

# Homi Bhabha Centre for Science Education

## Research & Development in Science, Technology and Mathematics Education

The research projects in science, mathematics and technology education in HBCSE can be broadly grouped under three categories: Learning and Reasoning with Representations, Teaching and Pedagogy, Policy and Curriculum Redesign. Projects in the first two categories work towards improving teaching/learning within the current curriculum, projects in the last category seek to critique and extend the existing curriculum and policies.

### I. Learning and Reasoning with Representations (LRR)

#### **Interactive simulation to learn vectors**

An interactive simulation in Javascript was developed for teaching and learning vectors. The system was tested with different groups of Grade 11 and 12 students, using a pre-post test format, combined with interviews and eye-tracking. The analysis of this data is ongoing, as is further development of the simulation system. [H. Agrawal, D. Karnam and S. Chandrasekharan]

#### **Interactive simulation to learn oscillation**

A simulation to teach and learn the oscillation concept was redesigned based on a pilot study, in collaboration with the Interdisciplinary Program in Educational Technology, IIT Bombay. A second study tracking students' interaction with this simulation was done using an eye tracker. Results from this study showed that interacting with the simulation allowed some Grade 7 students to understand the connection between equations, graphs and the pendulum, and make inferences based on this understanding, even though they had never encountered graphs, equations and trigonometry before. The eye-tracking data shows that students who could understand the connection between the representations had a more systematic interaction pattern, compared to students who did not understand the relationships. However, a systematic interaction pattern did not guarantee understanding. A paper reporting this result is currently in preparation. [A. Kothiyal, R. Majumdar (IDP-ET, IITB), H. Agrawal (IIT Roorkee) P. Pande and S. Chandrasekharan]

#### **Interactive simulation to learn non-linearity**

An interactive piecewise oscillator simulation was developed to help in teaching and learning the concept of non-linearity. This system will be tested in some engineering colleges during January 2017, which is when the related course would be next offered. [H. Agrawal and S. Chandrasekharan]

#### **Signed quantities: Learning trajectory**

The topic of integers is an important topic in middle school mathematics, which is difficult for students and a “hard spot” in the curriculum. Towards developing a learning trajectory on this topic, workshops for students on learning integers using the context of “Integer Mall” were held. Integer Mall is a representation that leverages the change, state and relation interpretation of integers, with change indicating movement; state the position; and relation the directed distance. This framework has been effective for teachers to invoke multiple contexts for teaching integers. A learning trajectory, which emerged from this framework is being implemented to track students’ learning and participation. Preliminary findings indicate that the context of integer mall facilitates learning of different meanings of integers but requires further refinement for integer arithmetic. [K. Subramaniam, H. Raval and N. Ponnuru]

### **Inclusive science education with a focus on visually impaired students**

Analysis of a study involving students with visual impairment (SVI) in inclusive settings was carried out. The study focused on understanding questions raised by students while observing diagrams and how students with and without visual impairments represented their visualisation. The study used adapted diagrams and models with small groups of students to facilitate peer to peer interaction. Contexts of collaborative learning through diagrams and models evoked higher order questions from students. The study also found that SVIs manipulate mental images, both visual and/or spatial. In another study with SVI, activities using multiple modes of perception were used specifically in the context of the science topic “historical approach to atomic models”. The study was conducted with two groups of students in different educational settings: an inclusive setting, and a special educational setting. The study indicates that verbal descriptions, tactile perceptions, 3-dimensional models and objects, and making drawings of perceived concepts are effective in providing learning experiences to SVI, and that students in inclusive settings benefit through collaboration. The study highlights the process of visualising and learning science among SVI and suggests changes in educational methodologies to benefit SVI. [A. Sharma and S. Chunawala]

## **II. Teaching and Pedagogy**

### **Research on science teaching at the middle school level**

A paper on our study on the outcomes of inquiry teaching, as evident in students' reflective writing, was prepared, including additional extensive data analysis in the review stage after submission. It documents cognitive, affective and epistemic outcomes of teaching science through inquiry in middle school students and has been published in the September 2015 issue of *International Journal of Science Education*. [A. Kawalkar and J. Vijapurkar]

### **Knowledge of mathematics at the horizon**

A longstanding problem in mathematics education has been to determine the knowledge that teachers need in order to teach mathematics effectively. A study was conducted where data of 14 teachers, teaching three content classes each, were analyzed to uncover knowledge of mathematics at the horizon. It was seen that this knowledge supported teachers in hearing students' mathematical insights, orienting instruction to the discipline, and making judgments about what is mathematically important. The study, rooted in practice, specifically looks at the encounters in the classroom, which place demands of mathematical knowledge at the horizon and identifies resources that lead to management of such demands. The analysis reveals multiple teaching actions aimed at managing “encounters with advanced mathematics” and reinforces specific tasks of teaching that have been identified previously. These teaching actions are important for effective mathematics teaching, and to address norms of equity in a classroom. [S. Naik, Deborah Ball (University of Michigan) and K. Subramaniam]

### **Teachers' specialized knowledge for teaching the topic of integers**

Two journal articles were published reporting work done towards developing a framework for teachers' specialized knowledge for the topic of integers. The framework elaborates integer meanings through a synthesis of previous research, and reports on the take up of the framework as teachers collaboratively planned and implemented lessons on the topic of integers. Analysis of teachers' talk in the collaborative meetings indicated a shift in teachers' role from reliance on textbook to using the knowledge of integer meanings to establish the connections between contexts and representations. [R. Kumar, K. Subramaniam and S. Naik]

### **Professional vision in practice-based professional development**

What teachers notice in their own teaching impacts what decisions they make while teaching, what

learning opportunities they design, and what constitutes their lesson for the next teaching sessions. Teaching labs were conducted at HBCSE and at Xavier's Institute of Education, where one teacher taught a group of school students and teachers/student-teachers observed this live. This was followed by intensive discussion on mathematical ideas in the work of teaching and of pedagogical practices adhering to fundamental practices of mathematics. This unusual context offered a site for looking into a particular form of practice-based professional learning, namely "professional vision of teachers". This is an ability of teachers to notice and interpret significant features of students' participation and engagement in a classroom setting. The study showed that practice-based training of noticing causes a shift in teachers' professional vision and in knowledge-based reasoning, which is applied to make sense of what they noticed. [S. Naik, T. Khan and K. Subramaniam]

### **Participatory Action Research Project under School Science Research & Development (SSRD)**

HBCSE's School Science Research and Development group (SSRD), has undertaken a Participatory Action Research (PAR) project in collaboration with Nutan Vidya Mandir (NVM), a neighbouring government aided school. The project seeks to understand and attend to existing challenges in science teaching and learning through active involvement, reflection and collaborative action of researchers from HBCSE and teachers from NVM. Three workshops were held with teachers of the school followed by regular interactions with the teacher and students of the selected class. The programme emphasizes finding ways to involve each and every student in the learning process. In May 2015 a summer camp was held for students of Grade 3 at HBCSE. The objective of the camp was to help students relate their day to day experiences to what is taught in school and to help them develop communication skills through different modes, such as, drawing, writing, mapping, expressing oneself, gesturing and raising questions. Collaborative action towards improving science teaching commenced in June 2015 with one division of Grade 3. The SSRD group taught all year round and designed relevant and effective science activities, worksheets, experiments and projects, for development of critical thinking and questioning abilities among students and problem-solving. The summer of 2016 will focus on students of Grade 4. Workshops with the teachers are planned to collaboratively assess the materials developed for teaching. [Core team: S. Chunawala, J. Ramadas, S. Bhide, N. D. Deshmukh, V. C. Sonawane, M. Kharatmal, P. Nawale, D. Gupta, V. Pawar, S. Chavan, T. Adangale, S. Ayare; Others: D. Prabhu, R. Shaikh, P. Sharma, S. Chopde, A. Muralidhar, S. Jaipurkar and B. Gera]

### **Health awareness among undergraduate students**

Two visiting teacher fellows from R. J. Jhunjhunwala College of Arts, Science and Commerce carried out a short term project with support from HBCSE. The project was titled "Health, physical fitness and wellness: A study of awareness of selected variables amongst undergraduate students" and was conducted with around 700 students of the college. In a survey aimed at understanding the level of awareness amongst students about health issues, it was found that a majority of students were unaware about information related to their own height, weight, blood group, etc. They engaged in limited physical activity, had unhealthy eating habits and irregular sleep patterns. Intervention activities included street plays, poster competitions, debates by students and talks on physical and psycho social aspects of health, including demonstrations and physiological measurements by experts. A post intervention questionnaire administered to the student participants indicated raised awareness amongst them regarding health. [B. Dutta, S. Moorthy, S. Chunawala, P. Sharma and A. Muralidhar]

## **III. Policy and Curriculum Redesign**

### **Study of rural innovators to inform engineering design education**

An interactive simulation of micro-hydro turbine design was developed, for understanding the

design thinking of rural innovators who with very little formal education develop micro-hydro turbines. [H. Agrawal, G. Date and S. Chandrasekharan]

### **Urban farming as a way to promote environment-oriented behavior**

A study was developed to understand how environment-oriented actions and behavior could be promoted among urban school students by introducing them to terrace farming. A preliminary study of how terrace farming changed the behavior of adult volunteers was first done, to develop a template for setting up school-based terrace farms and collecting data on their impact on students, teachers and the wider community. A farm has been set up in one school in Mumbai, and data collection is ongoing. [D. Dutta, A. Muralidhar and S. Chandrasekharan]

### **Environmental studies and outdoor engagement**

We developed a project to explore the possibility of children learning and engaging in their school lessons by learning outdoors through specifically designed outdoor activities. Our preliminary observations indicate that outdoor engagement can be a significant part of regular school curricula, particularly environmental studies at the primary levels of schooling. This engagement may be a viable way to provide students opportunities to connect with nature as well as society. [S. Bhide and S. Chunawala]

### **Science communications, media and scientific literacy**

Science media is an important means through which people encounter science-related issues in the real world. A scientifically literate citizen will be able to perceive, interpret, analyze and participate knowledgeably in socio-scientific concerns. Some skills that may be required in making connections between science knowledge and socio-scientific issues relate to; identifying key concepts and theories (subject content knowledge); understanding practices of science (eg. controls, reliability, validity, bias, etc.), generalization of core concepts to a variety of issues, application of relevant knowledge to reason about diverse concerns, etc. We propose that students can be helped to acquire these skills through learning modules aimed at motivating critical thinking as well as analysis and synthesis of science/socio-scientific issues presented in mass media. As a step in this direction we are developing modules that will help students across ages and grades distinguish between 'opinion' and 'fact' - aspects that involve critical reading, thinking and communication. [S. Bhide and S. Chunawala]

### **Problem identification when no design brief is provided**

Problem solving and problem identification are important components of design and technology curricula and research. Our interest is focused on “students' identification of problems”. We analysed a range of innovations registered on the website of the National Innovation Foundation, India (<http://nif.org.in/>). Preliminary analysis suggests that while the number of problems were similar in both groups, adults identified problems in a greater variety of areas. This result is surprising if one attributes greater flexibility to students, but attempts are being made to understand possible reasons for these differences and to identify conditions under which students can be made sensitive to problems in a diverse range of areas. [S. Datt and S. Chunawala]

### **Socio-scientific issues**

Analysis of a study involving interviews of 20 biology high school students (Grades 11 and 12) and their deliberations in two workshops on a socio-scientific issue related to commercial surrogacy was completed. This study investigates the epistemic, as well as the social, political and ethical considerations students bring to bear on the topic. One part of the study investigated students' evaluation of the evidence involved in a socio-scientific issue. We focused on how students understand the reliability and authenticity of various sources of primary and secondary evidence.

Findings reveal that students' understanding of the nature of various sources of secondary evidence and their reliability is sketchy. Not all students were able to evaluate the empirical adequacy of newspaper articles presented. Even when they did apply the criteria of empirical adequacy, they applied it inconsistently, often going by their biases or commitments towards stakeholders involved in the issue. [A. Raveendran and S. Chunawala]

### **Inclusive design and technology**

Efforts were made to explore the “inclusive nature” of design and technology (D&T) education. A two-day D&T workshop was organized in which 8 students (4 girls and 4 boys, age 11-13 years) participated. Students were provided a context for developing a product (solution) for a real-world problem: they had to design and make a product which could keep a bottle of cold water chilled for the longest possible time. Despite diverse backgrounds, students were able to work collaboratively and communicate with each other through verbal and non-verbal modes to express their ideas and critique products. The products made by students were influenced by their home settings, their school learnings and their prior exposure to the technology, skills and knowledge relevant to the D&T challenge. Further, the activity required them to use their cognitive and motor skills. Students tested their product on evaluation criteria that they developed, which also demonstrated their values on issues of economics, environment and aesthetics. [R. Kapil, S. Bhide, A. Muralidhar, D. Gupta, P. Sharma and S. Chunawala]

### **Exploring Ableism in mathematics education**

A series of Mathematics lessons was conducted at a School for Blind Children. It was observed that on presenting mathematics as a process, the students would themselves explore the properties of numbers so as to debate about them. A student also constructed a novel, mathematically consistent definition of even and odd numbers and hypothesized its history with his peers. The study revealed that students resist Ableism in mathematics by consciously and actively not conforming to the imposed nature of mathematical form and content that constructs them as being less capable of doing mathematics. The study suggested possible approaches for addressing structural oppression that are produced and reinforced by curricular mathematics and dominant pedagogies. [R. D'Souza]

### **Science education and the possibility of social transformation**

In order to understand the nature of formal education experience of 14-16 year old students of a marginalized community that lives close to the Deonar dumping ground, classroom observations were conducted in five schools in the area when topics related to waste management and health were taught. The science and social science teachers were subsequently interviewed to elicit their understanding of the subject matter, and their value commitments regarding waste, health and hygiene, and socio-economic development. The relevant textbook chapters were also analyzed from the Bernsteinian perspective of 'classification' and 'framing' of educational knowledge.

Preliminary analysis indicates that the topics on waste and health are presented as if they are well-insulated from each other. The classes run in didactic fashion with very little room for students to raise a concern, or ask a question. The pedagogical practices across schools disregard the lived reality of the community. The control over content lies mostly with the teachers, though the structure and the examples discussed in a class are largely determined by the textbook. The textbook works as a gatekeeper and maintains a 'strong' boundary between the knowledge worth-teaching and the community-based experiential knowledge. There is a class bias in the chapter on waste management which adopts a managerial approach and remains silent on the political economy of waste. Further analysis of the chapters and classroom data from a 'Critical Discourse Analysis' framework is underway. [H. Srivastava]

## **Development of Curricular and other Educational Materials**

### **E-learning portal and educational materials in hindi**

The e-learning portal in Hindi (<http://ehindi.hbcse.tifr.res.in>) contains a variety of curricular, co-curricular, and popular science materials including pedagogic presentations, books, lectures, magazines, articles, reports, documentaries, glossaries, questionnaires and short biographies of some Indian scientists. Reviews of recent books of the Hindi Cell were published in periodicals and links added to the e-hindi site. [K. K. Mishra, K. Sinha, D. Mishra, A. Sankhwar, and R. Nichat]

A co-curricular book titled '*Gyan-Vigyan - Shaikshik Nibandh (Book-4)*' was published by HBCSE. It contains 17 selected educational essays based on pedagogic presentations by experts who participated in the 4<sup>th</sup> National Workshop on Development of Educational E-materials in Hindi (organized by HBCSE collaboratively with Vigyan Parishad Prayag in November 2014). [K. K. Mishra, K. Sinha, S. Deoram and D. Mishra]

### **Middle school inquiry science curriculum**

Video records of our science classes with middle school students document several successful classroom strategies for teaching concepts in science, and involving students in the processes of science. Analysis of classroom interactions, to trace in detail the development of successful pedagogy of particularly difficult but essential concepts in introductory science was nearing completion towards the end of the period of this report. Writing up of the curricular material continued. [S. Patil, A. Sawant and J. Vijapurkar]

### **Marathi Vishwakosh**

HBCSE has been working with the Maharashtra Rajya Vishwakosh Nirmitti Mandal to produce Kumar Vishwakosh (a junior encyclopedia) on 'Biology and environment' in Marathi, as reference material for teachers and students at Secondary and Higher Secondary School Levels. Two volumes of the Kumar Vishwakosh are already published in print and on the internet. During the period of this report, work continued on Volume 3, consisting of about 260 articles. About 80% of the work of this volume is completed, and has been prepared in Unicode for easy portability. [V. D. Lale, N. D. Deshmukh, A. Ajgaonkar and Editorial Committee, Kumar Vishwakosh, Chaired by H. C. Pradhan]

### **An instrument to teach sound frequency to visually impaired students**

A low-cost model which can be used by teachers to teach the concept of frequency to visually impaired students is being developed and tested. The model uses a IC LM555 with resistors, capacitors, buzzer, speaker and keys. This device has applications in designing circuits like sequential timing, time delay generation, pulse generation, pulse width modulation, pulse position modulation, linear ramp generator, precision timing; some of these were used in our model. Change in time delay leads to change in frequency, which in turn results in specific sounds which act as indicators for students with visual impairment (SVI) to identify different frequency ranges. Additionally, the knobs which control time delay have braille panels so that SVIs can themselves manipulate the model. Testing of the model has been done with one SVI. The circuit has been given to the blind school for further feedback. [S. Kulkarni and S. Chunawala]

### **Knowledge laboratory**

New features were added to the GNOWSYS online platform and its stability was enhanced as a result of development carried out by lab members as well as interns from colleges. Notable among the new features are: (a) recording benchmarks for every registered procedure executed with the information of who initiated, when and time taken; (b) fine grained analytics based on benchmarks providing numerical and graphical reports to users on their performance; (c) an ABCD MOOC

(Activity Based Collaborative Distributed Massive Open Online Course) framework; (d) distributed sync functionality between multiple instances of GNOWSYS servers; (e) packaging server software as a docker container (<http://docker.com>) for distribution in schools and colleges; (f) mutation of resources into various interactive types (reply, submit, voice response, single choice, multiple choice, check boxes); (g) User Interaction and User Interface Design for the Course Player. GNOWSYS started in 2013 is now considered a highly active project on openhub (<https://www.openhub.net/p/gstudio/>). Analytics from the code repository show 9700 commits made by 73 contributors representing 197,387 lines of code at (<https://github.com/gnowledge/gstudio>).

