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CULTURALLY RESPONSIVE PEDAGOGY IN SCIENCE CLASSROOMS

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Abstract:-Indian society is an amalgam of diverse cultures and so are the Indian classrooms. Learners from diverse cultures bring the vast repertoire of traditional and indigenous knowledge of their culture to the classrooms (Snively & Corsiglia, 2000). They come to schools with their own fund of knowledge built upon the stories, beliefs, customs, folklore, value systems, history, language and perspectives owned by their respective cultures. The learner, with already having his/her own baggage of culture, has to interact with the culture of school science, which is in nothing but the culture of scientific community itself. In such case, learners are forced to abandon or marginalise their own worldviews to internalise a different way of conceptualising about events and processes happening around them. They might feel alienated in a science classroom where the science pedagogy is oriented to the typical western modern science (Ogawa, 1995). In other words, traditional science content reflects a western sub-culture which aboriginal children find difficult to comprehend (Aikenhead, 1996, 1997).

A *cross-cultural* (Aikenhead, 1997) science education may benefit various children who are at disadvantage due to their cultural differences, social status and/or marginalisation. As an implication, the science teachers must be knowledgeable of the socio-cultural background of their students (Snively & Corsiglia, 2000); have a sense of appreciation for diversity among learners; be aware of their diverse needs and interests; and competent enough for a culturally responsive pedagogy. Richards, Brown and Forde (2007) suggested catering to *institutional*, *personal*, and *instructional* dimensions in order to facilitate a culturally responsive pedagogy. With this understanding, author has attempted to suggest possible implications for various elements of school science curriculum, including suggestions for teachers, textbooks and instructional strategies; that would help in promoting culturally responsive science pedagogy to respond well to the inherent diversity in our Indian society.

Keywords: Science Classrooms , Indian society , traditional and indigenous .

INTRODUCTION :-

Science classrooms are traditionally found to act as site of cultural conflict where the learners are generally made to acquire an unfamiliar culture of school science. Learners from diverse cultures bring the vast repertoire of traditional and indigenous knowledge of their culture to the classrooms (Snively & Corsiglia, 2000). They come to schools with their own fund of knowledge built upon the customs, beliefs, stories, folklore, value systems, history, language and perspectives owned by their respective cultures. Similarly, Furnham (1992) (cited in Cobern & Aikenhead, 1997; p.3) had also identified several powerful subgroups that influence the learning of science that include- the family, peers, the school, the mass media, and the physical, social, and economic environment. Members of each subgroup generally embrace a specific system of meaning and symbols through which social interaction takes place.

Science itself is considered a subculture of 'Western' or 'Euro-American' culture and scientists share a well defined system of meaning and symbols through which social interaction takes place across scientific community (Cobern & Aikenhead, 1997). The main goal of school science has been cultural transmission of the subculture of science. Owing to their unique socio-cultural backgrounds, learners find it difficult to assimilate traditional science content and generally feel alienated to the culture of school science. The learner, with already having his/her own baggage of culture, has to interact with the culture of school science. In such case, learners are forced to abandon or marginalise their own worldviews to internalise a different way of conceptualising events and processes happening around them. Aikenhead (1996, 1997) emphasised that

traditional science content reflects a western sub-culture which aboriginal children find difficult to comprehend. Students have to struggle a lot to negotiate the cultural borders between their indigenous subcultures and the subculture of science.

CULTURAL PERSPECTIVE ON SCIENCE EDUCATION

Traditional science education aims at developing scientific literacy among learners and preparing them for specific professions in science and technology. In conventional sense, this scientific literacy is mainly confined to acquisition of scientific facts and principles. Learners are made to undergo the science curriculum where they are supposed to abandon their own cultural way of thinking for accommodating scientific way of comprehending nature. Certain students, who find some identical features in scientific subculture and their own cultural context, may find it easier to undergo this enculturation. Everyday thinking of these students who are able to adopt the scientific subculture is found to be dominated by scientific thinking. Some learners however devise certain strategies (so called “fatima's rules” as mentioned in related literature) to learn science content without actually understanding it meaningfully. However, others who can't assimilate the scientific perspective remain marginalised in their classrooms and do not achieve much in traditional science curriculum. Aikenhead (1997, p.223) summarised the cultural perspective on conventional school science curriculum as shown in figure1-

