ENVIRONMENT EDUCATION AT HBCSE: A REVIEW

Adithi Muralidhar

Homi Bhabha Centre for Science Education (TIFR), Mumbai

adithi@hbcse.tifr.res.in

Since its inception in 1974, the Homi Bhabha Centre for Science Education (HBCSE) has been involved in research, development, teacher professional development, science popularization and outreach activities in science and mathematics education. Since the 1990s, an array of research areas that include design and technology education, health and environment education, cognitive studies of science and mathematics learning, curriculum and classrooms transactions, sociocultural and attitudinal studies, history and philosophy of science have been explored. There is an emphasis at the Centre to engage in science communication and popularization through outreach programmes at the school and college levels. This has involved development of models of dissemination through a combination of face-to-face interactions as well as materials in print and on the internet. This paper will review some of the projects undertaken at HBCSE over the last two decades that have addressed environmental awareness, environment education and its related aspects, and critical reasoning.

INTRODUCTION

The world today faces several environmental issues, and these have grown in size and complexity over the last few years. These current trends in the environment have also been an increasing concern to the scientific community (Huston 1994). This has led many to believe that urgent and immediate actions are necessary to stem the tide of erratic climate changes, loss of species and over exploitation of resources (Ehrlich 2010; Primack, 2008). In such a scenario, environmental education has increasingly gained more importance in today's world, as it would engage people to make more informed decisions and urge them to act in their local areas (UNESCO, 1978; 1997). In India, environment education was made a compulsory component in the school curriculum only recently. Several academic and research institutions, NGOs and individuals have also taken on the responsibility of creating environmental awareness and conducting research in this field.

ENVIRONMENT EDUCATION AT HBCSE

The Homi Bhabha Centre for Science Education (HBCSE) which was established in 1974 is a national centre of the Tata Institute of Fundamental Research (TIFR). Since then, the centre has been involved in research, development, teacher professional development, science popularization and outreach activities in science and mathematics education. Areas of research include cognitive studies of science and mathematics learning, curriculum and classrooms transactions, socio-cultural and attitudinal studies in education, role of language in learning, design and technology education, health and environment education, and history and philosophy of science etc. Since the 1990s, some of the research and development at the Homi Bhabha Centre for Science Education (HBCSE) has explored the

social, pedagogic, and scientific content aspects for promoting learning of environmental science, creating environmental awareness and encouraging critical thinking among young people. The projects described below indicate the breadth of HBCSE's engagements in environment education and its related aspects.

Diagnosing Learning In Primary Science (DLIPS)

Objective: The project attempted to diagnose students' alternative conceptions about life and living, and studied their ideas about plants and forest ecology.

Methodology: The DLIPS project (1993-96) was carried out with primary school students in Class V and VI, from one urban and two tribal schools (*Ashram Shaala*) in Maharashtra. The data was collected by several modes: listing living and non-living things, drawing a favourite living thing, drawing a plant, and separately drawing each of its parts like a branch, a leaf, flower, fruit and seed, collecting a leaf from a plant and writing about it, and drawing a context map.

Results: The study revealed that tribal students had a rich understanding of plants, seasonal variations and the forest ecology, and could name and cite uses for a large number and variety of plants. However, their drawings of plants, which had rich contextual features at the macro level, showed some incorrect structural details. The study opened up rich teaching-learning opportunities in science linked to the students' environmental contexts.

On the other hand, the urban students, who named fewer varieties of plants, also mentioned processes. The study showed that tribal students were at a disadvantage in schools because of textbook content that was de-contextualized and which mostly covered cause-effects, processes and taxonomy of plants from certain contexts. Teachers tend to stick to textbooks, and make no links to traditional knowledge and local relevance (Natarajan et.al., 1996).

Tata Talent Search And Nurture (TATSAN)

Objective: The TATSAN project (1993-96) funded by the J. N. Tata Endowment aimed to develop English comprehension and communication, as well as analytical and quantitative reasoning skills among post-school students towards building good citizenship qualities.