HBCSE became a development partner with Tata Institute of Social Sciences (TISS) as a part of the CLIX (Connected Learning Initiative) project. The lab is contributing technical consultancy, distributed online platform, and the project's first course offering, 'Invitation to CLIX', dubbed i2c. Gnowledge Lab is involved in the development and implementation of Digital Literacy course, course platform and Management Information Systems (MIS) for National University Student Skill Development programme of TISS, Mumbai and in developing and maintaining the National Repository of Open Education Resources for Central Institute of Educational Technology, National Council of Educational Research and Training, New Delhi. [G. Nagarjuna, R. Thengodkar, A. Dhakulkar, R. Shaikh, S. Ghumre, S. Shende, U. Shah, M. Nachankar, N. Shinde, V. Sawant, K. Aitwadkar, R. Katkam, S. Bharswadkar, Keerthi K. R. D., and M. C. Arunan (Consultant)]

### **Collaborative Undergraduate Biology Education (CUBE)**

The CUBE Studio regularly hosts 10 to 25 students and teachers for trouble-shooting of their respective research programs as well as for learning about CUBE projects. A distinctive feature of CUBE is that, unlike vacation research programs, it is ongoing during the college term, integrating serious research with regular curricular work. Continued engagement is evidenced through more than a thousand group mail interactions per month.

<http://gnnowledge.org/pipermail/cube/>

New CUBE nodes emerged in Kudal, Delhi, Jaipur, Chandigarh, Patna, Chennai, Panjim, Thrissur, Cherthala and Guwahati. Senior 'CUBEists' at these locations have voluntarily assumed new roles in mentoring juniors, participating in conferences and conducting local workshops, apart from recording, reporting and discussing their project data. CUBEists from Mumbai, Delhi and Jaipur presented posters at the Indian Academy of Neuroscience conference, Chandigarh, one of which 'Behavioural modifications through associative conditioning in putative giant bacteria' won the best poster award. Students of Acharya Narendra Dev College, Delhi, established a TH!NK CUBE stall to demonstrate their model systems, winning the best exhibit award at the college silver jubilee event.

Students from Deonar Colony Municipal School have been regularly working on culturing of Daphnia, following activity rhythms in wild fruit-flies and distinguishing Aedes from non-Aedes mosquitoes, recording data meticulously and reporting it weekly. Cross-mentoring between school and college students is common: for e.g., school students helped Smt Chandibai Himathmal Mansukhani College (CHM) college students to establish Daphnia cultures. [G. Nagarjuna, R. Thengodkar, V. Sawant, S. Ghumre, R. Shaikh, U. Shah, S. Shende, A. Dhakulkar, N. Shinde, A. Zakaria, M. C. Arunan (Consultant)]

### **Process Oriented Guided Inquiry learning (POGIL)**

A project involving development of POGIL instructional material for undergraduate organic chemistry has been initiated by chemistry cell, HBCSE, since August 2015. The group is collaborating with Kelly Butler (Chestnut Hill College, Philadelphia, USA), a Fulbright-Nehru

Scholar who visited HBCSE from January 7 to February 10, 2016. Several teachers from local colleges in Mumbai are participating in the project: G. Carnerio (Sophia College), T. Parulekar (SIWS Colleges, Wadala), L. Ravishankar (KET V. G. Vaze College), G. Shridhar (V.K. Menon College) and G. Shaikh (St. Xavier's College). [K. Butler, S. Ladage, I. D. Sen and S. Narvekar]

## **Consultations, Collaborations and Support to External Institutions**

### **Maharashtra State Bureau of Textbook Production & Curriculum Research, Balbharati, Pune**

HBCSE has had two members on the science committee of Balbharati constituted in April 2013. During the period of this report, Balbharati produced a textbook on Environmental Studies for Class 5 in Marathi, with content based on natural science, geography and social science. It is being translated by Balbharati into eight different languages. HBCSE members contributed to the effort of streamlining the science curriculum from primary to higher secondary level and in scrutiny of e-learning material. [V. D. Lale and J. Ramadas]

### **Maharashtra Knowledge Corporation Ltd. (MKCL), Pune**

HBCSE members are part of the Educational Content Committee for the Shikshan Pandhari Project, sponsored by Rajiv Gandhi Science and Technology Commission (RGSTC), Mumbai. Under this project, five secondary schools in Pandharpur Taluka (Dist. Solapur, Maharashtra state) have been connected to MKCL through a node at a local engineering college. School visits were made between February 4-5, 2016. The content committee is guiding a team at MKCL to develop Open Educational Resources for the project schools, and also following up their implementation, including student projects on social and environmental issues. [H. C. Pradhan and V. D. Lale]

### **YCMOU Post Graduate Research Programme**

HBCSE is the study centre in Mumbai for Yashwantrao Chavan Maharashtra Open University (YCMOU, Nashik)'s two-year Post Graduation Research Programme (M.Sc., M.A., and M. Com.) in Subject Communication and Education Communication through distance mode. The batch of 2014-16 has 41 students and the batch 2015-17 has 72 students. Fourteen workshops were conducted for both batches between September 2015 and March 2016. Besides participation in these workshops, students are counseled on various subjects. Student assignments were assessed and help was provided to students in formulating their research problems and in developing their research projects. [S. Chunawala - Coordinator, N. D. Deshmukh, D. Prabhu, D. Gupta, P. Sharma, D. Pednekar, R. Sandhya and J. Tambe]

### **AEES-HBCSE Junior Mathematics and Science Olympiad - 2015**

The Atomic Energy Educational Society (AEES) and HBCSE continue to collaborate in several areas. The junior mathematics and science Olympiads, which is the first stepping stone for the National Olympiads, draw some of the best students of the Atomic Energy Schools from all over the country. The 16<sup>th</sup> camp was conducted in May 2015 with HBCSE academic, scientific and project staff along with the AEES teaching community. Interactive sessions on environment and sustainability, emotions, bio-mimicry, history of science, mathematics, computers, astronomy and simple pendulum were conducted during the 16<sup>th</sup> JSO-AEES programme. These sessions included besides lectures, hands-on and minds-on activities, where students worked in groups and performed tasks, activities and games. [S. Chunawala, K. Subramaniam, R. Vartak, A. Ronad, S. Pathare, P. Pathak, V. Ghanekar, S. Narvekar, I. D. Sen, V. C. Sonawane, A. Das, R. Dsouza, S. Takker, P. Ranadive, H. Misra, T. Khan, J. Rahaman, A. Muralidhar, D. Prabhu, S. Bhide and P. Sharma]

### **Support to national level assessment**



HBCSE members contributed to various prestigious national level assessment and admission processes organised by different external agencies and aimed at higher secondary students. Details of these cannot be listed for the reasons of confidentiality.

### **Support to teacher education institutions**

As part of National Council for Teacher Education (NCTE) Bhopal's inspection of Gujarat's District Institute of Education and Training (DIET) in the context of their B Ed application, in February 8-10, 2016, N. D. Deshmukh visited DIETs of Vadodara, Anand, Dahod, Narmada and Kheda districts. He also visited the State Institute of Science Education, Nagpur to evaluate the Activity Based Science Learning ABSL kit and activity manual on June 20-21, 2015 at Bal Shivai Mandir School, Dombivli.

### **Royal Society of Chemistry**

HBCSE members are collaborating with the Royal Society of Chemistry (India chapter) to conduct 'Innovative Teacher Training' as part of the 'Yusuf Hamied Inspirational Chemistry Programme'. The third workshop in the series was conducted in September 2015 to take a review of the programme and resource materials as well as to collect feedback from teacher developers. A course for chemistry teachers of Nashik Education Society was also conducted. Discussions are ongoing on evaluation of the program. [S. Ladage, V. D. Lale, I. D. Sen and S. Chunawala]

### **RMSA science teacher handbooks**

Rashtriya Madhyamik Shiksha Abhiyan (RMSA), Maharashtra, had organized workshops for finalization of Science Teachers' Handbooks for Grades 9 and 10 at HBCSE on January 21-22, 2015. After printing 3500 copies of these handbooks, RMSA organized regional workshops for headmasters of Government schools, including tribal, municipal corporation and Zilla Parishad schools. N. D. Deshmukh was a coordinator for science teachers for the workshops organised by RMSA at Pune, Mumbai and Nashik regions during August to October, 2015.

### **MSTA- Dr. Homi Bhabha Young Scientists Camp**

Maharashtra Science Teachers Association (MSTA) and HBCSE jointly organized Dr Homi Bhabha Young Scientist Camps during April 15-18, 2015. In these camps students from English and Marathi mediums, studying in Class 6 (105) and in Class 9 (62) participated. They were exposed to laboratory demonstrations and activities as well as content and enrichment sessions. [J. Ramadas, N. D. Deshmukh (Program Coordinator), V. C. Sonawane, V. D. Lale, P. K. Navale, A. Sule, P. K. Joshi, K. T. Hambir, P. Ranadive, V. Pawar, S. Mukherjee, S. Ayare and project staff]

### **Bombay Association for Science Education**

The Bombay Association for Science Education (BASE) is a voluntary organization run by TIFR scientists in collaboration with school and college teachers from Mumbai region. During the period of this report, BASE jointly with HBCSE organized two workshops on the themes: Application of light (August 8, 2015) and Managing School Laboratory (December 18-19, 2015).

### **National Children's Science Congress (NCSC)**

The National Council of Science and Technology Communication (NCSTC) of the Department of Science and Technology, Government of India organises NCSC, a nation-wide programme of children's creative science projects every year in December. About 800 students and 200 teachers participate in this programme. H. C. Pradhan served as the Chair of the Programme Advisory Committee of NCSTC, conducted the "Meet the Scientists" programme in which scientists answer questions from students, and also conducted discussion sessions for teachers who accompany the participating children during the Congress. [H. C Pradhan]

### **National Teachers' Science Congress (NTSC)**

The NCSTC organises a Science Teachers' Conference biennially in which about 250 teachers, selected through a rigorous selection procedure, present papers based on action research projects undertaken by them. The NTSC this year was hosted by Marathi Vidnyan Parishad, Mumbai and held in December 2015 at Indian Institute of Science Education and Research, Pune. H. C Pradhan served as the Chair of its National Organising Committee, and guided its proceedings. [H. C. Pradhan]

### **Support to schools and related activities**

HBCSE members actively participated in various capacities (evaluators, judges, chief guest, interviewer, project guide) in academic and school events. In this endeavor, A. Sule visited Jamnabai Narsi School (August 27, 2015), Jaffree School, Shivaji Nagar, Deonar (October 15, 2015), St. Anthony's school, Chembur (December 3, 2015), Hashu Adwani School, Govandi (December 8, 2015) and participated in the Techfest – Mars Habitation project competition (December 26, 2015) as well as the Homi Bhabha Young Scientist Examination (February 13-14, 2015). V. C. Sonawane participated in the P-Ward Science Exhibition & Co-curricular Activities Committee, at Adarsh Vidyalaya, Jogeswari (October 29, 2015), H-Ward Science Exhibition 2015-2016, at St. Mary's High School & Jr. College, Kalina Santacruz (December 3, 2015), R-Ward Level Inter school Science Seminar, at Mother Teresa English Secondary School & Jr. College, of Commerce and Science (August 4, 2015) and 43<sup>rd</sup> Jawaharlal Nehru Science Regional Exhibition, at Kendriya Vidyalaya, Colaba (October 12, 2015). V. D. Lale visited Mar Thoma School, Govandi (December 2, 2015). S. Mukherjee participated in EXPISCOR 2015, held at Vasaanji School, Andheri (December 5, 2015).

### **Student interns and visitors to HBCSE**

As part of our collaboration with academic institutes, HBCSE had numerous visitors and interns this academic year, during which they either carried out small projects in their area of interest or gave talks and/or offered short courses.

Visitors included faculty members from the following national and international institutes: Azim Premji University, Bengaluru, Shri Bapusaheb Vispute College of Education, New Panvel, R. J. Jhunjhunwala College, University of Waikato, New Zealand, University of Wisconsin-Madison, Srishti Institute of Art, Design and Technology, Bangalore, Centre for Studies in Science, Technology and Innovation Policy- CSSTIP, Gujarat, Chestnut Hill College, Philadelphia, USA, etc. [N. Varadarajan, A. Bardapurkar, S. Mali, R. Inamdar, B. Datta, S. Murthy, J. Lockley, P. Kishor, J. Czuplewski, S. Kar, T. Rode, Y. Shetty, S. S. Varughese and K. Butler]

Students interns from the following institutes visited HBCSE for durations ranging from 1 to 3 months: Tata Institute of Social Sciences, Hyderabad, IIT Roorkee, IIT Kanpur, D. Y. Patil School of Engineering, Pune, Mumbai Education Trust College, BITS Pilani, BITS Pilani Goa, BITS Pilani Hyderabad. [B. Gera, S. Jaipurkar, R. Kapil, H. Agrawal, N. Ponnuru and S. Kulkarni]

### **Olympiads and Related Activities**

The Indian Olympiad programmes in the sciences (Biology, Chemistry, Physics, Astronomy and Junior Science) and mathematics continued to flourish in 2015-2016, thanks to the dedicated hard work of the HBCSE Olympiad cell members, teacher associations and resource persons from across the nation. The Olympiads being international competitions at the highest levels of performance, the programme provides an international level benchmark for high achievement in science and

mathematics at the Secondary, Higher Secondary and, by extension, even at the Undergraduate stage in the country. Of the 30 student team members who represented India in the International Olympiads in Astronomy, Biology, Chemistry, Junior Science, Physics and Mathematics, 27 bagged medals and these included 10 coveted gold medals. Over 200 of the best students from across the nation were given experimental and theoretical training.

One of the major highlights of the programme this year was the successful hosting of the 46<sup>th</sup> International Physics Olympiad (IPhO) in Mumbai in July, 2015. Apart from the 650 international participants, this event involved more than 250 teachers, researchers and undergraduate students from all over India. The quality of the academic programme as well as the overall organization of the event were highly appreciated by the international community.

By designing conceptual and challenging problems, developing novel experiments, actively participating in book writing for Olympiads, national and state bodies, participating in several national assessment committees, the members of the Olympiad programme have extended the fruits of the Olympiad programme to different layers of the national education scene. They have also contributed to research articles in peer-reviewed technical journals. More than three hundred teachers attended resource generation and exposure camps, some from Bangladesh, Sri Lanka, Nepal and Thailand. Through these activities, and further by providing support to voluntary Teacher Associations, the programme has disseminated the quality material developed as well as striven to evolve a positive atmosphere for excellence in science.

The Olympiad selection procedure in all the subjects (Astronomy, Biology, Chemistry, Junior Science, Mathematics and Physics) followed the standardized routine. The first level tests in science subjects (the National Standard Examinations, NSEs) were held in November, 2015 at 1328 centres spread all over the country. These were conducted by the Indian Association of Physics Teachers (IAPT), with the assistance of Association of Chemistry Teachers (ACT) and Association of Teachers in Biological Sciences (ATBS). The NSEs had mainly objective type questions. The participation in the NSEs for the year 2015-16 was nearly 14000 in Astronomy, 19000 in Biology, 36000 in Junior Science, 40000 in Chemistry and 44000 in Physics. This amounts to an average increase of 20% in all subjects since last year, except Junior Science.

The second level examinations, the Indian National (Astronomy/Biology/Chemistry/Junior Science/Physics) Olympiad Examinations (INAO, INBO, INChO, INJSO and INPhO, respectively) were conducted by HBCSE at 18 centres nationwide. These tests had subjective problems, and were of high difficulty level, somewhat comparable to the international Olympiads. The top performers in NSE, numbering between 300 and 630 in each subject, participated in these examinations. In the next phase of selection, about 35 students in each subject were invited for Orientation cum Selection Camps (OCSC) held at HBCSE. Students appeared for several theoretical and experimental tests in these camps, leading to the selection of Indian teams for the international Olympiads. In mathematics, the first stage (Regional Mathematical Olympiad) was organized regionally and the second stage (Indian National Mathematical Olympiad) was organized by HBCSE and both stages had subjective questions. The selected teams for international Olympiads went through two weeks of pre-departure training (PDT) at HBCSE.

The Indian National Olympiad exams were organized during January 2016. The number of students selected were as follows: 308 students in Biology, 365 students in Physics, 402 students in Chemistry, 573 students in Junior Science, 634 students in Astronomy and 905 students in Mathematics. The OCSCs were organized during May-June 2016 and were attended by: 35 students in Biology, 35 students in Physics, 37 students in Chemistry, 35 students in Junior Science, 35

students in Astronomy and 32 students in Mathematics.

