9^{th} Annual Research Meet

Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research

March 13 to 15, 2019

Contents

Introduction

Research happens not in isolation. Discursive practices is integral to sustenance and growth of both research and research communities. On a global level conferences and journals mediates these discursive practices while peer review performs a dual role, that of a validator and a gatekeeper. At the local level, engagements with peers, mentors, literature and the artefacts help position one with respect to the practice. The arduous nature of the global discourse is often taxing, especially to young researchers, whereas the local is a familiar terrain and provides for a more relaxed atmosphere. Thus it is in the best interest of all concerned that the global and local are brought together every once in a while within a closely knitted community of researchers, so that a launchpad to initiate the young scholars to global challenges is created.

Annual Research Meets (ARM) at Homi Bhabha Center for Science Education is conceived as a local forum for discussion, presentation and sharing for researchers, scientific staff and research scholars of HBCSE and beyond, in which faculty members participate as collaborators and discussants. The meet aims to provide us with an intense, yet informal and supportive forum for presentation, discussion, sharing and debate.

The 9th ARM, organised from 13th March to 15th March 2019, has presentations from various domains of education research and allied fields such as Structure and Dynamics of Knowledge, Engineering Education, Mathematics Education, Environmental education, Philosophy and History of Science etc. Two symposiums titled "Resources for Teacher Education and Teacher Training" and "Research methods in Education Research: Experiences, challenges, ideas" with talks by senior practitioners are also a part of ARM 2019.

We hope this meet shall provide you with a fruitful experience, some fodder for thought and opportunities for collaborations.

Presentation Abstracts

Evaluation of Yusuf Hamied Teacher Development Programme in India

Hanza George, Rasika Bhujbalrao, Savita Ladage,
Sugra Chunawala, Vijay Lale
Homi Bhabha Centre for Science Education

Royal Society of Chemistry (RSC, UK) initiated the Yusuf Hamied Inspirational Chemistry Programme in year 2014. The programme has two major components; one has its focus on students whereas the other was primarily meant for teachers. The programme for teachers, referred to as Yusuf Hamied Teacher Development Programme was conceptualized as a five year programme (2014-2018) and aimed at training around 8000 chemistry teachers teaching in secondary schools across India.

Homi Bhabha Centre for Science Education (HBCSE, TIFR), Mumbai was invited to evaluate the teaching training programme in the year 2018. The evaluation activity focused on some government/government aided secondary schools in the states of Gujarat, Karnataka, Kerala and Maharashtra. Data collection involved interactions with different stakeholders; such as teacher trainers, teachers, students and classroom observations were also conducted. The detailed evaluation report is in press and the current talk presents glimpses of the evaluation.

The training programme was a cascade model, with teacher trainers of India receiving training provided by expert trainers from the UK and passing on their learning to secondary school teachers who would share these insights with students. Evaluation of the programme suggests the need for sustained interaction between the trainers and teacher participants to enhance the impact of the training and creating spaces for resource generation by teachers, preferably in regional languages.

Keywords: *Preliminary Data Analysis, Education Research*

Analysis of Education for Sustainable Development in Selected Schools of Raigad District, Maharashtra

Shraddha Kulkarni

Homi Bhabha Centre for Science Education

Ability to understand the environment in a holistic manner is critical for sustainable development. The present study evaluates the status of Education for Sustainable Development among secondary school teachers and students. The study was carried out amongst 30 students and 10 teachers of five different schools of different ecological contexts viz. tribal, rural, industrial township, semi-urban and urban area of Raigad- one of the tribal districts in Maharashtra. The study focuses on evaluation of understanding of their surroundings, awareness about environmental issues, behavioral patterns with respect to daily habits and their skills based on the identification of trees, seasons, directions etc. These four attributes were assessed on the basis of a questionnaire given to them. In addition, students ability to identify various component parts of an ecosystem with a focus on hidden interconnections among these parts was also determined based on an activity titled Web of Life. They were given a narrative of a river ecosystem and were asked to answer a few questions regarding possible implications of various interventions in the ecosystem. Students were then introduced to ideas of interdependence and resilience using the activity. After the activity, the students thinking skills were re-evaluated. A comparative analysis of these five attributes among teachers, boys, and girls of the selected schools is being presented in this paper. A positive change in students understanding after the activity is also addressed in the paper.

