



One-day Seminar
Road ahead in Science, Technology and
Mathematics Education in India
In memory of Late Prof. Chitra Natarajan, former Dean, HBCSE

followed by release of the book
Embracing lives, Chasing passions: Memoirs of Chitra Natarajan

October 14, 2015, V. G. Kulkarni Auditorium
Homi Bhabha Centre for Science Education, TIFR

Prof. H. C. Pradhan (Seminar Chair)

H.C. Pradhan retired as Senior Professor and was former Centre Director and Dean of the Homi Bhabha Centre for Science Education (HBCSE), TIFR. He is currently Raja Ramanna fellow and is associated with both HBCSE and the Centre for Excellence in Basic Sciences, Mumbai. Pradhan's research is in the areas of nuclear physics, physics education, mathematics education and science education. Between 1988 and 2011, he pioneered several new programmes at HBCSE, both of research and outreach, in science and mathematics education. Besides being a researcher, Pradhan is a reputed teacher, and an award winning author in Marathi on science.



1. Democratising STM Education: For All, For Life

Prof. Anita Rampal

Abstract

Trends of viewing Science, Technology and Mathematics Education as part of the competitive race for economic productivity of nations, while increasingly divorcing skills from knowledge, are analysed within a framework for democratic education for all, for life. The Education For All World Declaration 1990 had called for an 'expanded vision for education', "recognizing that traditional knowledge and indigenous cultural heritage have value and validity in their own right and capacity to both define and promote development". In India this had aligned with the participatory campaign for adult literacy addressing local cultural knowledge, followed by the National Curriculum Framework (NCERT, 2005) that espoused a social constructivist approach, and helped question the valorisation of certain knowledges within the hierarchies of school subjects. Using the rights framework, tying quality to equity, with high expectations from and opportunities for all children to participate with a sense of critical agency, there is need for a vision to bridge disciplinary discourses, of the home, community, or school, through culturally responsive pedagogies of empathy that enable democratic participation, in and out of school. Building on the efforts made, the challenge ahead is to evolve school science, technology and math to creatively integrate and translate into an inclusive curriculum for all. This also includes the restructuring of the examination which supports a decontextualised 'ritualised' form of science or math as 'gate keeper',

thus reserving future professional opportunities for the privileged, often those who can buy their way in, through the burgeoning industry of private coaching, allied with that of the ICTs.

About the Speaker

Anita Rampal is Professor and former Dean, Faculty of Education, Delhi University. She has been a Nehru Fellow, UGC Research Scientist, Chairperson of the NCERT Textbook Development Teams at the Primary Stage, co-chair at ICME TSGs, and has participated in several national committees and task forces. She has been associated with the Hoshangabad Science Teaching Programme, the People's Science Movement, BGVS and the National Literacy Campaigns, and her special interests include curriculum studies, policy analysis for equity in education, teacher education, and science and mathematics education. She has published in English and Hindi and has also produced documentary films on women's education and political participation.



2. Yielding Place to New

Prof. Padma Sarangapani

Abstract

In this talk I propose to discuss adequacy and preparation of Science and Mathematics teachers for schools. The most noticeable change in recent times has been in terms of supply of young graduates wanting to be science and mathematics teachers. Most policy discussion has only responded to this issue. However, in the last three decades there have been significant advances and changes in Education studies. There have been changes in the school science and mathematics curriculum, as well as changes in our understanding of subject teacher preparation, and to the scientific basis of teacher preparation itself. These justify that we examine teacher eligibility and preparation. However policy discussions on these matters has reached an unproductive deadlock. The damage that this situation can do is worse than we suspect, but our ability to engage with this in a manner that we can move forward will involve debating old truths and new truths for best truths by which we can craft solutions.

About the Speaker

Padma M. Sarangapani is Professor, School of Education and Chairperson of the Centre for Education Innovation and Action Research, Tata Institute of Social Sciences, Mumbai. This new Centre is engaged with investigating ways in which



Science, Mathematics and Language Education and Teacher Education can be renewed and invigorated by the thoughtful use of Technology. Her areas of interest include curriculum, teacher education and quality of education.