### **Orientation–cum–selection camps (OCSC) and Pre-departure training (PDT)**

#### **Astronomy**

The Astronomy Olympiad Cell conducted Orientation Camp cum Selection Camp in two parts; May 2-7, 2015 and May 26-June 5, 2015, and PDT for the Indian team in was from July 20-24, 2015. Astronomy OCSC programme covers a wide range of topics in astrophysics from positional astronomy, stellar and solar physics to large scale structure of the universe and cosmology. The students were evaluated on basis of 3 theoretical, 2 practical and 2 observation tests conducted during the camp and top 5 students were selected for merit awards and the Indian team for the international Olympiad. The five-member team at the 9<sup>th</sup> International Olympiad on Astronomy and Astrophysics held at Central Java, Indonesia from July 26- August 3, 2015 won three Gold and two Silver medals. Aniket Sule (HBCSE) and Swapnil Jawakar (S.I.E.S. College, Mumbai) were the team leaders and M. N. Vahia (TIFR, Mumbai), Najam Hasan (Moulana Azad National Urdu University, Hyderabad) and Ashok Kumar Mohapatra (NISER, Bhubaneswar) were the Scientific Observers. [A. Sule, A. Mazumdar, P. Ranadive and M. N. Vahia (TIFR)]

#### **Biology**

The Biology Olympiad Cell conducted OCSC during June 4-13, 2015 and the PDT for the Indian Team in July 1-10, 2015. Problem solving sessions in Cell Biology, Plant Sciences, Animal Sciences, Genetics & Evolution, Ecology and Ethology were conducted. Lab orientations and tests in the four lab areas namely Plant Anatomy, Biosystematics & Evolution, Animal Functional Morphology, Microbiology and Molecular Biology & Biochemistry were conducted during this camp. The four-member team to represent India at the international Olympiad was selected on the basis of two theoretical tests and four experimental tests during the camp. The 4 member Indian team at the 26<sup>th</sup> International Biology Olympiad held at Aarhus, Denmark from July 12-19, 2015 won two Silver and two Bronze medals. Kauresh Vachharajani (Maharaja Sayajirao University of Baroda), Rekha Vartak, (HBCSE) were the team Leaders and R. Radhakrishnan (Sardar Patel Vidyalaya, Delhi) and Anupama Ronad (HBCSE) were the Scientific Observers. [R. R. Vartak, A. Ronad and V. Ghanekar]

#### **Chemistry**

The Chemistry Olympiad cell conducted OCSC during May 26-June 5, 2015 and the PDT for the Indian Team in July 2015. The theoretical sessions at OCSC were related to chemical thermodynamics, spectroscopy, chemical kinetics, phase equilibria, biochemistry and fluorescence. The theoretical examinations at the camp were related to various phase equilibria of an organic compound, synthesis of drugs, inorganic reaction mechanisms, estimation of aluminium from different samples, fluorescence spectroscopy, biological redox reactions in mitochondria, thermodynamic cycles, protection and deprotection of functional groups in organic chemistry, chemistry of boron, use of reagents in organic synthesis and kinetics and catalysis-from laboratory to industry. The experiments that were developed and standardized for experimental examinations at OCSC covered the following areas:

1. Analysis of carbonate and bicarbonate content of a given sample,
2. Synthesis of copper acetylacetonato and estimation of its copper content,
3. Synthesis of an imine and its reduction using sodium borohydride, and
4. Identification of organic compounds by qualitative analysis
5. Synthesis of a dye, acid orange
6. Estimation of Fe (III) and Cu(II) ions in the given mixture by iodometric titrations

## 7. Estimation of Ca (II) and Mg (II) ions in the given mixture by complexometric and redox titrations

A four-member team was selected at the end of the camp to represent India at the international Olympiad. The Indian chemistry team at the 47<sup>th</sup> International Chemistry Olympiad held at Baku, Azerbaijan from July 20-29, 2015 won two Gold medals and two Silver medals. Anindya Dutta (IIT, Mumbai) and Prodeep Phukan (Gauhati University, Guwahati) were the team Leaders and Avinash Kumbhar (University of Pune) and Abhijit Chavan (S. P. College, Pune) were the Scientific Observers. [S. A. Ladage, A. Gupta, S. A. Narvekar and I. D. Sen]

### Junior Science

The Junior Science cell conducted OCSC during May 7-26, 2015 and the PDT for the Indian Team was held from November 20-30, 2015. The camp consisted of around 30 lectures and 22 experimental sessions in advanced topics in Biology, Chemistry and Physics at the Class X level. Problems of high standard were set for theoretical and practical exams. On the basis of camp performance, a team of 6 students was selected for the international event. The Indian team at the 12<sup>th</sup> International Junior Science Olympiad held at Daegu, Republic of Korea from December 2-11, 2015 won five Gold and one Silver medal. Prodeep Kumar Burma (University of Delhi), Vinayak Katdare (Ruparel College, Mumbai), Surabhi Potnis (St. Xavier's College, Mumbai) were the team leaders and P. K. Joshi (HBCSE, Mumbai) was Scientific Observer. [P. K. Joshi and P. K. Nawale]

### Physics

The Physics Olympiad cell of SGTB Khalsa College conducted OCSC during June 9-19, 2015. The PDT for the Indian team was held in IISER, Pune in July 2015. Apart from lectures in Special Theory of Relativity, Fermat's principle and Thermodynamics, rigorous training was imparted in experimental work. A five-member team was selected at the end of the camp to represent India at the International Olympiad. The Indian team at the 46<sup>th</sup> International Physics Olympiad, won four Silver and one Bronze medal. Subhash Chandra Samanta (Midnapore, West Bengal, Patrick Das Gupta (University of Delhi) were the team Leaders and M. L. Ogalpurkar (IAPT, Pune), Ravi Bhattacharya (S.G T B. Khlasa College, Delhi), R. M. Dharkar (IAPT, Pune), and Pramendra R. Singh (Jagdam College, Bihar) were the Scientific Observers. Deepak Chandra (Delhi) and Mita Chowdhury (Kolkata) accompanied the team as Visitors.

### The 46<sup>th</sup> International Physics Olympiad

HBCSE hosted the 46<sup>th</sup> International Physics Olympiad (IPhO) in Mumbai from July 5-12, 2015. This academic competition was fully supported by the Government of India and had delegations from 83 countries which included 382 students, 160 teacher leaders, 80 observers and 18 visitors. The preparation, administration, evaluation and moderation of the academic tasks were carried out by a team of 128 teachers, researchers, educationists and undergraduate students assembled from all over the country. The final theoretical and experimental tasks were selected through a rigorous academic exercise, initiated more than a year previous to the event, and involving about 80 teachers and scientists. One of the major challenges was the assembly and testing of 430 identical sets of experimental apparatus, a task handled by a group of about 60 teachers at an intensive workshop at HBCSE in April-May 2015.

The experimental examination at IPhO 2015, lasting five hours, dealt with the phenomenon of diffraction of light as a probe of matter. The first part, inspired by Rosalind Franklin's famous experiment to reveal the double-helical structure of DNA, used diffraction of a laser beam to determine the characteristic length scales of a spring and a double helical pattern. In the second part, the surface tension and viscosity of water were measured through the diffraction of laser light at

grazing incidence by surface capillary waves. The theoretical examination at IPhO also was of five hours duration and consisted of three tasks. The first theoretical task focused on learning about the interior of the Sun from the photons and neutrinos that it emits. The second task dealt with the extremum principles in physics, connecting the thread of the ubiquitous variational principle between optics, classical mechanics and Schrodinger's wave mechanics. The third problem of IPhO 2015 was based on the design of nuclear reactors where students were guided to determine the optimum specifications of a nuclear reactor so that energy is released in a controlled fashion for safe operation.

The student scores followed closely the range and distribution recommended by the international statutes, which indicate that the problems matched the desired level of difficulty. The international community present in IPhO unanimously expressed their appreciation for the excellent standard of the academic programme and the organisation of the event as a whole. The IPhO President and Secretary have described it as the "*best International Physics Olympiad we have ever had*". The questions, solutions and the scores of all the medal winners are available at the official homepage of IPhO 2015: [www.ipho2015.in](http://www.ipho2015.in)

[Academic and organizational contribution: A. Mazumdar (Convener), R. B. Khaparde, S. R. Pathare, P. P. Pathak, H. C. Pradhan. Organizational contribution: J. Ramadas, A. P. Sule, R. R. Vartak, S. A. Ladage, K. R. Manoj, S. A. Narvekar, A. Ronad, V. Ghanekar, P. Ranadive, R. Nichat, A. Sankhwar, M. D. Gaitonde, S. V. Amin, V. P. Raul, G. Mestry and numerous other academic, scientific, administrative and technical staff]

### **Mathematics**

The Mathematics Cell conducted IMOTC during April 20-May 18, 2015 and PDT for the Indian team during June 29-July 7, 2015. A six-member team was selected at the end of the camp to represent India at the 56<sup>th</sup> International Mathematical Olympiad held at Chiang Mai, Thailand in July, 2015. The team won one Silver medal, two Bronze medals and three Hon'ble Mentions. C. R. Pranesachar (IIS, Bangalore) and Rajendra Pawale (Mumbai University) were the leaders. K. N. Ranganathan (Vivekanand college, Chennai) and Prithwjit De (HBCSE, Mumbai) were the Scientific Observers. [P. De]

### **Resource Generation Camps (RGCs)**

Several Resource Generation Camps (RGCs) in which teachers and scientists from across the nation gathered for development of curriculum and Olympiad material were held in all the subjects. The Biology RGCs were organized during: September 3-4, 2015; September 14-15, 2015; October 27-28, 2015; November 26-27, 2015 and December 7-8, 2015, having 4, 4, 3, 3 and 3 participants respectively. The Chemistry RGC were organized during: September 30-October 3, 2015, having 31 participants. The Junior Science RGCs were organized during: March 6-7, 2015; March 14-15, 2015; April 25-26, 2015; July 18-19, 2015; August 22-23, 2015 and October 31- November 1, 2015, having 30, 30, 25, 25, 20 and 14 participants respectively. The Physics RGCs were organized during: January 3-5, 2015; February 9-14, 2015; October 1-3, 2015; January 15-19, 2016 and February 5-9, 2016, having 5, 8, 12, 24 and 7 participants respectively.

### **Exposure Camps (EC)**

Several short 3-4 day exposure camps were held in different subjects where a large number of school and college teachers were invited. Participants in these camps included teachers from neighboring countries. Olympiad problems and experiments were discussed in these camps. Towards the end of the camp the teachers were invited to suggest challenging tasks for the students and critique existing textbooks. The Astronomy EC was held during November 10-13, 2015 for 45

participants; the Biology EC was held during October 14-16, 2015 for 18 participants; the Chemistry EC was held during November 16-18, 2015 for 38 participants and the Physics EC was held during November 30- December 3, 2015 for 42 participants.

### **Other activities**

Several workshops were held during April to June, 2015 at HBCSE for the academic preparation of the 46<sup>th</sup> International Physics Olympiad (IPhO 2015), involving more than 70 teachers and scientists from across the nation. These included a five-week workshop with 50 college teachers to assemble, test and record data on 430 sets of the experimental apparatus of IPhO 2015.

Teacher orientation workshops for Junior Science Olympiad were held at multiple places throughout the year; for 32 teachers in Vapi, June 7 and 9, 2015; for 29 teachers Kutch University, June 15 and 17, 2015; for 60 teachers in Pal, Maharashtra, June 23-28, 2015; for 14 teachers at HBCSE in collaboration with Janakalyan Samiti, Mumbai, August 10-13, 2015; for 26 teachers in Majhihira, West Bengal, September 8-10, 2015; for 39 teachers in Dombivli, September 25-27, 2015; for 28 teachers in Guwahati, October 8-10, 2015; and for teachers at Atomic Energy Central School, Tarapur, January 21- 23, 2016. [P. K. Joshi, P. K. Nawale and S. Mukherjee]

## **National Initiative on Undergraduate Science (NIUS)**

Since its inception in 2004, the primary aim of the National Initiative on Undergraduate Science programme (NIUS) of HBCSE has been to promote undergraduate research and learning. The programme has been contributing towards R&D in training of students and teachers in experimental science, development of theoretical and laboratory courses and preparation of pedagogical materials. Around 1300 undergraduate students have benefited from the NIUS programme in various ways by being a part of the exposure-cum-enrichment camps. This year about 91 undergraduate students were invited to attend the NIUS camp and many of the students were from non-metropolitan colleges. In these camps, students have intense interactions with scientists, researchers and passionate teachers and thus, experience the vibrant and exciting aspects about being engaged with science. The quality of these interactions reflect in the project work carried out by NIUS students and the resultant publications in national and international journals.

### **Biology**

The NIUS camp for Biology (XII.1) was conducted at HBCSE from November 2-6, 2015. Forty-two students from regular B.Sc. or integrated M.Sc. courses were selected and the camp was attended by 37 students. The resource persons for the camp included HBCSE resource persons and B. B. Nath (Pune University), D. Singh (MS University, Baroda), J. D'souza (Centre for Excellence in Basic Sciences, Mumbai), K. Vachharajani (MS University, Baroda), S. Menon (Therapeutic Drug Monitoring Lab, Mumbai). The theoretical sessions at the camp were related to basic concepts of biology, bio-analytical techniques in studies of medicinal plants, spectral identification of plants, marine biology, chromosome studies, and irreducible multi-protein complexes in cells and research in plant sciences. The laboratory sessions covered experiments related to biochemistry, molecular biology and animal behavior. From this batch, 3 students were selected to pursue NIUS projects in different areas of biology. In addition, 12 students from earlier batches of NIUS Biology visited HBCSE to complete their projects and are in process of writing their reports. [R.Vartak, A. Ronad and V. Ghanekar]

### **Chemistry**

The NIUS camp for chemistry (XII.1) was held at HBCSE from December 23-31, 2015 and was attended by 49 students from regular B.Sc. /BS or integrated M.Sc. Courses. The speakers at the

camp included A. Dutta (IIT Mumbai), A. Kumbhar (University of Pune), A. A. Natu (IISER Pune), D. Jain (BARC, Mumbai), L. Ravishankar (V. G. Vaze College, Mumbai), M. Sundararajan (BARC, Mumbai), P. Chobe (Formerly, BASF India Limited, Mumbai), R.V. Jayaram (ICT, Mumbai), S. D. Samant (ICT, Mumbai), S.S. Bhagwat (ICT, Mumbai), S.K. Ghosh (BARC, Mumbai), T. Ghanty (BARC, Mumbai), T. Parulekar (SIWS College, Mumbai) G. Shridhar (V. K. Menon College, Mumbai) and S. Chunawala (HBCSE).

The theoretical sessions at the camp were related to fluorescence, overview of research areas in inorganic chemistry, nature of science, bio-inorganic chemistry, computational chemistry, quantum chemistry, organic synthesis and mechanisms of organic reactions, catalysis, overview of surfactant science, solid state chemistry, chemical thermodynamics and spectroscopic techniques for structural elucidation. The camp also included following workshops a) using Process Oriented Guided Inquiry Learning (POGIL) instructional material to understand concepts such as formal charge, structure and bonding in organic chemistry, b) reading of scientific papers, c) designing of experiments.

The laboratory sessions at the camp were aimed at planning the experiment for a specific purpose with the list of chemicals and glassware provided to students. They had to assess the merits and demerits of their planning and also look at the safety and risks involved. Example of representative experiments suggested were estimation of carbonate/bicarbonate in a mixture, identification of type of organic mixture and separation procedure of mixtures, kinetic studies of methylene blue-glucose reaction and hydrogen peroxide-potassium iodide reaction.

At the computational chemistry laboratory sessions, students were introduced to GAUSSIAN-09 and Gaussview. Students did computational calculations about different conformations of hydrogen molecule, hydronium ion, ammonia/ ammonium ion, fumaric acid-maleic acid (cis-trans conformations). Twenty-seven students were selected for project work and in addition, 39 students from earlier batches of NIUS Chemistry visited HBCSE for further development of their projects. Seventeen students have completed the projects and submitted their reports. [A. Gupta, A. Kumar, S. Ladage, I. D. Sen and S. Narvekar]

### **Physics and Astronomy**

In the summer of 2015, 13 students from earlier batches of NIUS physics and astronomy visited HBCSE, and 22 students visited HBCSE in winter 2015, to complete their projects and prepare their project reports.

Students from previous years of Astronomy and Physics Olympiad and NIUS were invited to participate in the Eleventh Nurture Camp held at Maulana Azad National Urdu University, Hyderabad from December 2-14, 2015. [A. Sule, A. Mazumdar, P. Ranadive and M. N. Vahia (DAA, TIFR)]

## **Professional Development of Teachers and Teacher Educators**

Facilitating teacher professional development (TPD) through workshops for teachers has been a part of the activities of HBCSE from its inception. These workshops are held based on requests received from schools and organizations, and also as planned intervention programmes. Most of these workshops are collaborative with a number of HBCSE academic, scientific and project staff members from different laboratories coming together to enrich the training of teachers. This collaboration extends to numerous groups that approach HBCSE for TPD. This year, our collaborations included DSERT Karnataka, Zonal Institute of Educational Training (ZIET), Kendriya Vidyalaya Sangathan, Vissanji Academy, Rayat Education Society, Hemendra Kothari



Foundation, Chiplun Taluka Vidnyan Mandal, Tata Institute of Social Sciences, etc. Apart from these, there have been workshops for DIET faculty, varied individual schools/teacher education colleges of Mumbai and Maharashtra. Additionally, there were two residential courses organized by HBCSE for teachers and teacher educators from Sri Lanka and East Timor.

Since 2015, the School Science Research and Development (SSRD) cell of HBCSE has regularized the schedule for TPD workshops focusing on capacity building of school teachers/student-teachers and/or teacher educators. Details of these workshops catering to in-service or pre-service teacher training were uploaded on the HBCSE teacher education website: <http://teacher-ed.hbcse.tifr.res.in/>. The details are in the form of a yearly calendar for teacher education, and specify varying durations of courses and possible themes.