Methodology: The study involved 100 contact hours for each batch of about 30 students. During these periods, a variety of activity based sessions were conducted, which focused on quantitative and critical reasoning as well as communication. Several of the real world challenges raised by the students were linked to environmental issues (Natarajan, 1996). A series of activities were initiated that lead the participant from simple issues and ideas to complex ones, requiring the students to make linkages, as well as integrate their curricular knowledge with environmental and developmental issues of concern. The activities were designed to develop communication and analytical skills, use quantitative reasoning, which are essential for a practical shared understanding of issues at the interface of science, technology and society.

Results: The pedagogic strategies used in this project, and the outcomes of engagement with students are embodied in a series of 8 books, known as *Activity-based Foundation Curriculum in Science, Technology and Society*. Most activities suggested in the books have been tried with post-school students during the programme.

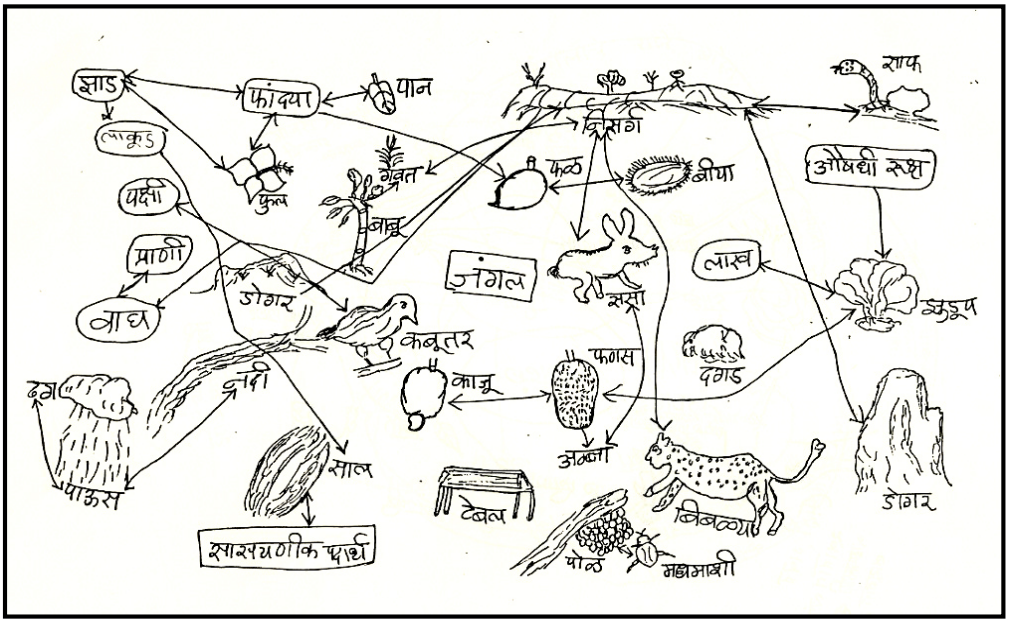

Fig.1: Context map drawn by a tribal child

Source: Natarajan et.al, 1996

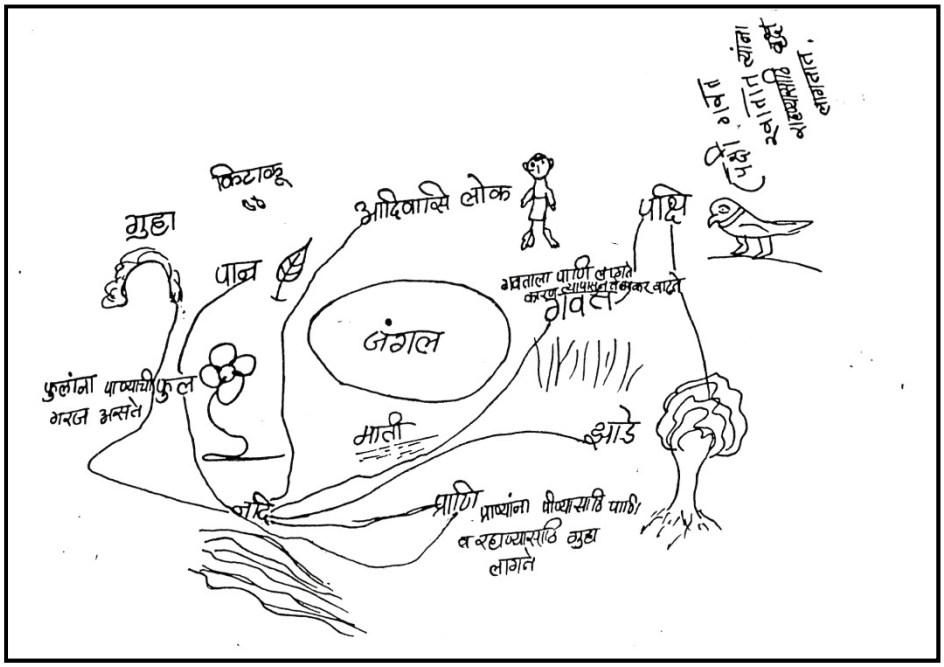

Fig.2: Context map drawn by an urban child

Source: Natarajan et.al, 1996

The entire series (Population, Energy, Land & Air, Education, Global climate change, Ecological balances, Health matters and Conflicts) are available for free download at the HBCSE website from http://www.hbcse.tifr.res.in/publications/curricular-books/foundation-curriculum

Health and Environment: Action-based Learning (HEAL)

Objective: The project involved two aspects: (a) field work, where NSS students from colleges were supervised by teachers, who were trained at HBCSE on how to carry out

various environment monitoring studies; and (b) a six-month orientation course where experts from the field of health and environment gave students a better understanding of their field work.

Methodology: The HEAL project (2004-07) approached about thousand student participants associated with the National Service Scheme (NSS) of the University of Mumbai, drawn from five colleges in Navi Mumbai. The project was a massive collaborative effort involving not only the students, their Principals, teachers and NSS coordinators, but also Navi Mumbai Municipal Corporation (NMMC), doctors from L.T. Medical College in Mumbai, and volunteers of Navi Mumbai, including police, shop keepers and residents. Through supervised field work, students carried out various environment monitoring studies. Their understanding of their field work was supported and enhanced by a six-month orientation course by experts from the field of health and environment. Students collected data about the quality of air, water and other allied aspects, along with health status of residents in the vicinity and tried to correlate health and environment.