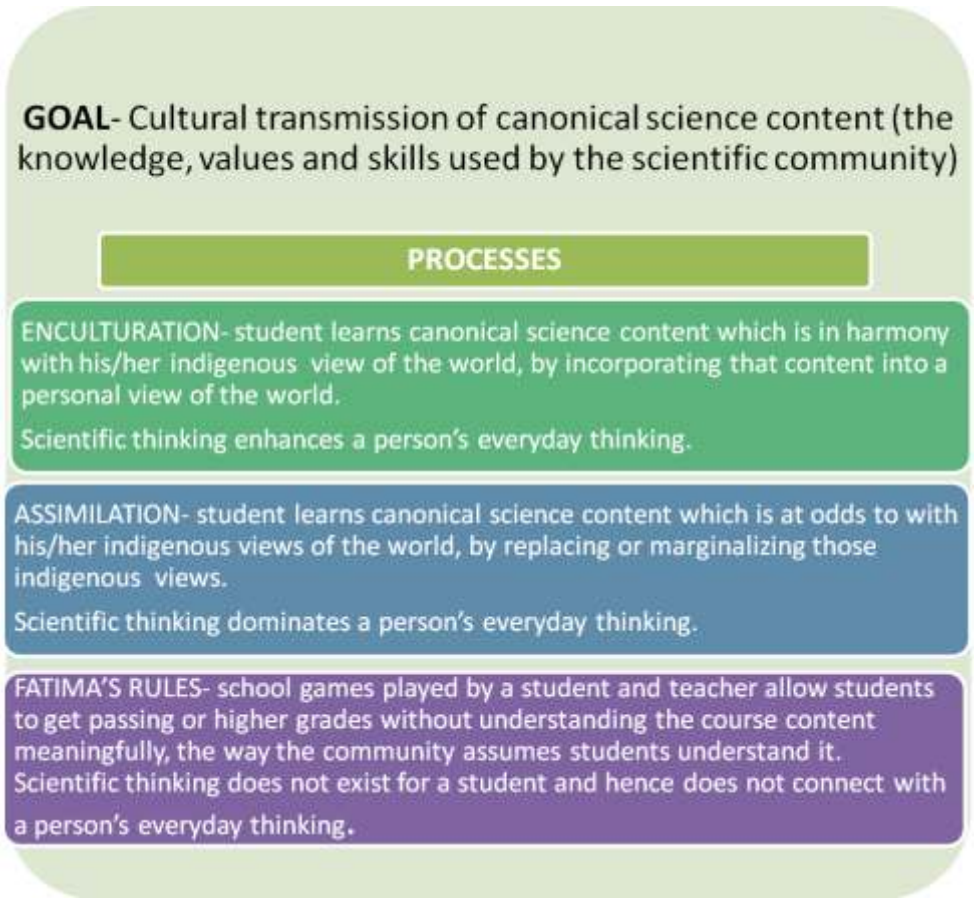

Figure The conventional school science curriculum (source: Aikenhead, 1997, p.223)

A cultural perspective on science education is founded on several assumptions as summarised by Aikenhead (2001; p.4)-

(1)Western science is a cultural entity itself, one of many subcultures of Euro-American society;
(2)people live and coexist within many subcultures identified by, for example, language, ethnicity, gender, social class, occupation, religion and geographic location;
(3)people move from one subculture to another, a process called “cultural border crossing;”
(4)people's core cultural identities may be at odds with the culture of Western science to varying degrees;
(5)science classrooms are subcultures of the school culture;
(6)most students experience a change in culture when moving from their life-worlds into the world of school science; therefore,
(7)learning science is a cross-cultural event for these students;
(8)students are more successful if they receive help negotiating their cultural border crossings; and

(9)this help can come from a teacher (a culture broker) who identifies the cultural borders to be crossed, who guides students back and forth across those borders, who gets students to make sense out of cultural conflicts that might arise, and who motivates students by drawing upon the impact Western science and technology have on the students' lifeworlds.

Aikenhead (1980) suggested the need to renegotiate the culture of school science in order to improve science education. He emphasised that science educators need to replace conventional school science aiming at pre-professional training, with the school science that may develop savvy citizens having an understanding of the social context of science and technology. While Aikenhead (1996, 2001) talked about role of science teacher as 'culture broker' to facilitate 'border crossing' by students for learning science content, Jegede (1995) proposed a 'collateral learning' of both western and traditional knowledge of science. He emphasised on teaching science concepts to non-western students from both western as well as traditional point of view in order to help them construct both western and traditional meanings of simple science concepts which can be used by them strategically in both the western and traditional environment.

Aikenhead (1997, p.228) has proposed that one curriculum implication for science would be to develop instructional materials that-

Make border crossings explicit for students.
Facilitate border crossings.
Substantiate the validity of students' personally and culturally constructed ways of knowing.
Teach the knowledge, skills, and values of Western science and technology in the context of societal roles (social, political, economic, etc.), including the role of a hegemonic icon of cultural imperialism.
In order to enable learners assimilate this scientific subculture and develop a harmonious balance between western science and their own traditional cultural knowledge, a culturally responsive pedagogy may be of great help to science teachers.