*Teacher Workshops for Rayat Shikshan Sanstha Satara:* Several workshops were organised for teachers of this institution on the request of the Chairman and Secretary of the Sanstha. Three residential workshops of 5 days each were organised at HBCSE: (i) Elementary teachers' workshop was organised from June 8-12, 2015. The workshop had the aim of preparing worksheets for class III, Environmental Science, which the teachers can use for classroom teaching and learning. Totally 36 teachers participated in this workshop (ii) School science teachers' and Junior college teachers' workshop was organised from August 24-28, 2015 at HBCSE on the theme – Science Education and Introduction to Science Olympiads for 44 teachers (iii) Science teachers' workshop on 'Science Education, Science Project and INSPIRE Program' was organized at HBCSE from October 5-9, 2015 and was attended by 37 teachers. [N.D. Deshmukh (Program Coordinator), J. Ramadas, S. Chunawala, S. Ladage, R. Vartak, A. Gupta, P. K. Joshi, A. Sule, S. Pathare, M. Kharatmal, V. Ghanekar, A. Ronad, V. C. Sonawane, S. Bhide, P. K. Nawale, K. T. Hambir, S. Ayare, R. Shaikh, V. Pawar, T. Khan, H. Mishra, H. Raval, A. Sadanandan, P. Khatri, S. Kolambe, A. Kadam, R. Subedi, V. Kurmude, P. Choudhari, B. Dhebhe and S. Mukherjee]

*Rayat's D.Ed college workshop* focussed on 'Students' conceptions in science' was conducted for students and teachers of Shahu Maharaj D. Ed. college at HBCSE from January 11-12, 2016 [N.D. Deshmukh (Program Coordinator), V. C. Sonawane, K.T. Hambir, V. Pawar, S. Chavan]. *Chiplun Teacher Professional Development Workshop* organised by Chiplun Taluka Vidnyan Mandal for 25 teachers, Chiplun, Ratnagiri was also organized at HBCSE on January 11, 2016. [V. C. Sonawane]

*Karnataka DSERT TPD:* On the request of the Department of State Educational Research and Training, Karnataka, a teacher workshop for their physics teachers was held from June 22–26, 2015 at HBCSE, aimed at equipping the teachers in laboratory work based on grades 8-10 Karnataka State curriculum along with pedagogic strategies. [V. C. Sonawane (Program Coordinator), J. Ramadas, S. Chunawala, K. Haydock, A. Kumar, P. K. Joshi, K. Subramaniam, H. C. Pradhan, N. D. Deshmukh, M. Kharatmal, V. Pawar, S. Ayare, D. Gupta and R. Shaikh]

*SIAC Project:* For the past two years, HBCSE is involved in setting up 'Science and Innovation Activity Centers' (SIAC) in Maharashtra. A workshop on 'Setting Sustainable Goals, Resources and Practices for Science and Innovation Activity Centers (SIAC) proposed in Maharashtra' was organized at HBCSE from July 13-15, 2015. This collaborative project involving HBCSE, the Nehru Science Centre, Mumbai, Bharatiya Vidya Bhavan's Muktangan Exploratory Science Centre, Pune and Vigyan Ashram, Pabal was funded by the Rajiv Gandhi Science and Technology Commission. The workshop aimed to help institutions form detailed project proposals. Six representatives from three centers (Nashik, Satara & Amravati) attended the workshop, where sessions were held explaining 'the significance of activities and role of science centres in classroom teaching & learning'. Visits were also arranged to the collaborative institutions in Mumbai, Pune,

and Pabal. [N.D. Deshmukh (Program Coordinator), J. Ramadas, V. C. Sonawane, K.T. Hambir, V. Pawar and R. Mishra]

*Two-Week Residential Course on Science and Mathematics Education for Sri Lankan educators:* The Science Branch of the Ministry of Education, Government of Sri Lanka requested HBCSE to organize a short course of 15 days for their science teachers and education officers. This course was conducted at HBCSE from November 13-30, 2015 for 20 participants. The course aimed to expose participants to science education research literature; models of learning and teacher professional development; designing worksheets for classroom use; and sharing and comparing Indian and Sri Lankan education systems. Sessions were conducted by HBCSE members on educational policies, curriculum frameworks, constructivist philosophies of learning, research readings, nature of science, socio-cultural aspects of education, design and technology education, textbook analysis, assessment, activity based teaching, and science through investigation. Visits to schools, teacher education institutes and Nehru Science Centre were also organised. Additionally, video screenings followed by discussions were organized on themes related to hands-on learning and sustainability. [N. D. Deshmukh (Program Coordinator), J. Ramadas, S. Chunawala, K. Haydock, S. Ladage, G. Nagarjuna, K. Subramaniam, H. C. Pradhan, A. Kumar, A. Gupta, M. Kharatmal, V. C. Sonawane, I. Das, S. Narvekar, S. Naik, S. Bhide, S. Varadarajan, G. Singh, K. T. Hambir, P. K. Nawale, R. Sandhya, R. Shaikh, V. Pawar, A. Muralidhar, D. Gupta, P. Sharma, R. Kapil, T. Khan, H. Mishra, P. Khatri, A. Sadanandan, S. Kolambe, B. Chirmure and S. Shende]

*KV-ZIET Workshop on Project-Based Learning:* As part of their regular Teacher Professional Development programmes, Kendriya Vidyalaya- Zonal Institute of Education and Training had organised a three day workshop on “Project Based Learning” (PBL) for TGT Science and TGT Social Science teachers from KVs all over India, from 18-20 November 2016. Resource persons were from HBCSE and KV. HBCSE members conducted sessions on; Introduction to PBL, implementation and assessment of PBL. Teachers had to select a PBL topic and they worked in groups to collect data and present their work on the final day of the workshop. [S. Chunawala, S. Bhide, A. Muralidhar and R. Kapil] HBCSE members were involved in reviewing and editing learning materials in mathematics produced by Zonal Institute of Kendriya Vidyalaya for teachers of grades I to V. [T. Khan, J. Rahaman, H. Raval, H. Mishra, S. Takker and S. Naik]

*Timor-Leste’s Teacher Visit Program:* A one week workshop on Science and Mathematics Education was organized for 11 teachers from Timor-Leste (a southeast asian nation) between January 18 to 23, 2016. Prof Curt Gabrielson (Watsonville Environmental Science Workshop) who was a mentor to the East Timor team also participated in the workshop. The sessions focused on sharing of experiences, insights and resources from HBCSE's science and mathematics education research, as well as development and outreach work done in India and Timor-Leste. Emphasis was also placed on educational research, curriculum design, hands-on science and mathematics, and design and technology. An excursion tour, visit to Pune Mukatangan Vigyan Shodika and visits to schools was also arranged. [N. D. Deshmukh (Program Coordinator), J. Ramadas, S. Chunawala, K. Subramaniam, J. Vijapurkar, V. C. Sonawane, S. Bhide, S. Naik, T. Khan, H. Raval, K. T. Hambir, S. Patil, A. Sawant, D. Gupta, P. Sharma, A. Muralidhar, V. Pawar, T. Adangale and S. Chavan]

*Teacher Professional Development in Mathematics:* The mathematics education research group continually conducts a variety of professional development workshops for in-service teachers. An important goal of the workshops is to address knowledge demands made by various tasks that are a part of teaching mathematics. Teacher preparation and education programs in India do not typically address such knowledge demands and hence do not adequately empower teachers for different tasks

of teaching. The TPD workshops generally include sessions on the following: (a) profound understanding of school mathematics, (b) pedagogical content knowledge, (c) learning from students' thinking and errors, (d) understanding curriculum in depth to develop representations, (e) contexts and models for teaching, (f) learning from artifacts of teaching such as videos and lesson plans, and (g) learning through problems that integrate mathematical content and pedagogy. The sessions are conducted in an interactive mode and some of the resource materials used are uploaded on the math-education website. Some of the schools/organizations for whom TPD workshops were conducted this year are – Anand Shala, Khopoli; Rayat Education Society, Pandharpur; Mukhtangan Schools, Mumbai; St. Xavier's Institute of Education, Mumbai; CEQUE and Parle Tilak Vidyalaya, Mumbai; Nashik Education Society, Nashik; Atomic Energy Central Schools (AECS), Mumbai.

Workshops on making and using the mathematics laboratory were also conducted for secondary, middle-school and primary teachers on designing mathematical activities, puzzles and games and understanding their pedagogical affordances. Such workshops including those focused on using GeoGebra (a free software for dynamic geometry and algebra) were held for the following schools/organizations: Kendriya Vidyalaya; AECS schools; Rayat Shikshan Sanstha. Various short workshops (typically half a day) were also held for the following schools/organizations: Vissanji Academy, Mumbai; Indian Women Scientists Association; St. Stalishnaus High School, Mumbai. [S. Naik, T. Khan, H. Raval, R. D'Souza, J. Rahaman, H. Mishra and K. Subramaniam]

*Astronomy Olympiad Exposure Camp:* An Astronomy Olympiad Exposure Camp was organised from November 10-13, 2015 at HBCSE for 70 teachers selected from all over India. [A. Sule, A. Mazumdar and P. Ranadive]

*Workshops organized elsewhere:* HBCSE scientific staff are involved in conducting workshops for science teachers at various locations outside HBCSE. This year most of these workshops were in Maharashtra. *The 3<sup>rd</sup> Shivaji Vidnyan Parishad* organised by the Shri Shivaji Education Society, Amravati focussed on 'Designing Constructivist Classroom Learning Environment'. This workshop was held at Jijamata Science College, Buldhana from December 21-23, 2015 and was attended by 58 science teachers. [N.D. Deshmukh (Program Coordinator), V. C. Sonawane and K. T. Hambir]. *Pandharpur Primary Teachers Workshop* organised by Lotus School Pandharpur was an activity based science teachers workshop. It was held in July, 29-31, 2015 and attended by more than 45 teachers [V. C. Sonawane (Program Coordinator), K.T. Hambir and R. Shaikh]. *Akluj Teacher Workshop* on Activity based science teaching was held on June 15, 2015, and was organised by Mohite Patil High School Akluj [N. D. Deshmukh and K. T. Hambir]. *Wardha District Science Teacher Association Workshop* held on February 13, 2016 focussed on 'Constructivist Science Learning and the Role of Experiments'. More than 200 science teachers participated in this workshop. [N. D. Deshmukh and K. T. Hambir]. *The 3<sup>rd</sup> Rayat Vidnyan Parishad* organised by Rayat Shikshan Sanstha, Satara on 'Science Learning' was held at Sadhana Sankul Hadapsar, Pune in collaboration with HBCSE from January 23-25, 2016. More than 600 science teachers participated in this workshop. [N. D. Deshmukh, V. C. Sonawane and K. T. Hambir]. A workshop for Biology teachers was held at the Department of Microbiology, St. Ann's college for women, Santoshnagar Colony, Mehdipatnam, Hyderabad. This 2 day workshop on 'Biology teaching-the missing link', was organised on January 6-7, 2016, and was a collaboration between HBCSE and Asian Association for Biology Education. Around 42 biology and science teachers participated in this workshop. [N. D. Deshmukh]

## **Science Popularization**

Over the years, HBCSE has developed a variety of popular science materials and has aimed at disseminating it to the masses of the country. During the period of this report, HBCSE staff members contributed articles, gave popular science talks and featured in radio and TV programs as a part of science popularization and outreach efforts. Expository articles were published in leading national science and technology magazines and newspapers of the country.

### **Visits to HBCSE**

HBCSE receives a number of visitors to its facilities and laboratories throughout the year including students from various schools and colleges along with their teachers, pre-service teachers from B.Ed. and D.Ed programmes along with teacher educators, children's visits to the Centre were also organized by non-governmental organizations of Mumbai region. In all, more than 450 students and teachers visited HBCSE during the year. Visitors from Parle Tilak, Kumud Vidyamandir, Aamchi Shala, AECS, Chhatrapati Shahu College, Rurki, Gokhale Education Society's HPT Arts & RYK Science College (Nashik) among other institutes had interactions with HBCSE members. [V. C. Sonawane (Coordinator), N. D. Deshmukh, K. T. Hambir, V. Pawar, T. Adangale, T. Khan and H. Raval]

### **National Science Day 2016**

As in every year, the National Science Day (NSD) was celebrated at the Centre by having an Open House that witnessed over 2000 visitors which included students, teachers, teacher educators and parents from Mumbai region. Some of the main attractions of the day were Rocket demonstration, Computer Corner, Botanical Garden tour, Design & Technology activities, Mathematics games, the Liquid Nitrogen Show, and Hindi Cell display of books and materials and exhibition of educational posters. Posters on science and technology prepared by student volunteers were displayed on the occasion. Technical staff members of HBCSE displayed several gadgets and demonstrated the working of household equipment. The Design and Technology (D&T) Lab had arranged an array of activities aimed to spark creative problem solving and expression and give visitors opportunities to think, make and test while the Junior Science Olympiad cell demonstrated science experiments along with a question-answer session. An activity around the Gender and Science Exhibition was also organized for all students. The Centre's publications, as well as publications, resources, toys, posters of other organisations were displayed and kept for sale. [V. C. Sonawane (Coordinator) and all HBCSE staff members]

### **Web-based popular science materials**

The Hindi Cell of the HBCSE developed a variety of popular science materials and made them available on its portal (<http://ehindi.hbcse.tifr.res.in>). The portal is aimed at improving scientific literacy in the country and inculcating scientific temper among its masses. Popular science articles, magazines and other related materials were uploaded on the portal throughout the year. [K. K. Mishra, K. Sinha, D. Mishra, A. Sankhwar and R. Nichat]

During the International Physics Olympiad organised in Mumbai by HBCSE, a print and web based newsletter titled *Reflections* was published. Nine issues were released and each issue contained information about the day's events, photo collage, puzzles, games, jokes, articles on famous Indian physicists, Mumbai and India. HBCSE members developed the design, layout, resources and content for *Reflections* 2015. All the issues are available online at <http://www.ipho2015.in/reflections/> [S. Chunawala, M. Nair, A. Muralidhar, D. Prabhu, D. Gupta, P. Sharma and S. Ayare]

### **Science popularization at GMRT, Pune**

HBCSE participated in the National Science Day programme held at Giant Meterwave Radio

Telescope (GMRT) Center, Pune. GMRT organized a two-day programme on February 28-29, 2016 whose theme was “Make in India: Science & Technology Driven Innovations”. HBCSE took active part in the programme and put up many gadgets, working models and exhibits including the rocket show and webcam microscopy. [V. C. Sonawane (Coordinator), K. T. Hambir, T. Adangale, D. Gupta and S. Kulkarni]

### **Science outreach at Bhiwandi**

HBCSE in collaboration with Thakar Educational and Welfare Society organized an outreach program, Adbhut Vigyan on March 6, 2016 at Damodar Shishu Vihar School, Bhiwandi, Thane. More than 3000 students and parents visited this exhibition. [V. C. Sonawane (Coordinator) and other staff members]

### **Activities of the Hindi Cell and Rajbhasha Committee**

The Hindi Cell was involved in promoting the use of Hindi language in general at the Centre and in particular in the area of development of educational and popular science materials. Hindi Cell also took care of the ‘Aaj ka Shabd’, where interesting educational poems, cartoons and other information were put up on the display board throughout the year. [K. K. Mishra, K. Sinha, D. Mishra and S. Deoram]

### **CUBE in media**

Collaborative Undergraduate Biology Education (CUBE) initiative of HBCSE featured in the news several times this year: DNA Mumbai (October 19, 2015), Times of India, Chandigarh (November 21, 2015); Malayala Manorama (August 7, 8, 2015) and Dainik Samachar, Jaipur (October 2015). Additionally, a 3-day workshop on Do-It-Yourself, techniques in building laboratory equipment was organized in February 2016. The final day of the workshop was a public event towards popularizing Science, at Chembur, where participants of the workshop displayed the artefacts they created over the course of 3 days.

## **5. STAFF LIST [Page 166]**

### *Members*

J. Ramadas (Centre Director), K. Subramaniam, (Dean, HBCSE Faculty), B. J. Venkatachala (upto 31/10/2015), S. I. Chunawala, S. A. Ladage, R. R. Vartak, A. Mazumdar, G. Nagarjuna, K. K. Mishra, J. Vijapurkar, R. B. Khaparde, A. P. Sule, P. K. Joshi, P. De, K. Haydock (upto 29/02/2016), S. Chandrasekharan, A. Gupta

N. D. Deshmukh, V. D. Lale, V. C. Sonawane, S. R. Pathare, A. Das (upto 31/12/2015), A. D. Ghaisas (upto 30/04/2015), S. M. Narvekar, A. Ronad, R. P. Nichat, M. B. Kharatmal, D. D. Pednekar, T. S. Rajashekar, P. K. Nawale, Manoj K. R., S. S. Naik, P. P. Pathak, A. Muralidhar, I. Das, A. Sankhwar, V. S. Ghanekar, P. Ranadive, H. Raval

### *Visiting Fellows*

S. Bhide, R. Thengodkar, S. Krishnan (upto 23/12/2015), D.Gupta, S. Datt

### *Research Scholars*

A. Srivastava (upto 31/07/2015) S. Ghumre, (upto 31/07/2015), S. Takker (upto 31/07/2015), J. Rehaman (upto 31/07/2015) R. Shaikh, P. Pande, R. Varkey, G. Singh, R. D’Souza, H. Srivastava, G. Date, S. Kabir (upto 29/01/2016), K. Mishra, D. Karnam, D. Dutta, S. Philip (upto 31/07/2015), C. Navare, M. Shah, Ratna, S. Varadarajan

*PhD students (external)*

A. Raveendran, A. Sharma, A. Dhakulkar, R. Kumar, A. Kawalkar

*INSA Senior Scientist*

S. M. Roy, D. P. Roy

*Raja Ramanna Fellow*

H. C. Pradhan

*Administration*

M. D. Gaitonde (Sr. A. O.), V. P. Raul, M. M. Mastakar, (upto 31/05/2015) S. V. Amin, S. N. Burli, M. B. Bamne, M. P. Akhade, M. S. Thakur, S. L. Rasam, R. A. Shrotri, D. R. Mhapsekar, S. K. Desai, M. G. Shinde, G. A. Tawate, H. M. Mandlik, T. S. Shirodkar, R. Sawant, S. Shejwal, S. Wairkar

*Technical*

N. Y. Tribhuwan, S. D. Pardeshi, V. C. Jacob, H. H. Rane, V. P. Ahire, K. T. Hambir, J. J. Tambe, S. S. Chavan

*Auxiliary*

J. B. Waghmare, U. V. Shenoy, R. G. More, N. K. Kadam, B. L. Valvi, N. S. Thigale (upto 29/02/2016), G. V. Mestry, B. S. Bhagit

*Consultants*

P. K. Balakrishnan, M. C. Arunan, B. J. Venkatachala, C. R. Pranesachar

## **6. NATIONAL AND INTERNATIONAL INVOLVEMENT [Page 167]**

(Professional and academic memberships of editorial, academic and national committees, office bearership of professional societies, etc.)

**A. Mazumdar** was 1) National Coordinator, Science Olympiads; 2) Convener and Coordinator for Theoretical component of the 46<sup>th</sup> International Physics Olympiad; 3) Member, Academic Committee of the 46<sup>th</sup> International Physics Olympiad.

**A. Ronad** was 1) Executive Board Member, Association of Teachers in Biological Sciences

**A. Sule** was 1) Regional Coordinator (Asia-Pacific) for the International Olympiad in Astronomy and Astrophysics (IOAA) from January 1, 2012 to December 31, 2016; 2) Member of Coordination Committee for National Entrance Screening Test 2014, 2015; 3) Chair, Academic Committee, 11<sup>th</sup> Asia Pacific Astronomy Olympiad, Dhaka, Bangladesh, November 2015.

