The culture of environmental education: insights from a citizen science experiment in India

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The impact of culture on environmental education is well acknowledged by theorists and practitioners in the field; however, the particular mechanisms by which cultural factors may influence environmental educational practices are still relatively unexplored. In this note we describe a citizen science initiative that we attempted to implement in a rural area in southern India, and draw on our experiences with the project to show how cultural beliefs regarding the purpose of school education and the importance of environmental issues can interact in subtle ways to present challenging scenarios to environmental educators.

Debates on the efficacy of environmental education and the relative importance of school and non-school settings increasingly acknowledge that free-choice learning experiences are significant catalysts that promote a deeper and more inclusive awareness of the environment and the interrelations between humans and their biophysical surroundings[1]. Free-choice environmental learning refers to 'learning that occurs in environmental education settings when the learning is largely under the choice and control of the learner' and in practice occurs through a range of settings and sources such as the home, gardens, zoos, museums, television, internet, newspapers and outdoor recreation and tourism sites[1]. Both educators and conservationists have argued that experiential environmental education activities such as participating in outdoor programmes or ecological research efforts are meaningful ways of engagement that not only improve the learner's environmental literacy, but also positively impact pro-environmental motivations and behaviour at the individual level[2,3].

In this context, the emergence of citizen science and student–scientist partnership projects involving the participation of scientists, educators and lay citizens or students in ecological studies can be seen as an important means of achieving environmental education alongside scientific research[4,5]. These projects refer to the participation of 'citizen scientists' (volunteers who do not necessarily have a science background), or students to collect data in ecological projects. One of the main objectives of these studies is to raise participants' awareness about the science behind the projects and thus marry research with outreach and science education. An important critique of these approaches has been that they do not always foster experimental learning or encourage a spirit of scientific enquiry[4]. Experimentation or hands-on learning is considered an essential component of research activity and only enquiry-based learning can help participants develop from being merely data collectors to actually doing science[6]. Hence the true success of citizen science and student–scientist partnership projects not only rests on their ability to create a database of worthy scientific information but also to make lasting impacts on participants by furthering their research skills and promoting environment-positive attitudes among them.

A citizen science experiment in Kerala, India

Citizen science approaches have been successfully implemented in developed countries such as the United States, United Kingdom and in many parts of Europe; however, they have not been employed to any great degree in developing countries[7,8]. Yet this approach that offers an opportunity to integrate biodiversity monitoring with education is potentially the most appropriate tool to be used in a resource-poor country like India that has a rich but poorly known biodiversity, as well as low public awareness of biodiversity. In January 2010, we initiated a citizen science project in the Malappuram region of Kerala in southern India, in order to study the mammalian diversity of the area. Kerala lies in a biodiversity hotspot region and is home to extremely diverse flora and fauna, many of which are endemic to the region. In our study area, that was largely rural and hilly, houses tended to have large backyards that bordered forest patches or plantations in densely wooded areas and harboured a variety of small wildlife species such as the Indian fox, striped squirrel, common palm civet, common mongoose and Indian hare. One of the objectives of our study was to document the presence and density of small and common wildlife species that are found near human habitations by involving local school children in the data collection process, thereby raising their comprehension of the biological diversity of the area. In the first phase of the project, we proposed to test school children in the age group of 12–15 years on their awareness of regional wildlife species, train them to identify wild mammal species that are found locally, and involve them in collecting data on the presence and number of small wildlife species that are found in their backyards and near their houses.