CULTURALLY RESPONSIVE PEDAGOGY

According to Richards, Brown and Forde (2007)- "In a culturally responsive classroom, effective teaching and learning occur in a culturally supported, learner-centered context, whereby the strengths students bring to school are identified, nurtured, and utilized to promote student achievement" (p.64). They have explained three significant dimensions of culturally responsive pedagogy- *(a) institutional, (b) personal, and (c) instructional,* those significantly interact in the teaching- learning process (figure 2). Significant reforms at these three levels are necessary to ensure a culturally appropriate pedagogy in science classrooms.

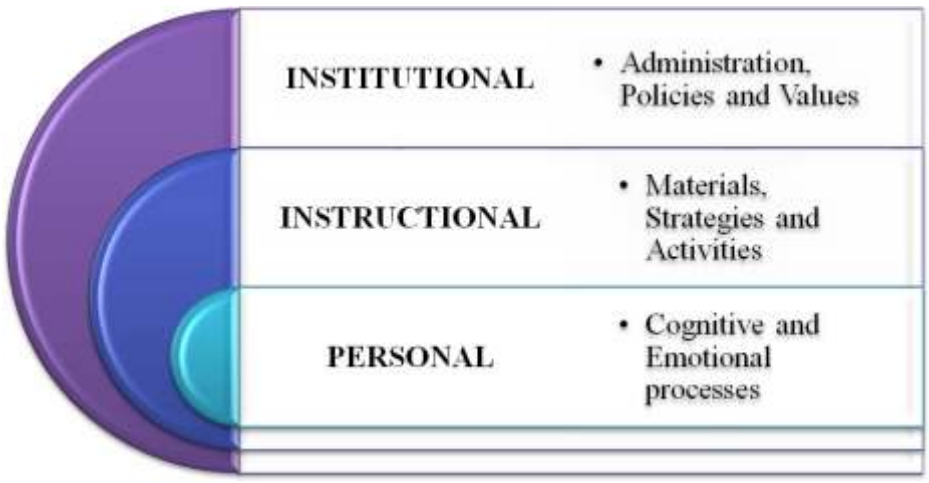

Figure 2. Dimensions of culturally responsive pedagogy (Richards, Brown & Forde, 2007)

1.Institutional dimension: This dimension is particularly concerned with making provisions for- organisation of school and administrative structure relating to the diversity; policies and practices for students from varied backgrounds and cultures; procedures for allocation of resources to learners belonging to diverse backgrounds; and, community involvement in school practices. These provisions eventually impinge upon next two dimensions that are directly related to pedagogical practices.

2.Personal dimension: The major concern for this level is teacher's self reflection on his/her own practices since their own beliefs, prejudices and value systems often impact their interaction with learners and teaching-learning process to a larger extent. Also they are expected to be aware of the social and cultural background and specific needs of their learners. It further

demands that the teachers be sensitive to the learners backgrounds and remain unbiased in their teaching practices. After all, to be effective in a diverse classroom the teacher must have developed an appreciation for the diversity inherent among the learners based on their class, caste, gender, language, religion, disability or any other basis.

3.Instructional dimension: It demands that the tools for instruction i.e. textbooks, teaching methods and activities etc. must be compatible with the learners' diverse cultural backgrounds and contextual experiences. So, the teachers must cognise the individual differences among the learners and their specific learning needs without any preconceived notions against them. Teachers must ensure the use of culturally supportive instructional material and textbooks for learners. More the familiar experiences provided to learners at school and classrooms, more the feeling of inclusion developed among them. Teaching learning activities must provide opportunities to learner for interacting with people with varied backgrounds and also with each other in a heterogeneous classroom. This develops among them the necessary knowledge, skills to relate and appreciate cultural differences in the classroom as well as in the society at large. Further, the teachers should be able to tap the community resources in their classroom teaching-learning process that would positively reinforce the school-community relationship also.

A science teacher has to play a catalytic role in culturally responsive pedagogy. Kelly-Jackson and Jackson (2011) mentioned that- "Culturally relevant teachers see themselves as members of the community and teaching as a way to give back to the community. They also believe that all their students are capable of academic success. When cultivating social relations in their classrooms, culturally relevant teachers demonstrate a connectedness with all of the students and encourage students to learn collaboratively and be responsible for one another. Finally, when it comes to conceptions of knowledge about the curriculum and content, culturally relevant teachers view knowledge as shared, recycled and constructed. They promote the idea that knowledge is not static and must be viewed critically"(p.409) It indicates that the science teachers needs to emphasise social, cultural, economical, political and ethical dimensions of science while teaching. Hence, in culturally appropriate teaching, the science teacher needs to go much beyond teaching simply facts and theories in order to enable learners critically evaluate science concepts in socio-cultural context.