3. Weaving Theory and Practice Together in Science and Mathematics Education

Prof. Jayashree Ramadas & Prof. K. Subramaniam

Abstract

The Homi Bhabha Centre for Science Education has always stood for practice-based R&D in science and mathematics education. Given the vast span of our work, from primary school to undergraduate level; from education for disadvantaged, underperforming students to talent nurture for the Olympiads, it is not always easy to find the common threads, to establish the links between the diverse activities of programs and the R&D mandate of the Centre.

The issue is not unique to HBCSE. In the country as a whole there remain vast disconnects between theorising in departments of education, developmental work of NGOs, outreach efforts of scientists and science popularisers and certification programs of teacher education institutions. In the microcosm of HBCSE we have striven to nurture these linkages, even to demonstrate that they exist. Some of our models have drawn from discipline-based educational research, others from participatory action research.

In this talk, we outline our quest for an organic link between theory and practice in science and mathematics education. We will begin this presentation with a few visualisations used to capture the linkages at HBCSE and elsewhere. We then focus on mathematics education at HBCSE.

Early work in mathematics education at the Centre, which was closely tied at the field intervention level to science education, was carried out along two dimensions – student learning and teacher professional development. While the talent nurture project with BMC schools of the 1980s focused on first generation learners, the ashram school project of the 1990s involved working with teachers. Research and material development with a focus on student learning included diagnostic testing to identify student errors and misconcepts at the middle school level and remedial mathematics text and workbooks at the high school level. This was followed by work on the primary mathematics curriculum. In parallel, there was continuous engagement with teachers, which had a major focus on enhancing teachers' knowledge of mathematics at the school level. Today, education researchers worldwide recognize the role of specialized knowledge of subject matter

as a critical variable in effective mathematics teaching. In recent years, mathematics education research at the Centre has aimed at characterizing the various strands of specialized mathematical knowledge that are needed for teachers and illuminating their connections with classroom teaching practice.

About the Speakers

Jayashree Ramadas is a professor of science education and Centre Director at the Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research, Mumbai, India. Her interest has been in cognitive studies of science learning, visuo-spatial thinking, primary science curriculum and teacher education.



K. Subramaniam is Associate Professor of mathematics education and Dean at the Homi Bhabha Centre for Science Education, Tata Institute of Fundamental Research in Mumbai, India. His research has focused on the learning of core topics in middle school mathematics such as fractions, ratio and proportion, algebra and geometric measurement, development of models for the professional development of in-service mathematics teachers and connecting out-of-school mathematical knowledge with school learning.



4. Teacher Dilemmas in the Uptake of Technology in Classroom: A Case of Game-based Learning in Singapore Classrooms

Dr. Swati Mehrotra

Abstract

Although much has been written concerning the potential of digital games to increase student motivation and strengthen student learning, the teacher's perspective when enacting gamebased learning in the classroom has been less extensively studied. Teachers who attempt pedagogical innovation with digital games face significant challenges. In this talk, I will dwell on the challenges faced by participating teachers in the uptake of "Statecraft X" digital gamebased curriculum that was tried in public schools in Singapore at the secondary school level. Drawing on interview data, we identified key dilemmas teachers had to negotiate in the context of the school system in Singapore. Our findings suggest that teachers are forced to wrestle with tensions engendered by alignments that

emerge from the innovation's tacit requirement for change and the system's inherent gravitation toward maintaining the status quo. These tensions revolve around resistance to and discomfort with a new mode of teaching and learning, teachers' perception of system requirements and normative expectations related to their professional role, pressure to ensure that students score high marks on standardised assessments, and weak alignment between mandated and innovation-based forms of assessment. These findings have implications for teacher professional development with respect to game-based learning and would also be relevant for the Indian school context where school is considered a normatively sanctioned cultural space. A school culture that cultivates innovative practice based on greater teacher agency is needed for innovative teaching/learning process to find a meaningful place in the classroom.

About the Speaker

Swati Mehrotra is a freelance educational consultant based in Singapore. Currently she is consulting a not-for-profit social organization for their training and professional development programs. In the past, she has been a Research Fellow at the National Institute of Education, Nanyang Technological University, Singapore. Her research interests are in the area of teacher professional development, socio-cultural aspects of learning and game-based learning. The work presented in this talk has been done while she was associated with the National Institute of Education and has been published.