Following an introductory workshop for local teachers and students, we were able to conduct a questionnaire survey on students' awareness and knowledge of wildlife species. However, our attempts to train the students and involve them in a larger ecological data-collecting process did not succeed. Participant school children were disinterested in the data collection exercise for two reasons. One, they felt that small and common wildlife species were well known to the general public in terms of their distribution or behaviour and that there was little they could observe or discover about them that would be new or exciting. Two, they believed that this particular activity would not aid or improve their school grades and therefore preferred to spend the little free time that they had in more recreational pursuits. Many teachers of these participating school children were ambivalent about the utility of such an exercise and suggested that such an endeavour was unlikely to help the students do better in their class examinations and that their time would be better spent in studies related to the school curriculum. Teachers also admitted that they were not familiar with mammalian diversity, were untrained in identifying many animal species and therefore did not feel competent to supervise the students in the project. They added that they may have been more inclined towards a project about medicinal plants as this was a subject they were knowledgeable about and that an exercise cataloguing medicinal plants would have been easier to conduct and more useful to society as a whole. Although a few individual parents and teachers supported our ideas, the larger majority remained unconvinced about the benefits of the children being involved in such a data-collecting exercise.

The culture of education

A critical evaluation of our project raises a number of interesting questions about the reasons for its non-success. The first, of course, concerns the fate of other citizen science projects in India. How have they fared? Although not numerous, citizen science projects are not unknown in India. Research institutes and universities such as SACON (Salim Ali Centre for Ornithology and Natural History, http://www.saconeducation.org), NCBS (National Centre for Biological Sciences, www.migrantwatch.in and www.seasonwatch.in) and the University of Delhi (http://www.lostspeciesindia.org) run various citizen science projects that monitor bird, butterfly and amphibian densities and vegetation cycles, whereas organizations such as SPACE (Science Popularisation Association of Communicators and Educators, http://www.projectdarkskies.org) coordinate projects that use a citizen science approach to collect data on constellation visibility and the extent of pollution in the skies. A review encapsulating the success rates of citizen science projects in India is currently lacking; however, data available on some of these projects indicate that the response from volunteers in terms of participation is fairly high[9,10]. The usual approach used by such projects is to utilize print and on-line media to send messages about the launch of the programme and invite all interested environmentalists, naturalists and wildlife enthusiasts to participate in it. The mode of focusing only on schools as participants is less common and is seen in some programmes such as the international GLOBE (Global Learning and Observations to Benefit the Environment) project, the SEED programme (Student Empowerment for Environmental Development) by Mathrubhumi (http://www.mbiseed.com) and Project Dark Skies run by SPACE. Also, SPACE operates through the technique of setting up science clubs in various schools and using the medium of these clubs to train students in astronomical techniques; some of these students then participate in the citizen science project run by SPACE.

A critical reason why SPACE was able to succeed in involving student participation (and our project did not) may lie in the links that the organization established with the students and schools before it launched the project. In their review of over 200 extant citizen science projects, Roy *et al.*[8] highlight the importance of tailoring projects 'to match the interests and skill-sets of participants' and 'understanding the motivations of the diverse and disparate communities participating in citizen science'. Insights gathered from our study not only underline the relevance of this observation, but also support conclusions drawn by previous studies[11,12] that participants' preconceptions may lead to biases in data acquisition or misinterpretation of results and that citizen scientists are motivated to continue their work only if they feel that they are making valuable contributions to the study. Citizen science projects are as much about citizens understanding science, as they are about doing science, and a greater cognisance on our part of the interests and motivations of the students, teachers and other community members in the study area may have succeeded in more deeply engaging them in the project. As an earlier study on environmental education noted: 'as outside facilitators we had little understanding of the way the students experience their world…if outsiders are to play a role in educational reform at the school level and environmental and social change at the local community level, they will have to be sensitive to all members of the (school) community'[13]. Learners' knowledge or views on environmental matters are influenced both by the immediate family as well as their larger social circle that includes peers, teachers and other community members[14]. For this reason, it may be important to include and involve local community as a whole in environmental education initiatives that are targeted at school children.