Keywords: *Environment Education, Pilot Study, Sustainable Development, Web of Life, Intervention, Interdependence*

Exploring cultures of empathy and cooperation in Mathematics learning

Rossi DSouza, Jeenath Rahman

Homi Bhabha Centre for Science Education

It is a common practice in education research to juxtapose the researchers alternate pedagogies with traditional classrooms. As educationists, we may describe traditional teaching/learning approaches using terms like teacher-centric, rote-learning, banking model, body of knowledge, etc. As opposed to this traditional teaching approach, researchers recommend their methodology, which they may demonstrate to be more child-centric, activity-based, or constructivist, where learning is regulated by values of student autonomy, cooperation and peer learning rather than competition, comparison and rivalry, where cultural differences are respected and questions concerning race, gender, disability, etc., are handled sensitively. Finally, pedagogical implications are shared by researchers. And some of these implications make their way to policy documents. However, despite all calls for reform backed by data, mathematics classrooms continue to remain traditional. Explainations for the stability of traditional teaching practices have usually centred on teacher beliefs and culture (a notable example is the 1999 book, The Teaching Gap by Stigler and Hiebert who described teaching as a cultural activity). However, references to culture end up being circular arguments in which, as Parenti (2006) puts it, the thing that has to be explained - culture - is itself treated as the explanation, a kind of self-generated causality (p. 22). Also, culture is hardly ever neutral and ...one cannot talk intelligently about culture if one does not at some point also introduce the dynamics of political economy and social power (p. 17). In this presentation, we use the lens of political economy to explore the material forces that engender particular cultures. We analyse outcasted learning environments in which a culture of empathy and cooperation dominated learning practices despite the absence of any intervention from researchers.

References: Parenti, M. (2006). Culture Struggle. Toronto: Seven Stories Press.

Keywords: *Education Research, Research Paper*

Mathematical Explorations

Jayasree S

Homi Bhabha Center for Science Education

This paper discusses a Pilot study and preliminary data analysis of two Mathematical Explorations that were done in two schools in Chennai. By Mathematical Explorations we mean open-ended and loosely-defined problem situations, that provide opportunities for students to engage in mathematical practices. This paper aims to delineate some of the practices observed in these sessions and discuss possible stages in these. The analysis is based on approximately 4-5 hours of teaching in each school. The students were drawn from grades 8 and 9 and there were 7-12 students in each session. The classes were taught by the researcher and audio recorded. Summary notes were written for each class soon after the session, and more detailed notes were made based on the audio recording a week later. These notes and reflections on them form the data for this study.

The modules involved the students in practices of justification, generalisation and algebraisation. One of the modules involved the use of algebra to express a generalisation and another involved using algebra to represent a problem situation and further using the representation to justify claims. These happened to different extents in both the schools and some common points of difficulty were observed where some scaffolding was required for the students to progress with the exploration. Also students were observed to use different means of justification for their claims. The attempt is to characterise these through examples and discuss some possible levels in the practices of justification, generalisation and algebraisation.

