**HOMI BHABHA CENTRE FOR SCIENCE EDUCATION (HBCSE)**

**Tata Institute of Fundamental Research**

August 10, 2018

# Personal narratives of graduate students

**Amit:**

My research interest is in the area of graphicacy, in general and use of graphs in education, in particular. Graphicacy is defined as an ability to understand, interpret, construct and communicate with inscriptions, which includes sketches, maps, diagrams, figures, graphs, photographs, graphic arts, plans or charts. Reading and creating graphs is an interdisciplinary skill, essential for a better understanding of science and mathematics. This skill needs to be developed in students through different grades. Graphs are essential tools for communicating and analysing large data sets. In mathematics, they present us with another way of looking at equations and situations. During the schooling and in the textbooks this skill is not developed in students. In our research work, we create modules/activities to address this problem. The modules/activities are informed by analysis of school textbooks for graphical practices and are based on constructionist framework with emphasis on mathematical modelling, real world data, close-to-life contexts and graphs. The activities use various ICT tools to aid collection of data and explore and create graphs. These different modules/activities span across subjects and can have different learning objectives for different learners.

**Ruchi:**

My own experience of teaching mathematics at primary level made me aware of the challenges that teachers face in developing understanding of concepts of mathematics among students. In our society, however, it is considered that primary teachers need not know anything more than the mathematics of the level that they are going to teach. In my research I explored how development of teachers' beliefs, knowledge and practice can be supported using several modes and contexts for in-service professional development. A group of teachers from government funded school engaged in several workshops, planned lesson collaboratively and collaborated with the researcher in their classrooms. The main philosophy behind the design of these different modes was that the tasks that teachers engaged in, should be close to the practice of teaching mathematics as it would facilitate the actual change in their classroom practice (Several researches indicate that it is difficult for teachers to change the way they teach).

The qualitative data collected in form of teacher interviews, videos of workshops, audio recording and logs of classroom interaction were used to develop case studies of teachers. The analysis reveals that change in teachers beliefs, knowledge and practice are inter-related to each other. Teachers' beliefs were initially close to viewing of learning as transmission of knowledge while later the teachers analysed in case studies indicated shift in their practice and beliefs. Teachers may develop beliefs conducive to developing understanding and may try to change their practice but the pedagogical content knowledge (knowledge of what student understand and what might be useful in developing understanding) might limit the teachers in sustaining the change in practice. Beliefs of students and lack of support from school community may also constrain teachers exploration of adopting new practices.

**Arindam:**

In Mathematics Education Research, it is increasingly being felt that learning mathematics can become helpful for the students if the classroom teaching involves familiar contexts and methods. Building on informal knowledge and meeting the equity demands for quality mathematics education for all children right from the early stage are considered to be instrumental in creating an educational culture that is equitable (NCERT, 2005). Several curricular documents including the ones that were adopted in India deliberated upon giving importance to connecting school learning with the child's lived experience.

In our study, we have explored the nature and extent of everyday mathematical knowledge possessed by middle graders living in an urban economically active low-income settlement and embedded in a micro-enterprise economy in a South Asian developing world context to unpack and document the connections between students' mathematical knowledge, work practices and identity formation, and inquire into the implications of these connections for school learning.

**Aswathy:**

My area of work is in Science, Technology and Society education. Science, technology and values intersect in various ways and there is a need to acknowledge this in the science curriculum. I am looking at how students in the 16-19 age group negotiate socio-scientific issues related to controversial medical technologies. We find references to these technologies in the print as well as visual media. I focus on the ethical, social and scientific value considerations students bring into their discussions of these issues. This work is motivated by a commitment to inculcating critical scientific literacy in students.

**Mashood:**

My work involved the development and evaluation of a concept inventory in rotational kinematics. A concept inventory is a ready to use diagnostic and assessment tool to probe student misconceptions and elicit their ill-suited reasoning patterns. Inventories hold the potential for large scale application. As such they are of particular relevance in the Indian scenario, owing to our huge student and teacher population. Part of the work has been published in peer-reviewed international journals. They have also been presented in conferences, within India and abroad.

**Saurav:**

I am particularly focusing on developing project based learning (PBL) module for Indian middle and high school level students in collaboration with teachers. The idea is to develop syllabus based projects, including opportunity of formative and summative assessment. It is hoped that this work will provide valuable insight on how to address NCF (2005) policy suggestions in Indian classroom.

**Anveshna:**

In the first phase of my research work, I made an attempt to explore biology undergraduate students' understanding of DNA structure and function, only to find that students were conceptually stuck at understanding the DNA structure itself. We, then, made use of 'ladder' analogy and 'palm' gesture along with multiple representations of DNA molecule to help students mentally visualize its 3-D structure.

In the second phase of my research, I became interested in the cognitive processes of learning, i.e., how students understand concepts and also how do they link different concepts to form a meaningful conceptual network? I'm using modified concept maps as an assessment tool to analyse this process of forming conceptual linkages by quantifying students' understanding of different concepts (using DNA structure as a test case). We further plan to explore if model building helps learners to improve conceptual linkages.