Results: HEAL project served as a means to sensitize a large number of students who came from a variety of different disciplines, about the importance of the environment and its complex relation with health. Students gained hands-on experience and were exposed to how science works in everyday life. Most importantly, this project encouraged students to adopt sustainable lifestyles (Mahajan et.al, 2005). The final report and protocols used for collecting the date are available here- http://www.hbcse.tifr.res.in/research-development/hee

Fig.3: Students of the HEAL project doing field-work and laboratory-work
Source: Mahajan et.al. 2005

Collaboratively Understanding Biology Education (CUBE)

Objective: The CUBE project aims to promote student centred learning, interdisciplinary research and active-learning curricula. In an attempt to transform the traditional laboratory practices to inquiry based and interactive research environments, CUBE discusses theory in the context of laboratory and field practices. The larger aim of CUBE is to develop "functional learning ecologies" by means of simple model systems and thus help in re-structuring the biology education in India at both school and college level (Ghumre, Nagarjuna & Arunan, 2013).

Methodology: CUBE, which begun in 2012 is a national initiative, invites students, teachers, researchers and other Indian citizens to participate in a mass collaborative effort to revamp the nature of biology teaching and learning. Initially, the project involved undergraduate students, but now includes school students as well. Some of the projects undertaken by the students in this programme are Behaviour Watch @ Home, which is a

citizen science project under CUBE, where participants carry out rigorous observations of nature in their own 'backyard' and report them on a common internet platform. Another project is the “Simple Model-Systems” where students work with simple organisms like daphnia, earthworm or snail and study their behavioural plasticity under varying environmental (controlled) conditions. More information on CUBE projects can be found on https://abcde.metastudio.org/cube

School Science Research and Development (SSRD)

Recently, a Participatory Action Research project was initiated under the “School Science Research and Development” programme. An important part of this project is directed towards working long term with a school and its teachers to design and develop innovative lesson plans for their existing environmental science curriculum. The process involves an iterative model where lesson plans are developed in collaboration with teachers, tested with small groups of students in summer camps, and then based on feedback, the plans are modified and implemented in regular classroom setups. The aim of this exercise is also to develop a workbook for students which will have interactive worksheets on themes related to their environmental science curriculum (Deshmukh et al., 2018). Further, one part of study also looked at ways in which students may be exposed to an outdoor component when learning environmental studies which is not a regular practice in schools (Bhide & Chunawala, 2017).