Keywords: *Pilot study, Preliminary data analysis*

How's How: Cartoon Ramblings on the Philosophy and the Politics of Science

Charudatta Navare

Homi Bhabha Centre For Science Education

I've been working on a book called How's How: Cartoon Ramblings on the Philosophy and the Politics of Science. It's a comic book on the nature of science and its interaction with society. Hows how engages with the sociology of science, and discusses the feminist and subaltern critiques of science. I would like to share the general outline of the book and a few snippets to elicit comments and feedback from the audience. This feedback would help

a lot, as will the external deadline of ARM in getting the book written. Here is a brief outline of the book (although I am not sure of the flow of the book yet). 'Spoils of War', the first chapter after introduction, illustrates hidden metaphors in the theories of immunology, and how they might have stemmed from the circumstances in which the theories appeared. 'Which Came First: the Sperm or the Egg?' describes the development of our understanding of human fertilization. It also talks about the way the values of people doing science can impact their findings. 'The Very Second Thing' discusses the 'medical construction of gender, which again illustrates the importance of diversity of people doing science. 'Penny for Your Research' talks about who funds science and how does that play a role in the process of science. It recounts the manoeuvres of tobacco, sugar, soft drink, and pharmaceutical industries to obtain desirable research findings and downplay undesirable ones. 'Shadows on the Wall' briefly recounts major debates in the philosophy of science. 'Implicitly Deficit' considers different takes on science communication and on public understanding of science. 'One Damn Thing After Another' engages with the history of science, and with the nature of institutions that made modern science.

Keywords: *Topical Discussion, History and Philosophy of Science, Science, Technology and Society*

From embodiment to grounded disembodiment: An explanatory account for syntactical symbolic activity

Durgaprasad Karnam, Megha Sanyal, Gaurang Yadav

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In this paper we propose an explanatory model of cognition where we try to account for the genesis of symbolic and syntactical activity within an embodied and action oriented framework. We do so through formulating three layers of sensorimotor actions of an agent: "beats" (non-modulatable actions which are mandatory for sustenance); "memets" (modulatable disengaged actions which may form patterns); and "remets" (recurring memets which get submerged and not always consciously accessible). The modulation of memets and the action space created by them leads to a recursive interaction between an agent and its environment. We claim that this modulation forms the basis of symbolic and syntactical activities. We present this model, juxtaposing it with popular agent and action oriented frameworks of cognition, on the one hand, and, on the other, the widely received view of how the brain plays a central role in cognition.

Keywords: *Structure and Dynamics of Knowledge, Topical Discussion*

Activity based learning & Experiences with students in a primary school

Sonawane Vinodkumar
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This paper highlights the importance of activities and experiments in the elementary school to facilitate an interactive classroom climate and consequently learning. The work reports on observations of students in a lower socio-economic school settings in a suburb of Mumbai and some efforts to implement activity based learning with elementary marathi school students, with the help of the classroom teacher. The subject of environmental science afforded a number of opportunities to allow student to relate the classroom activities related to science to their daily lives and raise a number of questions. Learning takes place in science classes differently, scientific terms becomes burden in their vocabulary. In their day to day languge they use some common words, but has a diffrent meaning, some aspects about languge and learning concepts are discussed in this paper related to the text book and standard (praman) marathi languge.

Keywords: *Research Paper, Cognitive Studies of Science Learning, Design and Technology in School Education, Structure and Dynamics of Knowledge*

Understanding Scaffolding Strategies To Mediate A Problem Based Learning Environment: Indigo dyeing waste water treatment

Sujatha Varadarajan
Homi Bhabha Centre for Science Education

With widely accepted need for shifting the current expository laboratory instruction style to the inquiry-based approaches, various scaffolding strategies are required for a smooth transition, especially, for problem-based learning environment which advocates students self-directed and independent learning. In the paper, we describe the different scaffolding strategies and demonstrate how group discussion and science writing heuristic proved to be the most effective of all the scaffolds in completion of the chemistry laboratory PBL task on indigo-dyeing waste water treatment. The trials

were carried out with a group of four teachers and 12 undergraduate students (from various college across India) at HBCSE guided by the DBR methodology. Field-notes, task sheets, questionnaires and audio-recording constituted the data. The effectiveness of the scaffolds were assessed based on the developed rubric and student- engagement with the scaffold. We find that the Group-Directed Learning (GDL) was effective in helping students to design/plan the laboratory task while Science Writing Heuristics (SWH) (Greenbow& Burke, 2006) helped students to report their findings meaningfully on the basis of their data.