**Jeenath:**

My area of research is to explore an understanding of how we measure area. Area measurement is a concept that connects and enriches the domains of geometry and number. However, building the conceptual connection between these two domains is full of challenges. In our study, we are trying to reformulate the area concept as a network requiring an integration of various other spatial and numerical concepts. Using this theoretical model, we are trying to develop a spiral of tasks, which can address different aspects of the area concept. We are trying out tasks with students to explore whether and how they can connect these different individual concepts in the network.

**Shikha:**

In my research I am trying to explore teachers' knowledge of students' (mathematical) thinking, its manifestation in classroom practice and ways in which it can be supported. With an understanding of teachers' knowledge of students' mathematical thinking, we designed tasks to connect research based ideas in decimal fractions with teachers' experiences of classroom teaching. Teacher reflections and learning from tasks is being analysed.

**Shraddha:**

I am working in the area of biology education at the undergraduate level. My interest is in analysing undergraduate research laboratory to construct an account of how scientific knowledge is produced in such settings. This laboratory setting is based on the idea of addressing sophisticated questions in the frontier areas of biology using simple model systems. This setting offers a unique learning environment in contrast to the traditional laboratories in the colleges. We intend to eventually illustrate the myriad of resources that such a setting can offer towards understanding scientific problem-solving practices in general and model based reasoning in particular as embedded in the social and material environments.

**Rafikh:**

Whenever I see kids using computers I wonder how do they do it with so much ease, while elders struggle. They use it for playing games, drawing, reading, seeking information, taking pictures-videos, communicating with friends and so on. One day I read a quote by Alan Kay — "Technology is anything invented after you were born" which helped me understand why kids do not have problems with computers.

But when I look at current schooling system in India, I don't see computers being used in schools. The world outside our schools have evolved and have become technology rich, while the school system is still caught in the last century. Can we change this? Can we connect the world outside-school with the world inside-school? Can we use computers in school for teaching and learning as it does have some advantages over paper-pen or chalk-board method? These sort of questions motivate my research work at HBCSE.

**Rosemary:**

I am interested in investigating the dependencies between modern science, traditional knowledge, education and agriculture. My effort is to understand whether there is a need to incorporate farming in curricula. What motivates me is that even though no other field is as vital as agriculture, farmers in India are in distress.

**Gurinder:**

The broad area of my work is to understand the role of school laboratory in science education at middle and high school level. More specifically, I am trying to understand how children's prior ideas about the natural world guide them in scientific observations and experimentation. I plan to do this by letting children design their own experiments and solve some everyday problems using simple materials. I wish to understand how using everyday materials rather than sophisticated laboratory apparatus makes a difference in students' explorations during experiments.

**Himanshu:**

Development issues like management of natural resources or renewable energy are very much a part of the mainstream science curriculum. However, the relationship between science and development has always been a matter of debate. I plan to engage with this debate and develop a framework to understand the manifestation of the inter-relationship in the context of science education i.e. what do teachers understand of this relationship, how it is presented in the textbooks, how it is discussed in classrooms etc.

**Rossi:**

I'm trying to understand how the hegemony of normality operates in science and mathematics education. Through teaching music to blind children, I explore the social construction of blindness from their perspective as well as others associated with them. I plan to develop a pedagogy sensitive to the blind; and that which challenges the hegemony of dominant pedagogies irrelevant to them.

**Shweta:**

I am working with middle and secondary school mathematics teachers to develop practices for mathematics problems solving. Mathematical practices are defined as the practices that mathematicians do to generate mathematics. However, these practices are often unknown to learners or available in a abstract sense. The study will first elicit teachers’ mathematical practices through problem solving and then collaboratively learn more or required practices by designing and solving mathematics problems. The second part of the study will focus on how teachers develop lessons to teach problem solving to their students, which will reveal what aspects of problem solving are valued by them and how they plan to deliver those aspects.

**Charudatta :**

I am interested in studying the visual culture and the visual rhetoric of biology. I look at the visual discourse from the socio-scientific lens as well as the conceptual lens. I analyse the intermixing of knowledge and rhetoric in the visual discourse of biology. Along with this discourse analysis of visuals, I also talk to science illustrators and their audience to try to understand the construction and reception of biological visuals. I am specifically interested in how (implicit and explicit) motion, dynamicity, colours, shape, and size play a role in making meaning from visuals. A few of the things I am obsessed with include: comics, the second world war, evolution and puns.

**Geetanjali:**

My research work focuses on the pedagogy of socially-engaged engineering innovation for sustainability. The effort is to understand / characterize the design process and thinking of 'grassroots designers' (non- formal grassroots innovators and formal practitioners), who design technology solutions to address the needs of the 'base of the pyramid' of the society. This work is connected to the broader research area at the interface of Engineering design education, Cognition, and Engineering Studies. My data from the practice of such designers are in the form of interviews, artifact (design) histories, photos, and secondary data. We trace the historical trajectory of artifact design changes, to understand the interaction of need, problem context, and various kinds of technical knowledge in such design. The objective is to bring insights from this analysis to engineering curricula/pedagogy using the case studies, so that engineering undergraduates are better trained at innovating sustainable solutions to socially relevant problems.