Urban Farming and Environment Education

This study focuses on urban farming, as a community practice based intervention that seeks to motivate environment-conservation oriented behavior among middle school students. This action-oriented perspective strives to address the gaps and shortcomings of the information-based environment education approaches, that are currently prevalent in the Indian curriculum, and that have not adequately motivated students to adopt sustainable practices in their every day lives (Dutta & Chandrasekharan 2016; 2017). A part of this study also looked at underlying motivations amongst adults who volunteered their time in an urban farm, to indulge in environment-friendly activities (Dutta & Chandrasekharan, 2017).

Vigyan Pratibha

Recently, a project titled Vigyan Pratibha was launched in 2017 which envisages working with students with diverse backgrounds in Classes 8-10 to nurture their talent in science and mathematics (http://vigyanpratibha.in). Activities in physics, chemistry, biology and mathematics are being developed that is grounded in deep understanding, appreciation and a sense of excitement about the concerned subject. In addition, some activities are categorized as local context, which are inter-disciplinary in nature, and requires students to work with their immediate surroundings and do science. Some of these are directly or indirectly related to environment. For example, a learning unit on observing birds focuses on developing an understanding about birds and their relationship with the biotic and abiotic environment. It also aims to develop students' observation, recording and documentation skills, and more importantly re-establish students' fading connection with nature. Another learning unit focuses on observing microbial diversity from water samples collected from students' immediate surroundings.

Other Studies Other studies and research at HBCSE have included students' ideas on photosynthesis (Patel, Shome & Natarajan, 2009), their understanding of the term,

"species" (Shome, 2013), discussions on meaningful environment education (Shome & Natarajan, 2007), symbiotic approach towards environmental sensitization, and monitoring and conservation through community involvement (Shome, Khunyakari & Natarajan, 2009) etc.

In addition to the above, the centre is in the process of developing an integrated nutrient recycling system on campus, as a proposed longterm outdoor project at HBCSE campus. Some of important elements of this would be composting and farming activities, which brings together science, society and technology in various ways. The facility would not only aim to serve as a recreation corner for students, educators, and visitors, but also provide opportunities of; doing science, indulging in interdisciplinary learning initiatives, discussion and debate around socio-scientific issues.

CONCLUSION

Worldwide, there has been an upsurge in collaborative projects and international networks, in the field of environment education. Undoubtedly, this can help in the larger goal of making an impact of changing the attitudes of children and adults towards a gain for the environment. However, this requires environment education programmes to be relevant and contextualized, and include all other linkages to science, technology and society. In order to do so, efforts need to be put into researching the gaps that exist in today's environment education programmes. A vast body of reliable empirical research will set a strong foundation for designing well-structured environment education programmes. Institutes like HBCSE are also aiming at contributing to the generation of a large pool of resources and research that guide future courses of action.

ACKNOWLEDGEMENTS

I thank the (Late) Dr. Chitra Natarajan who guided and encouraged me to write this paper. I also thank Dr. Sugra Chunawala, Dr. Pooja Birwatkar, Dr. M.C. Arunan, Dr. G. Nagarjuna, Deborah Dutta who provided their valuable inputs. Thanks to Dr. Shubhangi Bhide and Dr. Rohini Karandikar for their continued guidance. This paper, in its earlier version was presented at the *Seminar on Promotion Environmental Literacy in Maharashtra,* organized by Conservation Education Center, BNHS, 21 September 2013.

REFERENCES

Bhide, S., & Chunawala, S. (2017). Making a case for outdoor engagement in environmental studies at Indian schools. *Conexão Ciência 12*(2), 223-230.