**G. Nagarjuna** was 1) Member, Institutional Advisory Board, Central Institute of Educational Technology, NCERT, New Delhi; 2) Associate Editor, *International Journal of Conceptual Structures and Smart Applications* (IJCSSA), an Official Publication of the Information Resources Management Association; 3) Reviewer, *Science & Education*, Springer; 4) Chairperson, Free Software Foundation of India; 5) Member, Board of Software Freedom Law Centre of India, New Delhi; 6) Member, Advisory Board, K.J. Somaiya College of Engineering, Mumbai; 7) Member,

Web Server Committee, National Board of Higher Mathematics.

**J. Ramadas** was 1) Member, IUPAP International Commission on Physics Education (ICPE) for the period 2011-16; 2) Member, Governing Council of the Atomic Energy Education Society (AEES), 2011-16; 3) Member, Science Committee, Maharashtra State Bureau of Textbook Production & Curriculum Research, Pune.

**K. K. Mishra** was 1) Member, National Academy of Sciences, India; 2) Member, Executive Council, Lok Vigyan Parishad, Delhi; 3) Joint Secretary, Peoples Council of Education, Allahabad; 4) Member, Vigyan Parishad Prayag, Allahabad; 5) Member, Advisory Board, Vigyan-Ganga, Banaras Hindu University, Varanasi; 6) Member, Advisory Board, Technical Today, a national science and technology magazine brought out by Mewar University; 7) Member, Editorial Board, Vigyan Prakash, World Hindi Foundation, Oswego, New York, USA.

**K. Subramaniam** was 1) Member, National Council for Teacher Education (NCTE); 2) Member, Academic Committee, NCERT, New Delhi; 3) Country representative for India, International Commission for Mathematics Instruction; 4) Member, Journal Editorial board, Contemporary Education Dialogue; 5) Member, Journal Editorial board, At Right Angles; 6) Member, Advisory board, Information Age Publishing: International Sourcebooks in Mathematics and Science Education; 7) Member, Advisory Board, World Bank study on "Time on Task in Secondary Schools".

**N. D. Deshmukh** was 1) Executive Director for 26th Biennial Conference of the Asian Association for Biology Education; 2) Executive Member, Asian Association for Biology Education; 3) Executive Member, Indian Ocean Comparative Education Society and Executive Committee member for 2015-2017 IOCES conference; 4) Editorial Board Member, Asian Journal of Biology Education (AJBE); 5) School Council Member, YCMOU Nashik B.Sc. Course; 6) Advisory Member, Shikshan Sankramann Journal; 7) Honorary Member, Vidnyan Warta Journal.

**P. K. Joshi** was 1) President of the International Junior Science Olympiad for the period 2015 – 2018; 2) Chairman, Bombay Association for Science Education.

**P. Pathak** was 1) Member, Academic Committee of the 46<sup>th</sup> International Physics Olympiad; 2) Member, International Advisory Committee of International Physics Olympiad for the period 2013-17.

**R. Khaparde** was 1) Coordinator for Experimental component of the 46<sup>th</sup> International Physics Olympiad; 2) Member, Academic Committee of the 46<sup>th</sup> International Physics Olympiad.

**R. Vartak** was 1) Executive Board Member, Association of Teachers in Biological Sciences;

**S. Chandrasekharan** was 1) Adjunct Associate Professor, Interdisciplinary Program in Educational Technology, Indian Institute of Technology Bombay, Powai, Mumbai, India; 2) Grant Reviewer, Science Technology and Society program, National Science Foundation, USA; 3) Committee member, Ph.D. Thesis Advisory Committee for Paul Clifton, Digital Media Program, Georgia Institute of Technology, Atlanta, USA; 4) Advisory Board Member, Studies in Applied Philosophy, Epistemology and Rational Ethics, Springer book series; 5) Conference Convener, epiSTEME 6 International Conference, India, 2015 (with Sahana Murthy, IIT Bombay); 6) Program Committee Member, Technology for Learning of Thinking Skills, The 22<sup>nd</sup> International Conference on Computers in Education, 2016, Mumbai, India; Technology for Education (IEEE), 2015, Warangal,

India; and Technology for Education (IEEE), 2016, Mumbai, India.

**S. Chunawala** was 1) Reviewer for Indian Educational Review, NCERT; 2) Executive Council Member of the Peoples Council of Education for the year 2012-2015; 3) Member, Departmental Advisory Board (DAB), Department of Gender Studies, NCERT; 4) Member, Board of University Teaching and Research, YCMOU; 5) Member, Board of Studies, SNDT University, Marine Lines, Mumbai; 6) Local Management Committee member, KJ Somaiya Comprehensive College of Education, Training and Research; 7) Reviewer, epiSTEME 6 conference; 8) Executive Board Member, 2016-2018, Representative of South Asia, IOSTE.

**S. Ladage** was 1) National Coordinator, National Initiative on Undergraduate Science (NIUS) programme; 2) Co-opted member, Executive Council, Association of Chemistry Teachers (ACT)

**S. Narvekar** was 1) Secretary, Executive Council, West Zone, Association of Chemistry Teachers (ACT)

**S. Pathare** was 1) Member, Academic Committee of the 46<sup>th</sup> International Physics Olympiad

**V. D. Lale** was 1) Editorial Committee Member, Kumar Vishwakosh (Biology & Environment), Maharashtra Rajya Vishwakosh Nirmitti Mandal, Wai; 2) Academic Committee Member, Shikshan Pandhari Project, Maharashtra Knowledge Corporation Limited, Pune; 3) Author and Member, Science Committee, Maharashtra State Bureau of Textbook Production & Curriculum Research, Pune.

## 7. VISITS [Page 167]

**G. Nagarjuna** participated in the Design Workshop for Connected Learning Initiative (CLIX) at MIT Boston from August 3-14, 2015.

**H. Srivastava** participated in the Design Workshop for Connected Learning Initiative (CLIX) at Massachusetts Institute of Technology, Boston from August 3-7, 2015.

**K. Subramaniam** 1) participated in a research collaboration seminar-cum-workshop on Video Analysis of Classroom Mathematics Teaching at the Wits University, Johannesburg, August 11-20, 2015; 2) attended the meeting of the Internal Quality Assurance Cell of the St. Xavier's Institute of Education as an external member, February 13, 2016.

**S. Chunawala** participated in an International Visual Methods Seminar, at the University of Antwerp from August 23- September 5, 2015.

**A. Sharma** participated in the All India Association For Educational Research Annual Cum International Conference on Standards and Benchmarks for Excellence in Learning, Teaching and Research, Thiruvananthapuram, Kerala, November 26-28, 2015.

**A. Sule** participated as the Chair of the Academic Committee of the 11<sup>th</sup> Asia Pacific Astronomy Olympiad, Dhaka, Bangladesh, November 2015.

**S. Chunawala and A. Muralidhar** participated in the National Seminar on Education of Socially Disadvantaged Groups in India, Regional Institute of Education, Bhopal, March 5, 2016.

**P. Pande** participated in the Visualization in Science and Education Gordon Research Conference, Bates College, Lewiston, Maine, USA, August 2-7, 2015; Conference on Cognition, Brain and Computing, Indian Institute of Technology, Gandhinagar, December 5-7, 2015.

**H. C. Pradhan** attended 1) Educators Academy, Intel International Science and Engineering Fair,



Station Square Sheraton Hotel, Pittsburgh, PA, USA, May 10-15, 2015; 2) National Convention of the Indian Association of Physics Teachers, St Pious X College for Women, Nacharam, Hyderabad, October 30-November 1, 2015; 3) National Teachers' Science Congress, hosted by Marathi Vidnyan Parishad at Indian Institute of Science Education and Research, Pune, December 18-20, 2015; 4) National Children's Science Congress 2014, Chandigarh University, Mohali, Punjab, December 26-31, 2015.

**R. D'Souza** participated in 'Mathematics Education and Society 8' conference held at Portland State University, Portland, USA, June 21-26, 2015.

## **8. AWARDS AND DISTINCTIONS [Page 5-6]**

### **A. Ghaisas**

Honourable Mention for Homi Bhabha Award in Science Education (2014)

### **K. K Mishra**

Rajbhasha Gaurav Award (2014), from the Department of Official Language, Ministry of Home Affairs, Government of India.

### **V. Singh**

The Homi Bhabha Award in Science Education (2014)

### **A. Raveendran**

Kusum Mathradas Kothari Research Fellowship, Hemendra Kothari Foundation (2015-16)

### **S. Naik**

Kusum Mathradas Kothari Research Fellowship, Hemendra Kothari Foundation (2015)

## **9. INVITED TALKS [Page 168]**

### *H. C. Pradhan*

1. Multifarious physics of light (Keynote Address), *National Conference on Light and Its Applications*, organized by IAPT - Gogate College, Ratnagiri – Government College, Quepem, at District Library, Madgaon, Goa, March 18, 2016
2. History of the concept of light (Keynote Address), IAPT-GUJCOST Workshop to celebrate the International Year of Light and General Theory of Relativity, Science City, Gandhinagar, June 28, 2015

### *J. Ramadas (with Durgaprasad Karnam)*

Spatial thinking in undergraduate science education, *International Conference on Innovations in Teaching, Learning and Evaluation in Higher Education*, Modern College, Shivajinagar, Pune, January 29-30, 2016

### *K. Subramaniam*

Encouraging and supporting students' thinking in the learning of science", Chitra Natarajan Memorial Lecture and Keynote Address, *One-day Teachers' Conference on Encouraging and Supporting Students' Thinking in the Learning of Science*, Navi Mumbai Science Foundation, Vashi, February 6, 2016

S. Chandrasekharan

Modeling Modeling: An incorporation account of model-based discovery, and how it informs learning sciences research (Keynote presentation over Skype), *Sixth International Conference in Model-based Reasoning*, Sestri Levante, Italy, June 26, 2015

S. Ladage

Research in chemistry education and its implications for teaching and learning of chemistry at tertiary level (Review Talk), *epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education*, December 17, 2015

## 10. CONFERENCES / WORKSHOPS ORGANIZED BY THE CENTRE [Page 169]

### **Two-Day National Conference on “Creative Writing in Science for Children”**

HBCSE, October 3-4, 2015

The Marathi Vidnyan Parishad and HBCSE (TIFR) jointly organized a two-day national conference on *Creative Writing in Science for Children*, at HBCSE, October 3- 4, 2015.

### **Annual Research Meet**

HBCSE, October 12-13, 2015

### **One-Day Seminar on “ROAD Ahead in Science, Technology and Mathematics Education in India,”**

HBCSE, October 14, 2015

HBCSE organized a one day seminar on *Road Ahead in Science, Technology and Mathematics Education in India*, October 14, 2015. The seminar is in memory of Late Prof. Chitra Natarajan, former Dean, HBCSE. Speakers at the seminar were- Prof Anita Rampal (Central Institute of Education, Delhi University), Jayashree Ramadas, K. Subramaniam, Swati Mehrotra (Educational consultant, Singapore), Arvind Kumar, Aswathy Raveendran. Prof H. C. Pradhan chaired the seminar. It was followed by a function to release the book “Embracing lives, Chasing passions: Memoirs of Chitra Natarajan”, edited by Dr. R. Rajagopal.

### **Two-Week Residential Course on “Science and Mathematics Education”**

HBCSE, November 13 –30, 2015

A two week workshop was jointly organized by HBCSE and the Science Branch, Ministry of Education, Sri Lanka, HBCSE, for 20 Science Teachers and Education Officers of Sri Lanka.

### **International Conference epiSTEME-6**

HBCSE, December 15-18, 2015

Conference epiSTEME-6, the sixth in the series of epiSTEME conferences, was jointly organized by HBCSE and the Inter-Disciplinary program in Educational Technology Program, Indian Institute of Technology, Bombay (IITB), from December 15-18, 2015. Conference epiSTEME-6 focused on three central research strands: Historical, Philosophical and Socio-cultural studies of STME, Cognitive and Affective Studies of STME, and Curriculum and Pedagogical Studies in STME. This year's conference had an additional focus theme –“Emerging Computational Media and Science Education”. The conference consisted of review talks by invited speakers, paper and poster presentations, pre and post conference workshops, and a panel discussion. The conference received

a total of 84 paper submissions, which were blind peer-reviewed; 26 papers (31%) were accepted for oral presentation, and a further 29 papers (34%) were accepted for poster presentation. Conference epiSTEME-6 was attended by 16 foreign participants (6 review speakers) and 102 Indian participants (not including HBCSE participants). There were 4 panel speakers. Sanjay Chandrasekharan from HBCSE and Sahana Murthy from IITB were the conveners of epiSTEME-6.

**Infosys Award Function 2015** (in association with the Infosys Foundation and the TIFR Endowment Fund)  
*December 22, 2015*

**Timor-Leste's Teacher Visit Program**  
HBCSE, January 18-23, 2016

A one week workshop on Science and Mathematics Education was organized for 11 teachers from Timor-Leste.

**Inauguration And Workshop on "CLIX" Project** (Joint venture of TATA Trusts, TISS, MIT and partners HBCSE, Eklayva, University of Mizoram, SCERT, CERP and the State Governments of Chhattisgarh, Mizoram, Rajasthan and Telangana)  
*HBCSE, Mumbai, January 27-30, 2016*

**One-Day Teachers' Conference on "Encouraging and Supporting Students' Thinking in Classroom Learning Of Science"** (organized along with Navi Mumbai Science Foundation)  
*Vashi, February 6, 2016*

### **Workshops for Students**

- Homi Bhabha Young Scientist Awardees Student Camp (HBCSE, April 15-18, 2015);
- Sixteenth AEES Junior Science and Mathematics Olympiad Programme (HBCSE, May 6-15, 2015);
- Olympiad Orientation-cum-Selection Camps (OCSC) in Mathematics (for junior and senior batches), biology, chemistry, astronomy and junior science (April- June 2015);
- Pre-Departure Training Camps for international Olympiad teams: European Girls Mathematical Olympiad and International Mathematical Olympiad, International Chemistry Olympiad, International Biology Olympiad, International Astronomy Olympiad (April- July 2015);
- Workshops on 'the issue of waste' for high school students (Shivaji Nagar, Govandi, April 14-24, 2015);
- Summer camp for students of Nutan Vidya Mandir (HBCSE, May 2015);
- NIUS project camp (HBCSE, June-July 2015);
- Research scholar orientation programme for batch of 2015 (HBCSE, August 10-19, 2015);
- Effective use of activities and experiments with the 'Phirti prayog shala' from Konkan – (HBCSE, August 12, 2015);
- Workshop on 'Learning angles' for BMC school students (October 15-31, 2015);
- Workshop on 'Integers' with students from Kendriya Vidyalaya (October 19-30, 2015);
- Workshop on "Mathematics laboratory", TIFR open day (November 1, 2015);
- NIUS Biology camp Batch XII: Camp XII.1 (November 2-6, 2015);
- Workshop on design and technology for students from Class 8-9 (HBCSE, November 21-22, 2015);
- Pre-Departure Training Camps for junior science international Olympiad (HBCSE,

- November- December, 2015);
- Pre-conference (epiSTEME 6) workshop on “Mapping data and knowledge for citizen science” (HBCSE, December 7-11, 2015);
- Workshop on “Problem solving in mathematics”, for NTS students (December 8, 2015);
- Workshop on “No solution is also a solution in mathematics”, for Shishuvan School Students (December 21, 2015);
- NIUS Chemistry project camp Batch XII: Camp XII.1 (December 23-31, 2015);
- Workshop on “Understanding area through geometry”, for Shishuvan School Students (December 23, 2015);
- Nurture Programme for NTS Scholars, Secondary and Higher Secondary students (HBCSE, January 4-8, 2016);
- Workshop on “Exploring theorem of Pick”, for NTS students (January 8, 2016);
- One day workshop for class 9 students from Nutan Vidya Mandir' School (January 30, 2016);
- Workshop on “Trigonometry through puzzles”, for St. Aloysius High School Students from Jalgaon (HBCSE, February 3, 2016);
- Workshop on “Tree-mapping”, for 80 students, Nalanda Public School (Mulund, February 20, 2016);
- Workshop on “Efficient cut for understanding area”, for NMMC students, RAINBOW programme (IWSA, Vashi, March 3, 2016);
- Workshop on “Algebraic patterns”, for NMMC students, RAINBOW programme (IWSA, Vashi, March 3, 2016);
- Workshop on D&T activities, Adhbhut Vigyan, Thakkar organization (Bhiwandi, March 6, 2016);
- Workshop on “Hands-on-minds-on in mathematics”, Thakker Education Society (Bhiwandi, March 6, 2016)

#### *Collaborative Undergraduate Biology Education (CUBE) Workshops*

- CUBE Summer workshops (Batch I & Batch II) on “Introducing simple model systems to address sophisticated questions” (HBCSE, April 17 to June 3, 2015);
- Citizen Science workshop on Tree mapping and phenology mapping –Seasonomics (Mapusa, Goa, May 2015);
- Workshop conducted at KBP College, Vashi and at RD National College (Bandra, June 2015);
- CUBE Mumbai Summer Meet 2015 (HBCSE, July 5, 2015);
- CUBE Mid-Semester Meet (HBCSE, September 26, 2015);
- Workshop on Tree-mapping for students for Universe Simplified, Science Resource Center (Andheri, Mumbai, November 21, 2015);
- CUBE workshops outside HBCSE for students (Dhempe College, Mushtifund School, Panjim, Goa, November 14, 2015; Acharya Narendra Dev College, Delhi, December 29 to January 2, 2016);
- Visit and workshop at CHM College (Ulhasnagar, December 15, 2015);
- Workshop on “Various biological systems” at Ruia College (Mumbai, January 6, 2016); Deonar Colony Municipal School, Mumbai for grade 5 to 7 students (December 4 to February 25, 2016);
- Regional meet at Delhi for students (January 27, 2016);
- Workshop at CHM College, for undergraduate and post-graduate students (Ulhasnagar, February 9, 2016)