Keywords: *Education Research,Research Article, Chemistry Education*

Intricacies in Identification of Biological Misconceptions

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The term misconception is complex in nature and also has been conceptualized as alternative conceptions, preconceptions, alternative ideas, conceptual stumbling blocks, erroneous concepts, alternative framework etc., in various contexts by the multidisciplinary researchers. Identification of misconceptions is a challenging task due to various factors such as cultural context, individual differences, teaching-learning processes, studentsṕersonal experiences etc. Science is a systematic study of natural phenomenon. At school level general science is a subject which deals with Physics, Chemistry, Biology etc. every subject has its content along with approaches and methodology to extend and enrich the knowledge. Biology as a subject deals with study of living organisms and plants in the nature. Hence its misconceptions are based on personal experience, observations and cultural context as well. Since the conceptualization of misconceptions with reference to Biology as a school subject, it has been broadly and overarchingly studied by the researchers. In the current presentation the researcher has thoroughly reviewed and studied the identifications of misconceptions in Biology using mixed approaches along with tools, techniques and strategies. Today in the present context of multi and trans-disciplinary subjects, the identification of misconceptions has become essential and gain importance as they are contributing new knowledge and applications in science and technology. Hence, in the current presentation, the researcher has made an attempt to analyze the intricacies in identification of misconceptions in Biology. The presentation heavily relies on secondary sources of data.

Keywords: *Literature Review, Biology Education, Biological Misconceptions, Identification of Misconceptions*

Supernovae of Type IIP and their progenitor models using a stellar evolution code MESA

Gururaj Wagle

Homi Bhabha Centre for Science Education

Supernova (SN) explosion is the end stage of million years of stellar evolution for massive stars. A central problem of astrophysics involves the determination of the mechanism of core-collapse supernovae (CCSNe) and their dependence on progenitor properties. The final structure of the star plays an important role in determining the outcome of the subsequent supernova explosion. Using a stellar evolution code Modules for Experiments in Stellar Astrophysics (MESA), we explore the effects of several physical phenomena on the structure of the progenitor stars at the CC stage. We will present our preliminary findings relevant to the progenitor of SN 2013ej of type IIP, which occurred in a nearby galaxy. This SN has been widely observed in multiple wavelength bands as early as a couple of days after the explosion. There also exist observations of the progenitor of this SN a few years before the explosion. The initial mass of the progenitor of SN 2013ej is determined to be in the range of 12-14 solar masses in the literature, but another group of authors claims that even a progenitor in the range of 23-26 solar masses can produce similar SN output. We show systematically through our MESA simulations that the higher mass range progenitor is not possible because of the rapid oscillations in its luminosity and temperature a few years before the collapse, which can be easily observed. We find for our progenitor models that the convective mixing and overshooting are critical in determining whether or not the star will explode. We also find that for a certain range of values of the overshoot parameter, there exists a blue loop in the post main-sequence evolutionary track of the star in the Hertzsprung-Russel (HR) diagram. But the blue loop disappears when the overshoot is too high or too low.

Keywords: *Astrophysics - Supernova explosions, Preliminary Data Analysis*

Scientific relations of Meghnad Saha and Homi Bhabha in the early days of Atomic research in India

