of water very accurately measured by using a thermometer. The angle between two mirrors was measured correctly by using a protractor. Measurement units were also written properly.

Prediction Skill

- The 73.47 per cent of students' prediction skills were in the exemplary stage, wherein students correctly predicted the future occurrences based on the observation of pictures and experiments. For example, they correctly predicted that ice cubes float in water. They almost correctly predicted the time taken for 15 oscillations and angle between two joined mirrors. Reasons or explanation for their predictions were also correct.

Inference Skill

- The 76.95 per cent of students' inference skill was in the exemplary stage, wherein they correctly derived inference based on the observation of animals' pictures and experiments. For example, they inferred that the animals' pictures are herbivores, carnivores and omnivores; and oxygen is required for burning of a candle. Students acquired the skill of prediction.

Findings with regards to achievement on process skills and scientific knowledge

- It was found that girls scored better in the pre-test than boys after giving treatment through cultural relevant teaching.
- Both genders scored more in the post-test. However, boys slightly scored more in the post-test than the girls in understanding the knowledge on science process skills in the constructed achievement test.
- It was found that the girls performed better in pre-test score than boys. After giving treatment through cultural relevant teaching, both genders scored more in the post-test. However, boys scored slightly less in the post-test than the girls in understanding the concepts of the scientific knowledge.
- It was found that tribal students performed better in pre-test than the non-tribal students. After giving treatment through

cultural relevant teaching, both tribe and non-tribe students scored more in the post-test. However, tribal students scored slightly higher than the non-tribal students in the post-test in understanding the knowledge on science process skills.

- It was found 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 score better in pre-test than tribal students. After giving treatment through cultural relevant teaching, both tribal and non-tribal students scored more in the post-test. However, non-tribal students scored slightly more than the tribal students in the post-test in understanding the concepts of the scientific knowledge.

Hence, from the above findings, it can inferred that the implemented culturally relevant teaching is effective in terms of acquisition of science process skills and scientific knowledge, irrespective of gender and community.

Recommendations

The following recommendations are suggested to improve the quality of learning:

- Science Teachers need to create learning environments, learning resources and pedagogical materials, which are suitable for culturally diverse students and made accessible to all learners whenever required.
- The curriculum and textbooks should be more flexible and adaptive so that the local knowledge and lived experiences of the learners can be integrated effectively according to their need and interest.
- Science teachers must know the different cultural background of students' previous knowledge, interest, strength and learning style, and the learning strategy should be designed accordingly.

Implications of the Research

The following implications are derived based on the present study findings:

- The study results evidenced that the students in the classroom are culturally rich and varied, hence, there must

be a curriculum which is more culturally responsive in the pre-service teacher education programme so that the teacher educators can prepare the future teachers with knowledge and skills on culturally relevant pedagogy.

- The study findings imply that the students' acquired basic process skills may help them to acquire the integrated process skills, and develop higher order thinking skills among students.
- The students apply the basic process skills in their daily life to solve the problem.
- Tribal and non-tribal students develop their scientific attitude which help them to prefer science as discipline of study in their higher education.

Conclusion

Culturally relevant teaching deals with personal, moral, social, cultural, and academic knowledge and skills that are taught at the same time. The study results witnessed that the culturally relevant teaching significantly improved students' process skills and scientific knowledge. Further, it was found that they enjoyed the teaching-learning process. They felt that their culture was recognised and acknowledged. It indicates that in order to foster student's high academic achievement in science, it is required that the teaching should be culturally supported, culturally learner-centred, in which students' culture is identified, nurtured and utilised. As stated by the NEP 2020, the preservation and promotion of Indian culture, and arts and languages among the children is a high priority. It is through the development of sense of knowledge of culture, arts, language and traditions that the children can build a positive cultural identity and self-esteem. Hence, teachers need to build a pedagogical bridge that connects students' cultural knowledge and contents.