5. STSE Education: Current Trends and Challenges

Ms. Aswathy Raveendran

Abstract

Professor Chitra Natarajan, in the 1990s, launched Science-Technology-Society-Environment (STSE) education as an area of research in Homi Bhabha Centre for Science Education with her work on the Activity-based Foundation Curriculum on Science, Technology and Society. I was introduced to this field by her, and since 2010, this has been my area of doctoral research. In this talk, I will attempt to provide a broad overview of the field of STSE education in terms of the theoretical, methodological and ideological directions it has taken, on the basis of some review of literature in this area. I will also present some reflections on what I perceive are the challenges working in this area from the point of view of a fledgling researcher in this field.

About the Speaker

Aswathy Raveendran is currently enrolled as a PhD student in science education at the Homi Bhabha Centre for Science Education. Her area of work is in STSE education. Her academic interests are in critical studies in science education and feminist science and technology studies.



6. History of Science and Science Education

Prof. Arvind Kumar

Abstract

History of Science can be a useful resource in improving science learning in a number of ways. History provides inspiring narratives that can generate and sustain our interest in science. For several basic concepts in science, our spontaneous ideas have parallels with the historical antecedents of modern concepts in science. Knowing in detail the developmental route of scientific concepts can effect a more critical appreciation of the current concepts. Above all, history of science is a most natural setting for learning ‘nature of science’ that is now widely accepted to be an important goal of science education. Despite these positives, it is difficult to meet the growing content demands of science curriculum by history-based science teaching. What is needed is a comprehensive history-based materials package (to begin with, at the higher secondary level, we suggest) that demonstrably improves science learning of the core content of the subject at that level and also promotes more mature perspectives of nature of science. That, at present, seems like a distant goal, but is well worth pursuing.

About the Speaker

Arvind Kumar (b.1943) did his Ph.D. in Physics at TIFR in 1969. After two years of post-doctoral experience at Geneva (CERN) and London (Westfield College), he taught at the University Department of Physics, Mumbai for 12 years. In 1984, he joined HBCSE (TIFR) and was involved in the Centre’s diverse R&D and orientation activities till his retirement in 2008. Since then he teaches physics at the UM-DAE Centre for Basic Sciences, Mumbai. His main academic interests are theoretical physics, physics and physical chemistry education, and history and philosophy of science.



Schedule

- 09:30-09:45 : Opening remarks by the Chair, H. C. Pradhan
- 09:45- 10:00 : Welcome and remarks by Centre Director
- 10:00-10:45 : Democratising STM Education: For All, For Life – Anita Rampal
- 10:45-11:15 : Tea Break
- 11:15-12:00 : Yielding Place to New – Padma Sarangapani
- 12:00-12:45 : Weaving Theory and Practice Together in Science and Mathematics Education – Jayashree Ramadas & K. Subramaniam
- 12:45-13:45 : Lunch
- 13:45-14:30 : Teacher Dilemmas in the Uptake of Technology in Classroom: A Case of Game-based Learning in Singapore Classrooms – Swati Mehrotra
- 14:30-15:15 : STSE Education: Current Trends and Challenges – Aswathy Raveendran
- 15:15-16:00 : History of Science and Science Education – Arvind Kumar
- 16:00-16:15 : Summing up by the Chair
- 16:15-16:45 : Tea Break

Function to release the book “Embracing Lives, Chasing Passions : Memoirs of Chitra Natarajan”

- 16:45-16:55 : Welcome Address (Prof. Jayashree Ramadas, HBCSE, TIFR)
- 16:55-17:05 : Reflections: A TATSAN Student, Sonal Shivagunde,
Manager, Social Sector, GRID
PricewaterhouseCoopers (PwC), Mumbai
- 17:05-17:20 : Chief Guest Address (Prof. Anita Rampal)
- 17:20-17:25 : Release of the Book
- 17:25-17:35 : Author Remarks (Dr. R. Rajagopal)
- 17:40-17:45 : Vote of Thanks (Prof. Savita Ladage, HBCSE, TIFR)
- 17:45-18:30 : High tea