Alak Ray

Homi Bhabha Centre for Science Education

Meghnad Saha was one of the earliest initiators of atomic research in India. He arranged, with the help of Jawaharlal Nehru, to transport from America parts for a cyclotron to the University of Calcutta in 1942 during WWII. Saha and Homi Bhabha enjoyed cordial relations initially. In December 1940 Bhabha delivered a series of lectures on Cosmic Rays at Calcutta University at Sahas invitation that were published in the journal Science and Culture edited by Saha. The relations between the two however underwent strains in disagreements about the establishment and agenda of the Atomic Energy Commission of India and the safeguarding the future of Science and Culture. In the face of post-war American embargo on atomic research, in December 1947 Saha engaged with the leader of French Commissariat Energy Atomique in Paris, Frederic Joliot-Curie who was open to international collaboration on atomic research. On return to India, Saha recommended to the Government that India and France cooperate in the development of nuclear energy. Recently published work shows that Bhabha in consultation with the Prime Minister of India, had initiated a (then secret) cooperation program with the French the details of which were likely unknown to Saha, even when Frederic Joliot-Curie visited India in January 1950 during the inauguration of the Institute of Nuclear Physics in Calcutta (later S.I.N.P.), by the Nobel laureate nuclear chemist Irene Joliot-Curie. Saha had refused to be a part of the Atomic Energy Commission, in 1948, even at the personal invitation of Nehru and hence he may not have been privy to these developments in 1949-1950. The dynamics of interpersonal relations in the context of atomic research and international cooperation of the times and their long-range effects will be discussed with reference to documents from TIFR Archives, Meghnad Saha Archives and the papers of F. Joliot-Curie.

Keywords: *History and Philosophy of Science, Pilot Study*

Does knowing just the products of science without knowing the process (Nature of Science) render us incapable to build a scientific bent of mind?

Vinay B.R

Prayoga Education Research Centre

A good science curriculum needs to not only teach some science (products of science) but also teach about science (process of science). However, science curriculum in many countries overemphasize on teaching the products and undermine the teaching of the process of science, despite many high profile calls for the importance of teaching about the nature of science. Just as teaching (scientific) process without product fails to provide students with some of the major conceptual tools for making sense of their world, teaching (scientific) products without process fails to give students an authentic experience of the nature of scientific thinking. In order to ensure that students get relevant exposure to nature of science, a teacher herself should be equipped with the same. The textbook for B. Ed, pedagogy of science clearly states the qualities a science teacher must possess It goes without saying that the teacher should herself be competent in the area she teaches; she must be familiar with all the aspects of the nature of science; and she must have imbibed scientific temper herself. In order to test the extent to which this objective has been met, a survey of about 60 high school teachers was conducted. This article explores the preliminary data analysis of the pilot study conducted and literature review behind the extent to which nature of science is dealt in high school curriculum and its implications. The initial results indicate a low awareness of the scientific process and application of scientific principles in real life context when contrasted with the awareness of the scientific concepts itself.

Keywords: *Pilot Study, History and Philosophy of Science*

Gödel's Incompleteness and the Place of Experiments in Mathematics: Questioning the Divide between Mathematics and Experimental Sciences

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In the received tradition of thinking about mathematics a strict separation is made between the procedures of mathematics and sciences such as physics by setting forth that whereas the former is axiomatic-deductive the latter are observational-inductive and although there are many points of contact between the two they cannot be placed on the same plane epistemologically. One direct consequence of this has been that it has been often denied that experiments have any role to play in mathematics unlike their centrally important function in the sciences. As against this dominant way of thinking about mathematics this paper shows how empirical, contextual and contingent concerns inform the discourse of mathematics as much as the case is in the sciences. Specifically the paper looks at Gödels incompleteness results bringing out their proper mathematical context and with the help of textual analyses, ethnographic examples and interviews shows how sources of mathematical truth are much multiform and diverse than previously believed. In the process I take issue against some of the well known philosophical interpretations of incompleteness by showing how mathematicians make something very different out of this idea. In particular I chart a movement from the mathematicians Kurt Gödel, Alan Turing and then to Gregory Chaitin to show how the idea of incompleteness has evolved and now sits at the very core of mathematics. As Chaitin has shown, with a refined mathematical interpretation of incompleteness that rather than proving to be an impediment to research in the foundations, this idea gives us the sense of the infinite complexity, vitality and creativity of the subject. Following up on this analyses I also offer comments on how mathematical paradoxes can be used as pedagogical devices, a point which I presume will hold some importance for math educators. More broadly the paper demonstrates how mathematics can be seen as a quasi-empirical science and differences between it and physics are not as stark and unbridgeable as usually believed. It is hoped that by bringing out the place and role of experiments in mathematics the paper will enable us to rethink its epistemology and ontology in novel and, if it may be said so, in liberating ways.