CULTURALLY RESPONSIVE PEDAGOGY IN INDIAN SCIENCE CLASSROOMS

In the context of *'Science Education and Diversity'* (SED) project funded by the European Union's FP7 programme involving six partner countries (the UK, the Netherlands, Turkey, Lebanon, India and Malaysia), Chunawala and Natarajan (2011) have discussed the salient features of existing diversities in India. They have talked about the structure of education in the country, the various educational policies addressing diversity, the role of agencies responsible for curriculum development and the national curriculum framework with respect to the science education in the country. The SED project aims to understand the mosaic of cultural, socio-economic relationships with science education and accordingly design new approaches to science education that will appeal to all students and are sensitive to diversity. Authors have emphasised that- "lack of basic resources, poor curriculum development, language barriers, gender issues and a wide rural-urban divide acts as major barriers when it comes to supporting diversity in education. Right from independence, deliberate efforts have been made in India, in terms of educational policy-making, which has paid greater attention to the general educational deprivation experienced by the girl child or children from minority ethnic/cultural identity groups. The various policies like NPE 1968 and 1986, NCF 2005 were all bought into force to address the diversity existing in India." (P.139)

Findings of the first India Science Report (Shukla, 2005) by National Council of Applied Economic Research (NCAER) indicate that the interest in all types of science education does not decline much- 60 % of the students at the class 6 to 8 wanted to pursue some science education (pure science, engineering or medicine) at a higher level as compared to 57 % students in classes 11 and 12. Overall not too many students (10 % at the +2 level) stated that they keep away from science as it is a costly subject to pursue. About 45% stated that they were not pursuing science because they had no interest in science. Another 20% said that they had taken up arts/commerce because science is a difficult subject. In a sense, it indicates that the problem of students' negative attitude towards science and their disinterest in science education still persists in India. One of the reasons for the declining trend in pursuing science education at the higher levels is the increasing dissatisfaction of students with teaching of science in the higher classes in school.

For the reason of disinterest in science, a third of them said that they did not study science as they did not feel motivated enough. Another 40% said that the number of students in a class were too many for them to understand what was being taught. However, the teachers gave quite different explanations for limited interest in science among students such as costly and difficult education apart from limited job opportunities. Impact of socio-economic background on choice of subject at higher level is also one key finding of the survey. Children of agriculturists tend to study arts courses a lot more than those whose parents are salary earners or businessmen. Those in rural areas also tend to go in more for arts than those living in urban areas. A fourth of the students surveyed wished to become engineers, but the number was much lower for those whose parents were agriculturists/wage earners.

These findings of India science report and related research in the field of science education certainly impinge upon the need to have a science curriculum at school that students can really find interesting, relevant and responding well to their own contexts. National Curriculum Framework 2005 (NCERT, 2005) emphasises learner centered pedagogy for the school subjects. The position paper on teaching of science (NCERT, 2006) has also emphasised on using science curriculum as an instrument of social change to reduce the divide related to economic class, gender, caste, religion and region. It is stated in

position paper that- *"…. so far, the system has failed to address the issue of quality science education 'for all' adequately. Many students come out of schools as 'scientific illiterates' or would soon lapse into this state. This is basically because many groups of students are placed in a disadvantageous position vis-a-vis learning of science. The disadvantaged groups include girls, children from rural areas, tribal and other socio-economically underprivileged children in rural as well as urban areas, those with learning difficulties and physically challenged children. Learning needs of these disadvantaged groups require greater attention. The system, in general, and the teachers in particular have to be sensitive to the needs of these diverse groups of children. (p.28)"* Thus, it is required that teachers must be able to deal with these diversities existing within a classroom as well.

Following are the implications of cultural perspective on science education and culturally responsive pedagogy that would play a pivotal role in providing a meaningful science education to learners in Indian classrooms-

Access to science education for all- Science curriculum would respond well to all social groups if they have enough provisions for access to quality science education. Access to science education at higher levels is still limited in our country especially for students studying in government schools and particularly for girls. Provisions are required to ensure enough opportunities for certain sections of society for access and retention with respect to science education.