## **Workshops for Pre / In-Service Teachers**

- Train the trainers workshop on digital literacy (SM Shetty College, April 20-22, 2015);
- Resource Generation Camp (RGC) in Junior Sciences (April 25- 26, 2015; July 18-19, 2015; August 22-23, 2015; October 31- November 1, 2015; February 6-7, 12-13, 2016);
- Junior Science Exposure Camp for teachers (Swami Narayan School, Vapi, June 7, 9, 2015; Kutch University, June 15, 17, 2015; Pal, Jalgaon, June 23-28, 2015; Majhihira National Basic Educational Institute, Purulia, September 8-10, 2015; Dombivili, September 25-27, 2015; Guwahati, October 8-10, 2015; Atomic Energy Central School, Tarapur, January 21-23, 2016);
- Rayat Education Society's elementary teacher workshop (June 8-12, 2015);
- Half-day mathematics laboratory workshop (in collaboration with Zonal Institute of Educational Training, Kendriya Vidyalaya Sangathan) for teachers (June 9, 2015);
- One-day mathematics education workshop for in-service teachers from Anand shala (Khopoli Khalapur, June 10, 2015);
- DSERT Karnataka physics teachers workshop (June 22-26, 2015);
- One-day mathematics education workshop with Vissanji Academy (HBCSE, July 11, 2015);
- Workshop on Science and Innovation Activity Centres (SIAC) for teachers (HBCSE, July 13-15, 2015);
- Pilot testing workshop conducted for the course "Invitation to Connected Learning Initiative (CLIX)" for teachers and students (Hyderabad, July 24-28, 2015);
- Pandharpur's school teachers workshop (Lotus School Pandharpur, July 29-31, 2015);
- Workshop on 'Application of light' organized jointly by HBCSE and Bombay Association for Science Education (HBCSE, August 8, 2015);
- Junior science teacher training workshop organized in collaboration with Janakalyan Samiti (HBCSE, August 10-13, 2015);
- One-day workshop on "Inquiry based science teaching", with science teachers (grades 1-10) (Diamond Jubilee High school, Mumbai August 14, 2015);
- Orientation to field officers of the CLIX project on "Invitation to CLIX" (HBCSE, August 21-22, 2015);
- Rayat Education Society's High School and Junior College Sciences Teachers workshop – Science education and introduction to science Olympiads (August 24-28, 2015);
- One day workshop on 'Introduction to chemistry Olympiad' for teachers (August 26, 2015);
- HBCSE and Royal Society of Chemistry collaborative programme: Level three training camp for Teachers Developers (August 31-September 4, 2015);
- Resource Generation Camp (RGC) in Cell and Molecular Biology (September 3-4, 2015);
- Plant Sciences and Ecology (September 3-4, 2015);
- Animal Sciences (September 14-15, 2015);
- Ethology (November 26-27, 2015);
- Genetics (December 7-8, 2015);
- 14 workshops for YCMOU-PGRP, batch of academic year 2015-16 (September 13, 2015; October 18, 2015; November 1 and 29, 2015; December 20, 2015; January 10, 2016; February 7, 2016 and March 20, 2016);
- Resource Generation Camp for Chemistry Olympiad (September 30-October 3, 2015);
- Resource Generation Camp (Physics) for Olympiad session 2015-16 (October 1-3, 2015);
- Rayat Education Society's High School and Junior College Sciences Teacher workshop – Science Education, Science Project and INSPIRE Programme (October 5- 9, 2015);
- Workshop on Polyhedra- material preparation and development (HBCSE, October 9, 2015);
- Biology Olympiad Exposure Camp for teachers (October 14-16, 2015);
- Chemistry Exposure Camp for teachers (November 16-18, 2015);

- Workshop for teachers on “Project-Based Learning” (KV-ZIET Mumbai, November 18-20, 2015);
- Workshops on “Area-perimeter”, “Specialized content knowledge for teaching area”, “Specialized content knowledge for teaching Algebra” for Secondary School Teachers (November 11, November 24, December 30, 2015);
- Workshop on problem solving in mathematics, for St. Xavier’s Pre-service Teachers (Mumbai, December 4-5, 2015);
- Workshop on “Learning to teach mathematics using videos”, for Secondary School Teachers in collaboration with CEQUE (December 12, 2015);
- Hands on workshop on ‘Managing school laboratory’ organized jointly by HBCSE and Bombay Association for Science Education (HBCSE, December 18-19, 2015);
- Workshop for “Developing lesson plans”, for Secondary School Teachers in collaboration with CEQUE (December 30, 2015; January 5, 2016);
- Workshop on “Studying lesson plans”, for secondary school teachers (December 30, 2015);
- Workshop on designing laboratory sessions for meaningful learning in undergraduate Chemistry Laboratory, for 45 teachers from various universities in Maharashtra (SP college Pune, January 4-5, 2016);
- Workshop on 'Exposure to mathematics education', for Primary teachers of Nashik Education Society in collaboration with Hemendra Kothari Foundation (January 6-7, 2016);
- Two-day workshop for biology teachers on “Biology teaching-the missing link”, organized along with Department of Microbiology, St. Ann’s college for women, Santoshnagar Colony, Mehdipatnam, Hyderabad and Asian Association for Biology Education (January 7-8, 2016);
- Workshop on developing mathematical activities for D.Ed. students from Rayat Education Society, Rurki (January 11, 2016);
- Teacher Professional Development workshop of Chiplun Taluka Vidnyan Mandal, Taluka-Chiplun, District Ratnagiri (HBCSE, January 11, 2016);
- Workshop for D.Ed students from Shahu Maharaj college, on “Students conception” (HBCSE, January 11-12, 2016);
- Workshop on “Collective lesson planning”, for secondary school teachers (January 16, 2016);
- Workshop on “Science learning”, as part of the 3rd Rayat Vidnyan parishad, organised jointly by Rayat Shikshan Sanstha, Satara and HBCSE, for 600 science teachers (Sandhana Sankul Hadapsar, Pune, January 23-25, 2016);
- Workshops by Kelly Butler on Process Oriented Guided Inquiry Learning -POGIL (Abasaheb Garware College, Pune, KET V. G. Vaze College, Mumbai, January 25, 28, 2016; Ruia College, Mumbai, February, 2, 3, 5, 6, 29, 2016; New Arts, Commerce and Science College, Parner, Ahmednagar, March 5, 2016);
- Workshop on “Digital literacy” (Project of NUSSD, TISS) (Rajahmundry, Andhra Pradesh, January 23-25, 2016; February 1-3, 2016);
- Workshop for teachers I2C, Pilot, CLIX (Mizoram and Rajasthan, February 3-9, 2016; February 12-17, 2016);
- Teacher Training Programme for Science and Maths Teachers (Meghalaya, March 1-7, 2016);
- Workshop on “Understanding student errors”, for NMMC teachers in RAINBOW programme (IWSA, Vashi, March 3, 2016);
- Workshop on Tech-Knowledge Teacher, for teachers (March 16, 2016);
- Workshop on preparation for experience based holistic learning environment, for teachers (March 28, 2016)

## **Workshops for Resource Persons/ Trainers/ Teacher Trainers**

- One day workshop on the role of students' questioning in learning Science (HBCSE, April 10, 2015);
- Workshop on “Designing constructivist learning environment” organized by Shri Shivaji Shikshan Sanstha, Amravati and HBCSE, Jijamata Science and Arts College, Buldhana, (December 21-23, 2015);
- Kumar Vishwakosh workshops (November 16-20, 2015; January 18-22, 2016; February 8-12, 2016)
- Process Oriented Guided Inquiry Learning (POGIL) workshops by Prof Kelly Butler (February 4, 2016);
- Four day Do-It-Yourself Biolab workshop by Yashash Shetty, Shreyasi Kar and Tejas Rode (HBCSE, February 17-20, 2016)

## **11. NON-DAE RESEARCH PROJECTS [Page 170]**

*S. Chandrasekharan*

The cognitive mechanisms underlying model-based discovery and learning, DST Cognitive Science Research Initiative (Category: Exploring Higher Mental Functions), October 2013 to September 2016

*S. Chandrasekharan (in collaboration with Alexandra Mazalek [P.I.], Georgia Institute of Technology, Atlanta, USA)*

Getting a grip on the numerical world: Kinesthetic interaction with simulations to support collaborative discovery in systems biology, National Science Foundation, USA, September 2013 to 2016

*Jyotsna Vijapurkar (with A. Msimanga, University of Witwatersrand (P. I.) and other collaborators)*  
A multidisciplinary approach to language issues in science education in multilingual contexts.

## **12. PUBLICATIONS [Page 269 onwards]**

### **12 a) IN JOURNALS [Page 269]**

Chandrasekharan, S., & Nersessian, N. J. (2015). Building cognition: The construction of computational representations for scientific discovery. *Cognitive Science*, 39, 1727–1763.

Deshmukh, N. D., Mishra, R., & Tawade, S. (2015). Development of concept inventory on nervous system for students of standard 12. *Sanshodhan Chetana*, 4(III), 61-71.

Kawalkar, A. & Vijapurkar, J. (2015). Aspects of teaching and learning science: What students' diaries reveal about inquiry and traditional modes. *International Journal of Science Education*, 37(13), 2113-2146.

Kumar, R., Subramaniam, K., & Naik, S. (December 17, 2015). Teachers' construction of meanings of signed quantities and integer operation. *Journal of Mathematics Teacher Education*. DOI 10.1007/s10857-015-9340-9

Kumar, R. S., & Subramaniam, K. (2015). From 'following' to going beyond the textbook: Inservice Indian mathematics teachers' professional development for teaching integers. *Australian Journal of Teacher Education*, 40(12), 86-103.

Mashood, K. K., & Singh, V. A. (2015). Rotational kinematics of a rigid body about a fixed axis: development and analysis of an inventory. *European Journal of Physics*, 36, 045020.

Mishra K. K. (2015). Srinivasa Ramanujan – Ek vilakshan ganitagya. *Vigyan Prakash* 10(1-4), 3-7.

Mishra, K. K. (2015). Value-based education is the need of the time (in Hindi). *Anaupacharika* 40(8), 6-8.

Raveendran, A., & Chunawala, S. (2015). Reproducing values: A feminist critique of a higher secondary biology textbook chapter on reproductive health. *Indian Journal of Gender Studies*, 22(2), 194-218.

Raveendran, A., & Chunawala, S. (2015). Values in science: Making sense of biology doctoral students' critical examination of a deterministic claim in a media article. *Science Education*. DOI: 10.1002/sce.21174.

Ravishankar, L., Ladage, S., & Shridhar, G. (2015). Assessment and evaluation in tertiary chemistry education: Are we bothered? *Current Science*, 109(1): 18-20.

Patil, K., Singh, G., & Haydock, K. (2015, September). Do leaves need chlorophyll for growth? *Science in School*, 33, 47–51.

D'Souza, R. (2016). Where do/did mathematical concepts come from. *For the Learning of Mathematics* 36(1), 25-27.

Ravishankar, L., Ladage, S., & Shridhar, G. (2016). Is research mandatory for teaching undergraduate chemistry? *Current Science*, 110(6), 972-973.

Srivastava, A. (2016). Building mental models by dissecting physical models. *Biochemistry and Molecular Biology Education*, 44(1), 7-11.

## **12 b) IN PROCEEDINGS [Page 270]**

Banerjee, R., & Subramaniam, K. (2015). Emerging ideas of generalization, proof and proving among grade 6 students. In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 177 -185). Mumbai: Cinnamonteal.

Chandrasekharan, S., Date, G., Pande, P., Rahaman, J., Shaikh, R., Srivastava, A., Srivastava, N., & Agarwal, H., (2015). Eye to I: Males recognize own eye movements, females inhibit recognition, In C. D. Noelle, R. Dale, A. S. Warlaumont, J. Yoshimi, T. Matlock, C. D. Jennings and P. P. Maglio (Eds.), *Proceedings of the 37<sup>th</sup> Annual Meeting of the Cognitive Science Society* (pp. 327-332). Austin, TX: Cognitive Science Society.



- Dhakulkar, A., & Nagarjuna G. (2015). Exploring the transient phenomena of electromagnetic induction. In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 276 -284). Mumbai: Cinnamontal.
- Deshmukh, N. D. (2015). Why do school students have misconceptions about life processes? In E. G. S. Daniel (Ed.), *Biology Education and Research in a Changing Planet Selected Papers from the 25<sup>th</sup> Biennial Asian Association for Biology Education Conference* (pp 31-44). Springer: Singapore.
- Deshmukh, N. D. (2015). Use of OERs for school science and mathematics education: An Indian experience. Paper presented at the *Distance Education and Teacher Education Conference 2015*, Africa, Mauritius Institute of Education, Mauritius, July 20-24, 2015.
- Dutta, D., & Chandrasekharan, S. (2015). Developing a curricular framework for ecological sensibilities: exploring the activity of urban farming as a critical and relevant intervention n S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 292 -298). Mumbai: Cinnamontal.
- Mirani, S., & Chunawala, S. (2015). Teachers' perceptions of dealing with mixed ability classrooms. In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 43-50). Mumbai: Cinnamontal.
- Pande, P., Shah, P., Chandrasekharan, S. (2015). How experts and novices navigate chemistry representations – An eye-tracking investigation. In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 102-109). Mumbai: Cinnamontal.
- D'Souza, R. (2015). Challenging ableism in high school mathematics. In S. Mukhopadhyay and B. Greer (Eds.), *Proceedings of the Eighth International Mathematics Education and Society Conference, Volume 2* (pp 427-440). Portland, Oregon: MES8.
- Shah, P., & Chandrasekharan, S. (2015). Analyzing the role of digital media in science education: A distributed cognition approach . In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 169-176). Mumbai: Cinnamontal.
- Sharma, A., & Chunawala, S. (2015). Using diagrams in inclusive learning situations. In S. Chandrasekharan, S. Murthy, G. Banerjee and A. Muralidhar (Eds.). *Proceedings epiSTEME 6: International Conference to Review Research on Science, Technology and Mathematics Education* (pp 117-124). Mumbai: Cinnamontal.
- Deshmukh N. D. (February, 2016). Rachanawad: Vidnyan shikshan (Constructivist approach: Science Education). In *Rachanawadi Shikshan*. Kolhapur: Maharashtra Bal Shikshan Parishad.
- Deshmukh, N. D. (January, 2016). Shalay shikshanat dnyanrachana (Constructivism in School Education). In *Rayat Vidnyan Parishad Proceedings* (pp 26-27).
- Deshmukh, N. D. (February, 2016). Handling of students' common errors and related doubts.

*Proceedings of One Day Teachers' Conference on 'Encouraging and Supporting Students' Thinking in the Learning of Science* (pp 7-14). Navi Mumbai: Navi Mumbai Science Foundation.

### **12 c) WEB PUBLICATIONS [Page 271]**

Verma, K., Faria, J. P., Antia, H. M., Basu, S., Mazumdar, A., Monteiro, M. J. P. F. G., Appourchaux, T., Chaplin, W. J. García, R. A., Metcalfe, T. S. (2015). Asteroseismic estimate of helium abundance of 16 Cyg A, B. In R.A. García & J. Ballot (Eds.), *The Space Photometry Revolution - CoRoT Symposium 3, Kepler KASC-7 Joint Meeting, France, EPJ Web of Conferences, Volume 101, id.06066*  
<http://adsabs.harvard.edu/abs/2015EPJWC.10106066V>

S. Chunawala, A. Muralidhar, M. Nair, D. Prabhu, D. Gupta and P. Sharma (Eds.). *Reflections: Newsletter of 46<sup>th</sup> International Physics Olympiad* (Nine issues), July 5-12, 2015. All issues available on <http://www.ipho2015.in/reflections/>

### **12 d) IN BOOKS [Page 271]**

Kumar, R. S., Subramaniam, K., & Naik, S. (2015). Professional development workshops for in-service mathematics teachers in India. In B. Sriraman, J. Cai, K-H. Lee, L. Fan, Y. Shimizu, C. S. Lim and K. Subramaniam (Eds.), *The first sourcebook on Asian research in mathematics education: China, Korea, Singapore, Japan, Malaysia, and India* (pp 207-211). Charlotte, NC: Information Age Publishing.

Sridharan, R. & Subramaniam, K. (2015). Representations of numbers and the Indian mathematical tradition of combinatorial problems. In B. Sriraman, J. Cai, K-H. Lee, L. Fan, Y. Shimizu, C. S. Lim and K. Subramaniam (Eds.), *The first sourcebook on Asian research in mathematics education: China, Korea, Singapore, Japan, Malaysia, and India*. Charlotte, NC: Information Age publishers.

Nawale, P. (2015). *Mungyanchya Jagat*. In *Grade 5 Marathi Balbharati* (pp 13-14). Pune: Maharashtra State Bureau of Textbook Production & Curriculum Research.

### **12 e) BOOKS / EDITED BOOKS AND VOLUMES/ BOOK REVIEWS [Page 271]**

Chandrasekharan, S., Murthy, S., Banerjee, G., & Muralidhar, A. (Eds.). (2015). *Proceedings epiSTEME 6: International conference to review research on science, technology and mathematics education*. Mumbai: Cinnamontal.

Deshmukh, N. D. (July, 2015). *Science teacher handbook for class 9*. Mumbai: Rashtriya Madhyamik Shiksha Abhiyan.

Deshmukh, N. D. (July, 2015). *Science teacher handbook for class 10*. Mumbai: Rashtriya Madhyamik Shiksha Abhiyan.

Lale, V. D., & Agarkar, S. C. (2015). *Krutipradhan vidnyan adhyapan (Rasayanshastra)* (in Marathi) viz. Activity-based teaching (Chemistry). Pune: Dilipraj Prakashan.

Mishra, K. K. (Ed.). (2015). *Gyan-vigyan: Shaikshik nibandh (Pustakmala-4)*. Mumbai: HBCSE.

Sriraman, B., Cai, J., Lee, K-H., Fan, L., Shimuzu, Y., Lim, C. S., & Subramaniam, K. (Eds.) (2015). *The first sourcebook on Asian research in mathematics education: China, Korea, Singapore, Japan, Malaysia, and India*. Charlotte, North Carolina: Information Age Publishing.