Keywords: *Research Paper, History and Philosophy of Science, Structure and Dynamics of Knowledge, Science, Technology and Society, Education Research*

Investigating concreteness and abstraction in the context of mathematics education

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Mathematics as a field with a long history, trying to make sense of our world, had used abstraction as a key tool to work with the complexities that we see around us. Concrete forms like rocks, moon etc. were reduced to abstract representations like circle or variables in geometry and algebra. But now when we switch to the context of teaching mathematics in the education system, this very same abstraction often makes the students to not relate the concepts in real world context. Hence, this literature review was focused on finding frameworks of abstraction or concreteness, using which we could classify the content and questions of a secondary school mathematics topic with respect to the levels of abstraction. The 20 relevant papers found, could be broadly classified into the following four categories: 1. Concreteness fading related papers in mathematics domain, 2. Human cognition related papers on how abstraction works, 3. Abstraction in the field of computer science education, and 4. Levels of abstraction in the design field. The frameworks of abstraction found in these papers were analyzed for its ability to categorize a given topic in mathematics into various levels of representational abstraction. Finally, the literature review reports the implications comparing the frameworks and future directions to pursue.

Keywords: *Education Research, Design and Technology in School Education, Literature Review*

Understanding learners feedback seeking processes during collaborative problem solving and scaffolding it for enhanced learning

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According to Butler and Winne (1995), 'Feedback' is the information with which a learner can confirm, add to, overwrite, tune, or restructure information in ones memory. As per them, this information can be of domain knowledge, metacognitive knowledge, beliefs about self and tasks, or cognitive tactics and strategies. Feedback seeking is defined as the learners proactive search for feedback information in the environment in order to determine the correctness or adequacy of ones learning and ways to improve it (Ashford, 2014). More specifically, learners accomplish the above

purpose by monitoring, eliciting and identifying the attributes of better learning through interaction with the feedback sources (Boud & Molloy, 2013).

Our research problem emerges from the need to shift focus from the processes concerned with feedback provision to learner to that of learner feedback seeking. While there are multiple reasons discussed for advocating this shift, an important one is the learner agency being ignored in identifying and deciding upon the appropriate feedback needed (Boud & Molloy, 2013). As a result, students too often are said to view feedback as the responsibility of someone other than themselves (Hattie & Timperley, 2007). In contrast, research in organizational behavior and occupational psychology have found proactive feedback seeking as a valuable resource for individuals in workplace learning, adaptation and performance (Crommelinck & Anseel, 2013). Hence it is imperative that classroom learning contexts need to be reimagined as opportunities where learners develop and foster effective feedback seeking processes.

Underlying processes observed in feedback seeking by learners overlap with many other constructs studied in education research such as help seeking behavior, information seeking behavior, self-assessment, and formative assessment. However current models and frameworks for characterizing and understanding feedback seeking behavior are primarily in the context of organizational behavior and occupational psychology. They provide us with a fresh analytical perspective to study learners feedback seeking processes in collaborative problem solving contexts within the constraints and affordances of the learning environment. By employing their analytical lens, we study learners feedback seeking processes during a collaborative representational task in stereochemistry which is said to be both critical and challenging for chemistry students (Padalkar & Hegarty, 2015).