School-community interaction- Schools are required to provide opportunities for appreciating cultural expressions in science through various activities; such as, organising science fair emphasising portrayal of indigenous science and technology, interactions with community through filed visits, or inviting experts from local community to school for orienting children about traditional practices and technologies etc. Aikenhead (1997) also talks about 'community-based participatory research' as one way to develop an appropriate subculture for school science. This is how enculturation of science culture can happen among students with much ease.

Science textbooks- Science textbooks in India are still found to be dominated with portrayal of western image of science. Although NCF-2005 had recommended for contextualisation of science textbooks and linking science more with learners' own environment. Still we can see that the national level science textbooks by NCERT are propounding only western perspectives. There is very rare opportunity for students to get familiar with traditional / indigenous technologies of India and their significance to promote sustainable practices in various fields of science and technology. There are not enough opportunities for students to learn and acquire locale specific technological skills to enter the world of work. Moreover, contribution of Indian philosophers and scientists in the field of science and technology is not highlighted much. (Sharma, 2013)

No doubt if students will get the impression that knowledge of science is only a monopoly of western world. Other nations have not contributed significantly to scientific knowledge and technological development. Students should be made familiar about the people of Indian origin who have significantly contributed to the field of science. This would also motivate and inspire children for pursuing science with more interest if they also find some role models. Similarly, a sensitive representation of different social groups those are generally marginalised including women is needed to be ensured in science textbooks.

Relating science with learner's context- Science teachers must be aware of social profiles of their students and their individual differences in terms of backgrounds, cognitive strategies, specific needs and interests. This knowledge of learners' family and socio-cultural background will enable the teacher to plan a relevant learning experience for the learners. It encompasses the knowledge of history, traditions and indigenous knowledge of the social groups to which their learners belong. This may enable the teacher to contextualise and relate knowledge of science concepts with learners' everyday life knowledge. For instance, students whose parents are traditionally fabric weavers, potters or agriculturist would be aware of significant aspects of fibres, soil or crop production respectively. Their own fund of traditional knowledge should be given due recognition in science classes and taught the scientific concepts by relating and comparing with traditional knowledge. This is how teachers enable their learners 'cross cultural borders' in science classrooms.

Appreciation for diversity- Science teachers should be free from stereotypical notions or negative feelings towards learners coming from diverse backgrounds. Rather they should have a sense of appreciation for diversity and use it as resource while teaching science concepts. If the teacher finds textbooks not representing different groups in society adequately or may be propounding some stereotypes, then the teachers may supplement teaching with other relevant resources to address the situation. Teachers are needed to adopt a fair treatment to all students from diverse backgrounds and not to criticise a student's behaviour just because of his/her cultural influence. Their indifference to certain social groups particularly towards girls in science classes creates a negative image of science among learners and sometimes in their lower achievements in science subjects. When the teachers are free from such biases, they are better able to create a positive and congenial environment in their classrooms for students coming from diverse backgrounds.

STS approach to school science- As suggested by Aikenhead (1997, p.229), STS being a student oriented, critical, and environmentally responsible approach to science contextualises Western science in the social and technological settings relevant to learners. Such cross-cultural STS science curriculum would facilitate cultural border crossing for the purpose of enhancing students' capabilities and motivations to eclectically draw upon their own cultures and upon the subculture of science and technology. In Indian context also, NCF-2005 (NCERT, 2005; 2006) has suggested that science curriculum must relate to the environment (natural, technological as well as social) local as well as global. Thus, the use of STS approach for organising science curriculum is needed to ensure the goals of cross-cultural science education. For this, every concerned

aspect of school science curriculum (whether textbooks or pedagogy or assessment or teachers' orientation) need to be reformed.
Active learning among students – It must be acknowledged by the science teachers that all students have potential to learn regardless of their gender, socio-cultural background, abilities or disabilities. The teacher must abandon the elitist view of science and try to engage students in more inclusive teaching-learning activities. Opportunities for active engagement in science learning can be provided through cooperative tasks, discussions, creative expressions, observations and experimentation, designing and improvising, and problem solving activities.

CONCLUSIONS

This paper has tried to explore the cultural perspectives on conventional school science and dimensions of culturally responsive pedagogy as evident in related literature. Implications for a culturally responsive school science curriculum have been suggested keeping in mind the nature of Indian classrooms. It is surprising to note that even after so many reforms in Indian education we are still grappling with the issues of disinterest for science among students and limited access to science education for lot of social groups. Demands for 'quality science education for all' indicate a need to revamp our school curriculum to promote more inclusive pedagogy in science. In the light of cultural perspectives on school science curriculum, it becomes important that we should promote a culturally responsive pedagogy in our science classrooms and teachers accept their roles as culture broker as envisioned in recent debates on culturally appropriate science education.

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