Sule, A. (Ed.). (2016). *Problems and solutions: International Olympiads on Astronomy and Astrophysics* (Revised 2nd edition). University Press.

## **12 f) TECHNICAL REPORTS/ INTERNAL REPORTS [Page 271]**

Dutta, B., Moorthy, S., & Chunawala, S. (2015). Health, physical fitness and wellness: A study of awareness of selected variables amongst undergraduate students. Mumbai: R J Jhunjhunwala College and HBCSE.

Sule, A., & Ranadive, P. (2015). Report of the Indian Astronomy Olympiad Programme 2015. Mumbai: HBCSE.

## **13. LECTURES / LECTURE COURSES GIVEN ELSEWHERE [Page 292]**

*A. Bose*

Can exposure to work-contexts create opportunities for mathematics learning? A case of out-of-school measurement knowledge, Centre for Education Innovation and Action Research, TISS, July 23, 2015

*A. Gupta*

Scientific breakthroughs and the quantitative tradition- Their validity versus relevance to society, *Workshop on "Time and Again: Challenging Science"*, Sophia College, January 8-9, 2016

*A. Mazumdar*

1. Asteroseismology: Understanding starquakes, Indian Institute of Technology Bombay, September 30, 2015
2. Extrasolar planets, UM-DAE Centre for Excellence in Basic Sciences, March 28, 2016
3. Physics 303: Electricity and magnetism, lecture course, UM-DAE Centre for Excellence in Basic Sciences, Mumbai, 2015

*A. Muralidhar*

1. Environment and sustainability issues: Sustainable tourism, BMN College of Home Science, September 30, 2015
2. Tree-mapping at Nalanda Public School, NPS Mulund, February 20, 2016

*A. Muralidhar, R. Kapil and S. Chunawala*

Design and technology education as an inclusive approach to teaching-learning (Lead talk), *National Seminar on Education of Socially Disadvantaged Groups in India*, Regional Institute of Education, Bhopal, March 5, 2016

*A. Sule*

1. Introductory mathematics – 1 (M100) lecture course, UM-DAE CBS, August - November 2015
2. Introductory mathematics – 2 (M200) lecture course, UM-DAE CBS, January - April 2015; January - April 2016

3. Sampling techniques, Pillai College of Education and Research, August 12, 2015
4. The sun, Lecture in Astronomy Basic Course of Khagol Mandal, September 12, 2015
5. The sun, Lecture at Astronomy Club, IITB (Krittika), October 16, 2015
6. Astronomy in daily life, *AEES Teachers Workshop*, December 28, 2015

#### D. Dutta & S. Chandrasekharan

1. Developing an educational framework for ecological sensibilities: A philosophical perspective, *the 3<sup>rd</sup> International Conference on Creativity and Innovations at Grassroots*, Ahmedabad, India, 2015

#### G. Nagarjuna

1. History and philosophy of science (5 Guest Lectures), CEBS, Kalina, August 18-22 October, 2015
2. Make, share and seek in freedom, Tyagarajar College of Engineering, Madurai, Commemorating Software Freedom Day, Festival '15, August 29, 2015
3. Simple ideas create greater impact, *Innovating for Quality Education for All* event on occasion of 55<sup>th</sup> Foundation Day, NIE Campus, NCERT, New Delhi, September 1, 2015
4. Impact of FSF during the last 30 years, Maulana Azad University Jodhpur on the occasion of 30 years of Free Software Foundation, October 3, 2015
5. Let us create a sustainable and free digital India without tears, without fear! *Yellow Talks, Unconventional Conventions*, Mysore Association Auditorium, October 10, 2015
6. Free software for digital India, *Yellow talks*, November 19, 2015
7. Principles of designing connected learning environment for quality education at scale: A view point, CEIAR Weekly Seminar Series, January 20, 2016
8. Ethics of science, University of Mumbai, Kalina, February 10, 2016

#### H. C. Pradhan

1. Lectures for Course on "History and philosophy of science" (H302) for students of the Integrated M.Sc. Program, UM-DAE Centre for Excellence in Basic Sciences, August-November 2015
2. Lectures for Course on "Ethics in science and Intellectual Property Rights" (H601), for students of Integrated M.Sc. Programme, UM-DAE Centre for Excellence in Basic Sciences, January-April 2016
3. Understanding the discipline of science, UGC Refresher Course in Education, Academic Staff College, University of Mumbai, June 25, 2015
4. Science and mathematics education in India – An overview, Sahvichar, Forum of Professionals of Indian Origin in Washington DC Area, Maclean, VA, USA, August 30, 2015
5. Evolution of scientific rationality from ancient times to scientific revolution, Athiests' Forum, Savarkar Smarak, Shivaji Park, Mumbai, March 26, 2016

#### H. Srivastava

1. Textbook analysis and assessment, *Science Teacher's Workshop by Eklavya*, Hoshangabad, May 31- June 1, 2015
2. How are environmental problems understood and discussed in high school science? *Workshop on Political Economy*, Delhi, June 20, 2015

#### J. Ramadas

Research in science education and its implications for curriculum. *Workshop on Science Education*, IISER, Pune, March 6, 2016

*K. Haydock, G. Singh and R. D'Souza*

What difference does ideology makes in framing research problems in science education”, *Conference on Emerging Trends in Science and Mathematics Education*, Department of Education, University of Delhi, February 18, 2016

*K. K. Mishra*

Hindi mein vigyan evam praudyogiki lekhan, *Bhasha Sangoshthi*, Lucknow, March 20, 2016

*K. Subramaniam*

1. “Inferring pedagogical content knowledge from teaching” and “Formulating research questions”, two talks at the Doctoral research school, Southern African Association for Research in Mathematics, Science and Technology Education. Johannesburg, June 2015
2. Teaching integers, *KV-ZIET Workshop for mathematics teachers*, Zonal Institute of Education and Training, Kendriya Vidyalaya Sangathan, Mumbai, June 5, 2015.
3. Four lectures on “Scientific Rationality”. Summer course in Philosophy of Education, Azim Premji University, June 15 and 16, 2015
4. “Pedagogy of mathematics” and “Understanding the discipline of mathematics”, Two talks given at the Refresher Course in Education, University of Mumbai, June 30, 2015
5. Mathematics learning for higher secondary school students and teachers, Kerala Govt. Model Residential Schools, CREST, Kozhikode, September 26, 2015
6. Teacher action and teacher knowledge. *Conference on Philosophy of Education*, Azim Premji University, January 12, 2016
7. Relating knowledge gained from work contexts to school learning, *National Seminar on Mathematics Education and Social Justice Concerns*, Tata Institute of Social Sciences, Hyderabad, February 4, 2016
8. Re-conceptualizing teachers’ specialized knowledge for the teaching of mathematics, *Conference on Emerging Trends in Science and Mathematics Education*, Department of Education, University of Delhi, February 19, 2016
9. Specialized knowledge that teachers need to teach school mathematics. *Workshop on Science Education*, IISER, Pune, March 6, 2016

*K. Subramaniam, R. D'Souza and H. Raval*

1. Teaching integers, for AECS mathematics and physics TGT teachers, December 28, 2015
2. Enhancing TLP using Geogebra, for AECS mathematics and physics TGT teachers, December 29, 2015

*K. T. Hambir*

Yes, you can do it!, *Raigad District Science Teacher Association Workshop* on “How to prepare science exhibits”, Khopoli, October 13, 2015

*M. C. Arunan*

1. Convocation address at Bhiwandi, JM Momin's Womens College, January 19, 2016
2. Organized irresponsibility, *Pathways to Sustainable Society at South Asia Sustainability Hub and Network Conference*, Jawaharlal Nehru University, Delhi, January 29, 2016

*M. C. Arunan, R. Sud, S. Ghumre and D. Bhatia*

CUBE as a model for undergraduate biology education, *The 33<sup>rd</sup> Annual Conference of the Indian Academy of Neurosciences*, Chandigarh, October 31, 2015

*M. Kharatmal*

Language simplification of science texts: Action research project and concept mapping research, *One-day Teachers' Conference on Encouraging and Supporting Students' Thinking in the Learning of Science*, Navi Mumbai Science Foundation, Vashi, February 6, 2016

*N. D. Deshmukh*

1. Use of ICT in biology education and OER in biology education. *Collaborative Asian Association of Biology Education Pre-Conference Workshop*, organized collaboratively by HBCSE and DCT's Dhempe College of Arts & Science, Miramar, July 30, 2015
2. ICT and school education and USE of digital resources in school education, *Asian Association of Biology Education Pre-Conference Workshop* organized collaboratively by SCERT, Directorate of Education, Government of Goa, Dnyanprassarak Mandal's College, Khorlim, Goa and HBCSE, July 31 – August 1, 2015
3. Activity based learning, biology education through ICT and how to use OER, *Asian Association of Biology Education Pre-Conference Workshop titled "Inculcation of Activity Based Learning Practices in Science and Mathematics Teachers at Secondary Level and Exploration of Innovative Practices in Teaching – Learning and Evaluation Methods."* organized collaboratively by Shri Shivaji Education Society, Amravati and HBCSE, August 8-10, 2015
4. Salient features of science teachers handbooks, *Rashtriya Madhyamik Shiksha Abhiyan Teacher Handbook Workshop*, Dr B R Ambedkar School, Pune, August 16, 2015
5. Science teachers handbooks and its significance in classroom teaching, *Rashtriya Madhyamik Shiksha Abhiyan Teacher Handbook Workshop*, Mumbai, September 12, 2015
6. Role of science teachers handbooks in classroom teaching, *Rashtriya Madhyamik Shiksha Abhiyan Teacher Handbook Workshop*, Nashik, October 4, 2015
7. Science exhibition and design of exhibits, *Akola District Science Teacher Association Workshop on Science Exhibition 2015-16*, New English School, Akola, October 26, 2015
8. Designing science exhibits, St. Mary's High School and Jr. College, Kalina, Mumbai, December 3, 2015
9. Role of science exhibition, P-ward science exhibition, Dr Sarvepalli Radhakrishnan High School, Sundar Nagar, Malad, Mumbai, December 4, 2015
10. Innovation and Ignite mind, Innovation exhibition at Rotary Club Office, Dombivali (East), Thane, December 5, 2015
11. Science exhibition for science education, P/K-ward science exhibition at Parle Tilak English Medium High School, Vile Parle, Mumbai, December 9, 2015
12. What students learn from science exhibition? K-west-ward science exhibition at Kamaldevi Jain High School, Andheri (West), Mumbai, December 10, 2015
13. Career in science education, *27<sup>th</sup> Aryabhata Science Exhibition*, IES School Mulund (East), Thane, January 13, 2016

*N. D Deshmukh and K. T. Hambir*

Constructivist approach in science teaching and role of activities, *Wardha District Science Teacher Association Workshop: Theme-Constructivist Science Learning and Role of Experiments*, February 13, 2016

*P. Ranadive*

1. The solar system, Lecture in Astronomy Basic Course of Khagol Mandal, September 5, 2015
2. Life cycle of stars, Basic Course in Astrophysics, Extra Mural Department, University of Mumbai, December 27, 2015
3. Variable and binary stars, Basic Course in Astrophysics, Extra Mural Department, University of Mumbai, January 17, 2016

4. How and why in astronomy, A. P. S. I. T. College Thane, February 22, 2016
5. Lecture and telescopic observation session, AECS School 6, December 30, 2015
6. Telescopes, for National Talent Search' Program, HBCSE, January 5, 2016

*R. D'Souza*

1. Critical ethnography, disability oppression and mathematics education, Universidade Estadual Paulista (UNESP), Rio Claro, June 9, 2015
2. Can ideologies be (dis/en)abling, *Seminar on Mathematics Education and Social Justice Concerns*, TISS Hyderabad, February 4-5, 2016

*R. Thengodkar, M. C. Arunan, P. Kishor and Cubists*

Ecosystems and its simulation in labs, Navi Mumbai Science Foundation's Science Utsav, Vashi, February 7, 2016

*S. Bhide*

Assessment: A brief introduction to assessment and how to assess Project-based Learning (PBL), *KV-ZIET Teacher Workshop*, November 20, 2015

*S. Chandrasekharan*

1. The possibilities of new computational media: A learning sciences perspective, *Faculty Seminar*, Indian Institute of Management, Kozhikode, July 23, 2015
2. The empirical study of mathematics, Kerala School of Mathematics (jointly organised with Department of Psychology, University of Calicut), July 24, 2015

*S. Chunawala*

1. Introduction to PBL, *KV-ZIET Teacher Workshop*, November 18, 2015
2. Communicating research. Certificate course on Research Methodology by K J Somaiya Comprehensive College of Education, Training and Research, HBCSE, February 5, 2016
3. HBCSE and its activities (Inaugural address), Anjuman-I-Islam's Ahmed Sailor High School, Mumbai, February 13, 2016

*S. Ladage*

Learning from Indian Chemistry Olympiad programme: Reflections on Laboratory Experiments, *National Convention of Chemistry Teachers*, University of Lucknow, October 8-10, 2015

*S. Ladage and A. Gupta*

Science education research and development at HBCSE, *Symposium on Teaching Learning in Higher Technical Education* (A joint initiative of IIT Madras, TEQIP-Tamil Nadu and TEQIP-Kerala), Centre for Teaching and Learning (IIT, Madras), January 22-23, 2016

*S. Naik*

1. Learning through logical fallacies! Talk for secondary school students for an event organized by Institute of Science, Mumbai, February 13, 2016
2. Professional noticing: Learning through artifacts of teaching, Pre-service teachers from St. Xavier's Institute of Education, Mumbai, February 13, 2016

*V. C. Sonawane, K. T. Hambir and R. Shaikh*

Science through experiments, Shri Vithal Education and Research Institute (SVERI) *Pandharpur's School Teachers Workshop*, Lotus School Pandharpur, July 29-31, 2015

V. D. Lale

Use of chemistry demonstrations in day today teaching at the school level, *Chemistry Teacher Empowerment Programme organized by DIET, Kozhikode, Regional Science Centre and Planetarium, Kozhikode, December 30-31, 2015*

V. C. Sonawane

1. Harnessing light: Possibility and challenges, Ekveera school, Charkop, Kandivali, August 4, 2015
2. Guiding teachers for the preparation of exhibits, models and organizing exhibition, Malad, October 28, 2015
3. Science lecture, Royal School & Junior college, Hadapsar, Pune, January 27, 2016

## LECTURES, COLLOQUIA, SEMINARS

### 14. LECTURES BY VISITORS [Page 306]

**Padma Sarangapani** (*Tata Institute of Social Sciences*) and **G. Nagarjuna** (*HBCSE*), Introduction to the Connected Learning Initiative (CLIX), May 20, 2015

**S. Balachander** (*Dhrupad musician*), The art and science of music, May 21, 2015

**Rajaram Nityananda** (*Azim Premji University*), From irreversibility and ignorance to information and inference, June 26, 2015

**Anwar Jafri** (*Samavesh*), Improving quality of government elementary schools in Madhya Pradesh, October 5, 2015

**John Lockley** (*University of Waikato, New Zealand*), Teachers developing local curriculum and pedagogy to address national or state curricula, October 8, 2015

**John Lockley** (*University of Waikato, New Zealand*), The use of CoRes to enhance the Pedagogical Content Knowledge (PCK) development of initial teachers in Technology Education, October 15, 2015

**Douglas Allchin** (*University of Minnesota, USA*), Naturalizing as an error-type in science: Implications for science education, December 23, 2015

**Sneha Khandekar** (*Consultant Coordinator for the Savitribai Phule Gender Resource Centre*), Inclusive Workplaces & Sexual Ethics, December 29, 2015

**Anesh Kumar Maharaj** (*University of KwaZulu-Natal*), Pre-service teacher education in South African Democratic Union using Moodle. January 19, 2016

**Mona Seervai** (*Principal, Bombay International School*), Concept-based science education in schools. January 21, 2016

**Kelly Butler** (*Professor of Chemistry, Chestnut Hill College, Philadelphia, PA*), Process Oriented Guided Inquiry Learning, International Conference on Innovations in Teaching, Learning and Evaluation in Higher Education, Modern College of Arts, Science and Commerce, Shivajinagar, Pune, January 30, 2016

**Shiju Sam Varughese** (*Central University of Gujarat, Gandhinagar*), Science, media and risk politics: Constructing a scientific public sphere, February 17, 2016

**Shiju Sam Varughese** (*Central University of Gujarat, Gandhinagar*), Mediated publics of science: clinical trials controversy at the regional cancer centre, Kerala, February 18, 2016

**Rashi Vidyasagar** (*Resource Centre for Interventions on Violence Against Women (RCI-VAW) at*



Tata Institute of Social Sciences), Sexual harassment at the workplace, March 8, 2016

### **V. G. Kulkarni Memorial Lecture [Page 306]**

**Narendra Jadhav** (*Professor & Durgabai Deshmukh Chair in Social Development, Equity and Human Security at the Council for Social Development (CSD), New Delhi*), Global economic scenario and the future of the Indian economy, Fourteenth V. G. Kulkarni Memorial Lecture, September 9, 2015

### **Lectures at Olympiads Valedictory Functions and Infosys Functions [Page 306]**

**U. K. Anandavardhanan, IIT Bombay** (*Mathematics OCSC Valedictory Function*), Congruent numbers, May 18, 2015

**R. L. Karandikar, Chennai Mathematical Institute** (*Mathematics OCSC Valedictory Function*), Introduction to Monte Carlo simulation, May 18, 2015

**Abhay Chowdhary, Haffkine Institute** (*Junior Science OCSC Valedictory Function*), Current trends in virology research, May 25, 2015

**Somak Raychoudhury, Presidency University** (*Astronomy OCSC Valedictory Function*), What the universe is made of: Dark matter and dark energy, June 5, 2015

**Sunil Bhagwat, Institute of Chemical Technology** (*Chemistry OCSC Valedictory Function*), Science, society, chemical industry and you, June 5, 2015

**B. J. Rao, Department of Biological Sciences, TIFR** (*Biology OCSC Valedictory Function*), The story of chromosomes, June 13, 2015

**Anil Bhardwaj, Director, Space Physics Laboratory, Vikram Sarabhai Space Centre** (*Infosys Award Function*), Indian Mars Orbiter Mission to Mars, December 22, 2015.