Our presentation will cover the synthesis of literature reviewed and findings from the pilot study. We will discuss about the precursors to feedback seeking behavior observed during collaborative problem solving, purposes for which learners proactively seek feedback, processes involved in seeking feedback, determinants of decision making processes involved in identifying and choosing from multiple feedback sources and efforts involved in articulating and communicating the need for feedback.

Keywords: *Education Research, Preliminary Data Analysis*

Improving uncertainty management skills of the learners in the context of engineering design

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Indian Institute of Technology Bombay

Engineering design problems are ill-structured as there can be multiple solution paths and numerous methods to solve the problem. Due to such nature of design problems, a lot of uncertainties arise in the mind of the engineers during the design process. They can be uncertain about different aspects of the design problem like how to evaluate the efficacy of different alternative solutions, which solution method is optimal, what objectives should the final design fulfill, what functions it should perform and many more. Also, engineering design is a social process where teams work collaboratively towards solving a common problem. The collaborative nature of design tasks further expands the realm of uncertainties that design engineers face. The ways in which these uncertainties are managed collaboratively by the teams affects the design outcomes as well as the overall design process. Therefore, there is a need to learn how to manage these uncertainties effectively. By effective uncertainty management, we mean that students should productively engage in engineering design disciplinary practices while tackling the uncertainty. While uncertainty in engineering design activities is always there, not much work has been done to understand how to leverage it for promoting learning in a collaborative setting. Moreover, the skills related to collaborative uncertainty management are under-emphasized in current engineering education. We aim at developing a technology-enabled learning environment to help young students develop uncertainty management skills in the context of collaborative engineering design problem-solving. We have developed an analytical framework that lists and explains the types of uncertainty faced and uncertainty management strategies implemented by learners engaged in solving design problem collaboratively. We further conducted two research studies with sixth and seventh grade students for understanding how learners naturally manage engineering design uncertainties and what challenges do they face in doing so. From the insights gained from the analysis and future studies to be conducted, we will find what effective scaffolds can be used for helping learners manage uncertainties effectively in collaborative settings and what form and features should a learning environment possess, to ensure that learners are able to develop the skill of managing uncertainties effectively.

Keywords: *Education Research, Engineering Education, Design Problems*

Interactive Lecture Demonstration - An effective tool for science popularization

Ravi Sinha
Independent Scholar

Science Popularization is a way to arouse the curiosity of children for the subject. The article discusses my own experience and insights from the field by incorporating low-cost scientific toys as a means to ignite the curiosity in out-of-classroom settings for middle school children. In addition to that, the article also focuses on strategies which make the engagement interactive with a large number of students.

Keywords: *Topical Discussion, Science Popularization, Reflective Essay*

Artefact-use and cognitive consequences: Why history matters?

Gagan Deep Kaur
Homi Bhabha Centre for Science Education

The talk discusses the import of historical evolution of the symbolic code, talim, in Kashmiri-carpet weaving practice in the context of artifact analysis. It sheds light on codes status in its allied centre, i.e. Amritsar, its gradual/sudden replacement by graph-based designing over the years, the ensuing cognitive consequences such a replacement, and the eventual design outcome, as compared with code-based weaving in Kashmir. Besides interesting questions on whys and hows of the disappearance of code in the allied centre, the findings raise questions proper to cognitive science as well, e.g. what is the relation between a design representation (code or graph) and the design outcome (design complexity or simplicity)? Can complex designs, as found in Kashmiri carpets, be achieved only with code-based representation?

Talks

Measuring the Wall Street with a Tape: A case for 'Taking Back' the 'Weapon'

Tathagata Sengupta

Homi Bhabha Center for Science Education

In this presentation, we talk about ideas of 'magnitude', following Freudenthal—in the context of measuring lengths on the one hand, and measuring the price of a commodity in the market on the other—as an illustration of how 'mathematics' has been hijacked by the powers that be. We use this example as an opportunity to discuss the phenomenology of mathematics and mathematics education, and try to build a case for taking back 'the weapon of mathematics' from the rulers of the world, with an ambition towards equity and justice. This presentation is aimed at arriving at more questions than conclusions.