Deshmukh, N. D., Bhide, S., Sonawane, V. C., Chunawala, S., & Ramadas, J. (2018). Experiences and learning from Participatory Action Research with a local school. In S. Ladage and S. Narvekar (Eds.), *Proceedings of epiSTEME7: Seventh international conference to review research on Science, TEchnology and Mathematics Education* (pp. 204-213). India: CinnamonTeal.

Dutta, D., & Chandrasekharan, S. (2017). Time for action: Towards an integrative practice-based environment education. Paper presented at Philosophy of Education Conference, Bangalore, India, 9-11 January, 2017.

Dutta, D., & Chandrasekharan, S. (2017). Doing to being: farming actions in a community coalesce into pro-environment motivations and values. *Environment Education Research*. DOI: 10.1080/13504622.2017.1392485

Dutta, D., & Chandrasekharan, S. (2016). Practice-based approaches to nurturing environmental values: A case study of an urban farming group in Mumbai. Second Graduate Seminar School of Public Policy & Governance, TISS, Hyderabad, India.

Ehrlich, P.R. (2010). The MAHB, the culture gap, and some really inconvenient truths. *PLoSBiol 8, no. 4: e1000330.*

Ghumre, S., Nagarjuna, G., & Arunan, M.C. (2013). Collaborative Undergraduate Biology Research: Re-structuring Undergraduate Biology Education in India. In Nagarjuna G., Jamakhandi, A. and Sam, E. (Eds.). *Proceedings epiSTEME5: International Conference to Review Research on Science, Technology and Mathematics Education, HBCSE* (pp. 328-335). Cinnamonteal.

Huston, M. A (1994). *Biological diversity: The coexistence of species on changing landscapes*. Cambridge University Press: USA.

Mahajan, B.S., Bellara, K.M. & Nair, S. (2005). *Health and Environment: Action-based Learning (HEAL): Results and Trends: 2004-2005.* Homi Bhabha Centre for Science Education, TIFR: Mumbai.

Natarajan, C. (1996). *Tata Talent Search and Nurture (TATSAN) Report (1994-95)*. Technical Report No. 26, Homi Bhabha Centre for Science Education, TIFR, Mumbai.

Natarajan, C., Chunawala, S., Apte., S., and Ramadas, J. (1996). *Students' Ideas about Plants, Diagnosing Learning in Primary Science (DLIPS) Part-2, Technical Report No. 30*, Homi Bhabha Centre For Science Education, Mumbai.

Patel, A., Shome, S., Natarajan, C. (2009). Resolving conflict of ideas about photosynthesis among middle school students through multiple interaction modes. *Proceedings of the Second People Education Congress, Peoples Science Education Abstracts, Vol II,* 2009, pp. 70.

Primack, R.B. (2008). *A primer of conservation biology*. Sinaur Associates, Inc.:USA.

Shome, S. (2013). Exploring students' understanding of species: a study with class VIII students. In Nagarjuna G., Jamakhandi, A. and Sam, E. (Eds.). *Proceedings epiSTEME5: International Conference to Review Research on Science, Technology and Mathematics Education, HBCSE* (pp. 158 – 164). Mumbai: HBCSE, TIFR.

Shome, S. (2010). *State of India's forest, untold story*. In National Seminar on 'Biodiversity resources: Applications and conservation' organized by the Association of Teachers in Biological Sciences at Homi Bhabha Centre for Science Education from 11-12 December 2010.

Shome, S., Khunyakari, R., & Natarajan, C. (2009). A symbiotic approach towards environmental sensitization, monitoring and conservation through community involvement in North Eastern region of India. *Proceedings of the Regional Seminar on Recent Trends in Chemistry*, Dharmanagar, Tripura, pp. 77-78.

Shome, S., & Natarajan, C. (2007). Meaningful environmental education in schools – a proposal for equitable society. In the Indian Social Science Congress at SNDT Women's University, 27 – 31 December 2007.

UNESCO. (1978). The Tbilisi Declaration. Final report from the Intergovernmental Conference on Environmental Education, October 14–26, 1977, in Tblisi, USSR.

UNESCO. (1997). Educating for a sustainable future: A trans-disciplinary vision for concerted action. Paris: UNESCO (Document EPD-97/CONF.401/CLD.1.). (http://www.unesco.org)