A secondary reason why our citizen science efforts failed to take root may be the more insidious, 'culture of education' in India. Despite significant reform measures and educational intervention programmes, pedagogical practices in India are still largely rote- and memory-based, textbook-oriented, exam-centred and operate within a hierarchical framework of instruction[15–17]. Government policies have been more focused on increasing enrolment in schools rather than the quality of education, and this is reflected in low student learning achievements at primary and secondary schools levels, particularly in rural areas[18,19]. Analysing the implementation of a child-centred pedagogic reform programme called 'Joyful Learning' in rural Indian schools, Sriprakash[20] notes that although the teachers agreed that group-based pedagogy had many positive aspects such as development of children's sociability and motivation, they did not believe that an activity-based approach actually improved 'learning' in children. Only acquisition of syllabus material was seen as real learning and didactic modes of interaction between a teacher and pupil were described as the most effective means of achieving this.

The panoptic influences of culture on environmental education are well recognized in theory; in practice, however, particularly with respect to pedagogy and classroom curricula, less is known about the multiple ways in which cultural influencers interact with environmental learning and teaching practices[21,22]. Studies on the role of culture in environmental education have argued about the need for multicultural frameworks that inform the practice of environmental education[23], educational techniques that emphasize the interdependencies between culture and the natural environment, rather than reinforce separation between the two[24] and 'culturally sensitive research approaches' that guide environmental education research[22,25]. Based on the observations from our study, we suggest that it may also be important to consider how cultural constructs regarding teaching and learning practices affect environmental learning activities. The impacts of culture on pedagogy have been well-discussed[17,26] and we do not refer only to this. Instead we submit that as the environment is intrinsically a value-laden subject (in the words of Gibson[27], 'Any substance, any surface, any layout has some affordance for benefit or injury to someone. Physics may be value-free, but ecology is not'), teaching and learning practices in the specific context of environmental education assume a greater than usual burden of cultural imperatives and that an insufficient understanding of this factor can fatally disrupt a collective exercise in exploring science.

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Exploration for rare earth elements in North East India

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The rare earth elements (REE) are widely dispersed but rarely occur as ore deposits. They have high density, high melting point, and high electrical and thermal conductance, which make them essential for a variety of emerging and critical technology applications. Thus these metals are increasingly becoming a critical strategic resource.

Rare earth metals and alloys that contain REE are used in many high-tech gadgets in advanced military technology, mobile phones and many other devices of everyday use[1,2]. For geologists, REE are of utmost importance to understand petrogenesis of rocks.

REE minerals occur in a diverse range of igneous, sedimentary and metamorphic rocks in various geological environments such as in beach placers, peralkaline granites, syenites, pegmatites, carbonatites, residual lateritea, phosphoritea, iron–REE (hematitic granite breccia), ion adsorption clays, etc. There are many propitious geological environments in India where REE mineralization can be explored. The Geological Survey of India (GSI) is engaged in REE exploration and is expected to take up 75 exploration projects between 2012 and 2017 in the 12th Five-Year Plan[3].

Exploration for REE deposits in North East India has been intensified since 2010. During 2010–2012, two types of geological environments suitable for REE mineralization were identified and encouraging results of $\sum$REE (La–Lu) were reported in carbonatites of the Sung Valley ultramafic–alkaline–carbonatite Complex, West Jaintia Hills and East Khasi Hills districts of Meghalaya. The analysed $\sum$LREE values range from 895.17 to 1264.85 ppm and $\sum$HREE values range from 60.98 to 81.92 ppm. EPMA study of the carbonatite showed that the main REE-bearing minerals are bastnasite, ancylite, euxenite and britholite associated with calcite and apatite[1,4] (Figure 1 *a* and *b*). Appreciable amount of REE was also found in pyrochlore associated with magnetite in carbonatite sections (Figure 1 *c*). Anomalous REE concentration was also reported from the titaniferous bauxite capping, developed within the Sung Complex near Lumkynthang village. $\sum$REE in titaniferous bauxite ranges from 3645.98 to 5099.56 ppm ($\sum$LREE from 3525.85 to 4928.46 ppm and $\sum$HREE from 120.13 to 171.10 ppm)[1,4].

Sadiq *et al.*[5] reported encouraging REE values in variants of granite of Nongpoh Pluton, Ri-Bhoi district, Meghalaya.