Building an academic community in STEM education research areas

Jayasree Subramanian

Homi Bhabha Center for Science Education

Indian investment in education research is practically nil in spite of the fact that it is far from realizing its promise of Education for All. Major interventions in education in India have come from civil society initiatives and from institutions like HBCSE. The contribution of the Hoshangabad Science Teaching Programme (and Eklvaya) and HBCSE are significant in this regard as these two initiatives demonstrated that it is possible to teach science by carrying out experiments using locally available material in rural India. In order to take forward the vision of these initiatives in science and mathematics education, we need to invest in research and build a strong academic community. In this talk I will try and spell out what I mean by

a strong academic community and what is my vision for STEM education research in India.

Symposium

Research Methods in STEM Education Research: Experiences, Challenges, Ideas

Meena Kharatmal, Shirish Pathare, Aisha Kawalkar, Shikha Takker
Homi Bhabha Centre For Science Education

The symposium brings together senior research scholars and education researchers to talk about their learning to use research methods in their studies. This is aimed to give sense of research practice from actual working experiences in diverse settings, and to clarify doubts and queries of early researchers. Discussants will comment on their methodological challenges, scoping perspectives, and insights concerning connecting data to research questions asked, among other aspects.

The objectives are as follows:

1. To give a sense of research practice, in terms of actual working experiences with diverse research methods.
   (a) Exploring, using, developing, adopting from other fields, expanding etc.
   (b) Challenges and pitfalls in selecting appropriate methods, implementing in the field, analysing the collected data, dealing with the limitations of, and supplementing the methods.
   (c) A possible set of guidelines to keep in mind while choosing a particular method.
2. To clarify doubts and queries of early researchers through case/context-based anecdotes.

Resources for Teacher Training and Teacher Education

[1]Prof. K. Subramaniam, [2]Prof. Sybil Thomas, [3]Mr. Pralhad V Kathole, [4]Dr. Kalpana Kharade, [5]Mr. Kishore Darak

[1]Homi Bhabha Centre For Science Education; [2]Department of Education, Mumbai University; [3]Zilla Parishad School, Baliwali ; [4]Somaiya College of Education; [5]Tata Trusts, Mumbai

This symposium is aimed at bringing together experienced practitioners from different spheres of teacher education and teacher training to extend the discourse around various dimensions of resources for teacher training and teacher education, including but not limited to

1. Accessibility to research materials and their use in teacher training programs;
2. Availability of resource persons;
3. Infrastructural resources;
4. Cognitive, Political and Policy knowledge of the teachers;
5. Resources to support inclusive education;
6. Technological aids and access to technological aids;

Our panellists are experienced practitioners in different aspects of teacher training and teacher education. Prof. K. Subramaniam, the centre director of HBCSE, has been engaging and contributing to mathematics teacher education programmes all over India for the last couple of decades. Prof. Sybil Thomas is a faculty at the Department of Education, Mumbai University and her expertise lies in adult and continuing education and designing teacher preparation programmes. She taught prospective teachers for about two decades and also has been a part of various teacher training programmes. Mr Pralhad Vitthal Kathole is an assistant teacher, Zilla Parishad School, Baliwali, Maharashtra, and is deeply concerned about teacher education system particularly for rural parts of India, and is making contributions to this field from the capacity of a teacher trainer. Mr Kishore Darak is a well-known teacher educator who is now working as the Lead of Teacher Education for Tata Trusts, Mumbai, and he has been a part of various state board curriculum committees. Prof. Kalpana Kharade is an associate professor in K J Somaiya Comprehensive College of Education, Training And Research, Mumbai. Before becoming a teacher educator, she taught in urban BMC and private schools. Other than teacher education, her research work entails inclusive education, instructional interventions for struggling readers and writers, visually challenged and for children with diverse needs.

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