**Sourav Pal, Indian Institute of Technology Bombay** (*Infosys Award Function*), Science at the nano scale to atomic and molecular level - An inter-disciplinary approach, Infosys Award Function 2015, December 22, 2015

### **NIUS Seminars [Page 306]**

**Henry Throop** (*National Aeronautics Space Agency, Washington DC, USA*), NASA's new horizons mission to Pluto and beyond, November 3, 2015

**Anwesh Mazumdar, Shirish Pathare and Praveen Pathak** (*HBCSE, Mumbai*), The 46<sup>th</sup> International Physics Olympiad, November 23, 2015

### **Review talks and workshops by visitors at epiSTEME 6, International Conference to Review Research on Science, Technology and Mathematics Education [Page 306]**

**Paul Cobb** (*Vanderbilt University, USA*), A theory of action for supporting improvements in the quality of mathematics teaching on a large scale, December 15, 2015

**Paul Cobb** (*Vanderbilt University, USA*), Workshop on Design Research Methodology: Orientation and Issues, December 18, 2015

**Douglas Allchin** (*University of Minnesota, USA*), From test tubes to Youtube: Nature of science in socio-scientific issues and history, December 15, 2015

**Douglas Allchin** (*University of Minnesota, USA*), Post-conference workshop on teaching the nature of science through historical case studies, December 22, 2015

**Gautam Biswas** (*Vanderbilt University, USA*), CTSIM: A computational thinking environment for learning science using simulation and modeling, December 15, 2015

**Stephen Jull** (*GeoGebra Team, UK*), GeoGebra: A disruption in STEM education, December 16, 2015

**Stephen Jull** (*GeoGebra Team, UK*), Workshop on Design rationale for Geogebra, December 16, 2015

**David Landy** (*Indiana University, USA*), When is a grounding 'Good', for whom, and how can we build them? December 16, 2015

**David Hestenes** (*Arizona State University, USA*), Modeling theory and modeling instruction for STEM education, December 17, 2015

## LECTURES, COLLOQUIA, SEMINARS

### LECTURES BY TIFR MEMBERS (HBCSE, Mumbai) [Page 317-318]

#### Seminars at Annual Research Meet, October 12-13, 2015

*P. Pande*, How do experts and novices navigate chemical representations: an eye-tracking investigation

*R. D'Souza*, Concepts as processes

*K. Haydock*, The balance of nature

*V. C. Sonawane*, Experimentation in physics

*J. Rahaman*, Construction of area concept in a classroom

*D. Karnam*, Nature of trigonometric knowledge and representation

*G. Singh*, Exploring the relationship between observations and question asking among middle school students

*G. Date*, Design process of a formally trained engineer working at the grassroots

*H. Srivastava*, Transformation agenda in science education: stories and questions from the field

*R. Varkey*, Changing portrayals of farmers and agriculture: The case of SCERT (Kerala) Textbook

*V. D. Lale*, Science learning and visualization: How students with and without vision visualize atomic structure

*A. Sharma*, Science learning and visualization: How students with and without vision visualize atomic structure

*D. Dutta*, How to generate environment-oriented actions and motivation: urban farming as a possible method

*C. Navare*, Making a point with lines: Comics in education

*R. Shaikh*, Learning in a shared space: A study using instant messaging environment

#### In-House talks at Workshops organized in collaboration with HBCSE

*A. Muralidhar*

1. Environment and sustainability, Junior Science Olympiad, May 10, 2015
2. Video screening and discussion: Story of Stuff, Sri Lanka Teacher Workshop, November 24, 2015

*A. Muralidhar, S. Bhide, D. Gupta, R. Kapil*

Video screening and discussion: Powers of ten, Sri Lanka Teacher Workshop, November 23, 2015

*A. Gupta*

Use of history of science in teaching, Sri Lanka Teacher Workshop, November 24, 2015

*D. Gupta*

Introduction to teaching diodes and transistors. TPD Workshop for DSCERT Karnataka, June 26, 2015

*D. Gupta, A. Muralidhar, S. Bhide, R. Kapil*

Hands on learning: Arvind Gupta toys, Sri Lanka Teacher Workshop, November 25, 2015

*D. Prabhu*

Emotion management: Dealing with feelings, Junior Science Olympiad, May 9, 2015

*H. C. Pradhan*

1. Introductory biostatistics, International Biology Olympiad Orientation-cum-Selection Camp 2015, June 7, 2015
2. Misconceptions in physics, Orientation Course for Physics Teachers from the State of Karnataka, June 23, 2015
3. Place of history of science in school curriculum and objectives of teaching science, (two lectures), Sri Lanka Teacher Workshop, November 18, 2015

*J. Vijapurkar*

1. A short session on teaching with science teachers and teacher educators from Sri Lanka, Sri Lanka Teacher Workshop, November 26, 2015
2. Classroom processes in teaching science as inquiry, Timor-Leste Workshop, January 18-19, 2016
3. Teaching and learning science through inquiry at the middle school level, HBCSE, March 10, 2016

*S. Ladage*

Understanding experimental design in chemistry, Sri Lanka Teacher Workshop, November 23, 2015

*S. Naik*

1. Mathematical content beyond textbook horizon, Timor-Leste Workshop, HBCSE, January 19, 2016
2. What knowledge is needed to teach mathematics effectively? Timor-Leste Workshop, HBCSE, January 21, 2016

*M. Kharatmal*

1. Patpustikache vishleshan; Vidyarthiyanche prashnanche swaroop, Rayat Education Society's (Satara) primary science teachers workshop, June, 2015

2. Concept mapping for knowledge representation; POE approach for science learning; Textbook analysis: Comparison of science texts of Sri Lanka and India based on activity based science, Sri Lanka Teacher Workshop, November 2015

*M. Kharatmal, J. Ramadas*

Analysis of textbooks for science processes, DSCERT Karnataka Physics Teachers Workshop, June 22-26, 2015

*M. Kharatmal, N. D. Deshmukh, V. C. Sonawane, R. Shaikh*

Science through investigation, Sri Lanka Teacher Workshop, November 2015

*M. Kharatmal, N. D. Deshmukh, V. C. Sonawane*

Research readings in science education and science teaching, Sri Lanka Teacher Workshop, November 2015

*M. Kharatmal, R. Shaikh*

1. Learning science through POE approach, Rayat Education Society's (Satara) science teacher workshop. Theme: Science Education, and Introduction to Science Olympiads, August, 2015
2. POE approach for science learning, Rayat Education Society's (Satara) science teacher workshop. Theme: Science Education, Science Project, INSPIRE. October, 2015

*P. K. Joshi*

How to do science projects, Rayat Foundation program, HBCSE, October 5, 2015

*S. Chunawala*

1. Chala januya vidnyanache swaroop, Rayat Education Society's Teacher Workshop, June 9, 2015
2. Shikshanatil samajik va sanskrutik kahi prashna, Rayat Education Society's Teacher Workshop, June 11, 2015
3. Understanding the nature of science, TPD Workshop for DSCERT Karnataka, June 25, 2015
4. Project based learning as a teaching method, Sri Lanka Teacher Workshop, November 17, 2015
5. Gender issues in education, Sri Lanka Teacher Workshop, November 27, 2015
6. Nature of Science, NIUS students, December 24, 2015
7. Science, technology and society, Nurture Programme organized for NTS scholars, January 4, 2016
8. Design and technology education at HBCSE, Timor-Leste Workshop, January 20, 2016

*S. Chunawala, S. Bhide and D. Gupta (along with other members of SSRD group)*

SSRD summer camp and making, assessing worksheets: Experiences of participatory action research. Sri Lanka Teacher Workshop, November 23, 2015

*S. Bhide*

1. Enrichment session in biology: Nature and design, Junior Science Olympiad, May 11, 2015
2. Karyapatrika (Worksheets) Group work, Rayat Education Society's Teacher Workshop, June 9, 2015
3. Biomimicry, Rayat Education Society's Teacher Workshop, August 25, 2015
4. Perspective on design and technology in school education, Sri Lanka Teacher Workshop, November 26, 2015

V. D. Lale

Fire and fire safety, Homi Bhabha Young Scientist Awardee's camp, HBCSE, April 2015

V. C. Sonawane and P. Sharma

Simple pendulum, Junior Science Olympiad, May 11-12, 2015

V. C. Sonawane

Laboratory related lecture, for teachers of firati prayog shala (Mobile laboratory), HBCSE, August 11, 2015

## TRAINING

### 15. GRADUATE COURSES [Page 321]

#### HBCSE Graduate School

*Autumn 2015 (August to November)*

**Short Course on History of Education in India** (*N. Varadarajan, Azim Premji University*)

**Education, Society and Education Policy in India** (*Shekhar Krishnan*)

**Advanced Research Methods in Education** (*Sugra Chunawala*)

**History of Science** (*Ankush Gupta*)

**School teaching experience** (*K. Subramaniam and N. D. Deshmukh*)

**Philosophy of Science** (*G. Nagarjuna and K. Subramaniam*)

**Introduction to Science, Technology and Mathematics Education Research** (*Aniket Sule and Shubhangi Bhide*)

*Elective Courses*

**Reading Course on Representation** (*Sanjay Chandrasekharan*)

**Reading Course on Environment and Behaviour** (*Sanjay Chandrasekharan*)

*Spring 2016 (January to April)*

**Cognition, Cognitive Development and Learning** (*Jayashree Ramadas and Ankush Gupta*)

**Philosophy of Education** (*G. Nagarjuna and Abhijeet Bardapurkar*)

**Methods of Science and Mathematics Education Research** (*Aniket Sule and Shweta Naik*)

*Elective Courses*

**Environmental Science Education** (*Ankush Gupta*)

**Advanced Topics in Cognition** [based in IIT, Powai] (*Sanjay Chandrasekharan*)

### 16. PhD THESES [Page 324-325]

**Arindam Bose:** Work, knowledge and identity: Implications for school learning of out-of-school mathematical knowledge (K. Subramaniam)

## National Initiative in Undergraduate Science, HBCSE [Page 328]

### Biology

*Aditi Sunil Kadam* (V G Vaze College, Mulund); Study of growth characteristics of E.coli under varying concentrations of ethanol; (R. Vartak, HBCSE, Mumbai)

*Dimple Kamath* (Wilson College, Mumbai); To study implications of iron as a stress agent using chironomous larvae; (B. B. Nath, Pune University; R. Vartak, A. Ronad, HBCSE, Mumbai)

*Mohammed Ajmal P. Y.* (IIRBS Mahatma Gandhi University, Kerala); Study of Hydnocarpus pentandra fruit and seeds: Chemical analysis and influence on behavior of certain animals; (R. Vartak, HBCSE, Mumbai)

### Chemistry

*Amruta Nair* (IISER Pune); Synthesis and characterization of light absorbing perovskites; (D. Khushalani, TIFR, Mumbai)

*Anand Kumar* (IISER Pune); Picolinic acid complexation with actinyls: A density functional approach; (M. Sundararajan, BARC, Mumbai)

*Anita Kumari* (Hindu College, Delhi); Dynamics and delocalization in a one dimensional tight binding elemental and binary chain; (V. Singh, Formerly HBCSE, Mumbai, S.K. Ghosh, BARC, Mumbai)

*Anjali Rathore* (IISER Bhopal); Sonochemical synthesis and characterization of Sb<sup>3+</sup> and Co<sup>3+</sup> doped nano BiFeO<sub>3</sub>; (D. Dutta, BARC, Mumbai)

*Ankita Roy* (IISER Bhopal); Theoretical calculations of inner sphere reorganization energies of some uranyl complexes; (M. Sundararajan, BARC, Mumbai)

*Dhwanit Dave* (St.Xaviers College, Mumbai); Cloud point behavior of non-ionic surfactant Triton X-100 under the influence of transition metal cations as additives; (P. A. Hassan, BARC, Mumbai and I. D. Sen, HBCSE, Mumbai)

*Mayank Mishra* (IISER Bhopal); Walsh diagrams and matrix elements of three electronic Hamiltonian; (Y. Sajeev, BARC, Mumbai)

*Sagnik Datta* (CEBS, Mumbai); Theoretical investigation on the nature of Lewis acid-base complexes under the confinement of fullerenes; (K. R. S. Chandrakumar, BARC, Mumbai)

*Sanwardhini Pantawane* (CEBS, Mumbai); Molecular dynamics simulation of water in and around carbon nanotubes: A coarse-grained description; (N. Choudhury, BARC, Mumbai)

*Shraddha Agrawal* (UM-DAE CBS, Mumbai); 1. CO and O<sub>2</sub> adsorption on Au<sub>19</sub>H clusters 2. Nobel gas atoms confined in B<sub>40</sub> cages; (T. Ghanty, BARC, Mumbai)

*Siddharth Sharma* (IISER Bhopal); Determination of thermodynamic stability of SiTe<sub>2</sub>(s) by knudsen effusion mass loss technique; (S. Phapale and R. Mishra, BARC, Mumbai)

*Simran Kumari* (IISER Kolkata); Unraveling the electronic and geometric structures of nitrite

binding to metal mutants of oxidized myoglobin; (M. Sundararajan, BARC, Mumbai)

*Sourav Dey* (Ramkrishna Mission Vidyamandir, Belur, West Bengal); Theoretical prediction of noble gas insertion complexes; (T. Ghanty, BARC, Mumbai)

*Souvik Dey* (ISERC, Visva Bharati); Adsorption of DNA nucleobases on MoS<sub>2</sub> Sheet: A theoretical study with Dispersion Correction; (C. Majumdar, BARC, Mumbai)

*Vishnudas S* (IIRBS, Mahatma Gandhi University Kerala); Computational estimation of pK<sub>a</sub> values of substituted pyridines; (M. Sundararajan, BARC, Mumbai)

## Physics

*Akshay S* (IISER Pune); Solar imaging using the Murchison Widefield array; (D. Oberoi, NCRA, TIFR)

*Ananya Mondal* (IISER Kolkata); Study of chaos in a spring pendulum; (J. Bhattacharjee, Harish Chandra Research Institute, Allahabad)

*Goutam Sharma* (Hansraj College, Delhi); Interplay of atmospheric reactor and accelerator neutrino oscillations; (D. P. Roy, HBCSE, Mumbai)

*Niyati Venkateshan* (Women's Christian College, Chennai); Solar and reactor neutrino oscillation; (D. P. Roy, HBCSE, Mumbai)

*Priyanga G* (NISER, Bhubhaneswar); Measurement of electron mass using Compton scattering; (R. Palit, TIFR, Mumbai and P. K. Joshi, HBCSE, Mumbai)

*Saurabh Kadam* (IISER Pune); P and T violation and electric dipole moment of deuteron; (A. Kumar, HBCSE, Mumbai)

*Somadutta Bhatta* (NISER, Bhubhaneswar); Solar and reactor neutrino oscillation; (D. P. Roy, HBCSE, Mumbai)

*Subhajit Sinha* (St. Xavier's College, Kolkata); Interplay of atmospheric reactor and accelerator neutrino oscillations; (D. P. Roy, HBCSE, Mumbai)

*Vineeth S. Bhaskara* (IIT, Guwahati); Generalised concurrence for multiple pure quantum states using Lagrange's identity and wedge product; (P. K. Panigrahi, IISER Kolkata)

*Zafri Ahmed Barbaruah* (Tezpur University); P and T violation and electric dipole moment of deuteron; (A. Kumar, HBCSE, Mumbai)

## 17. POPULAR SCIENCE LECTURES [Page 332-334]

### A. Sule

1. Careers in physics (Marathi), Marathi Vijnan Parishad, April 5, 2015
2. Careers in science (English), Vishnudas Bhave Auditorium, Vashi, December 8, 2015
3. Careers in science (Marathi), Topiwala High School and Desai High School, December 11-12, 2015
4. Night sky watching programme, Topiwala highschool, Malvan, December 11-12, 2015
5. India in space (English), Cipla, Vikhroli. February 11, 2016

### H. C. Pradhan

1. Constructivism in teaching mathematics in primary schools, A. B. Goregaonkar Vidyalay, Goregaon, Mumbai, June 11, 2015
2. On scientific temper, *Seminar on Science and Society*, Y. B. Chavan Foundation, Y. B.

- Chavan Centre, Colaba, Mumbai, December 5, 2015
3. Relevance of nayee taleem today, Chief Guest's Address, Maa- Baba Puraskar for Educational Work for the Underprivileged, Nayee Taleem Samiti, Sevagram, Wardha, December 12, 2015
  4. Learning science, Nayee Taleem School, Sevagram, Wardha, December 13, 2015
  5. Face to face with scientists, Children's Question and Answer Session, National Children's Science Congress, Chandigarh University, Mohali, December 28 and 29, 2015
  6. Teaching science can be exciting, Teachers' Session, National Children's Science Congress, Chandigarh University, Mohali, December 28, 2015
  7. Milestones in educational reforms, *Seminar for School Counsellors*, Mumbai Psychological Society, Nehru Centre, Worli, Mumbai, January 7, 2016
  8. Planning for a meaningful career, Convocation Address, Dnyansadhana College, Thane, January 16, 2016

*P. Ranadive*

1. Sun and solar system, Bal Vidyalay, Kota, January 30, 2016
2. Sky observation program, Cipla, Vikhroli, February 11, 2016
3. Sky observation program, Navy Nagar School, Colaba, February 12, 2016
4. Overnight sky observation programs with Khagol Mandal, Mumbai, for general public, Neral, April 18, 2015; May 16, 2015; January 9, 2016; March 9, 2016
5. Overnight sky observation programs with Khagol Mandal, Mumbai, for Teach for India, Umbroli, Badlapur, January 2, 2016; February 13, 2016

*P. K. Joshi*

1. Misconceptions in science, Inspire Science Award, Nanded, September 1, 2015
2. Science olympiads, Nagarjuna High school, Nanded, September 2, 2015
3. Misconception in science, Prof. Rajendra Singh Science Centre, Nagpur, October 2, 2015
4. Science olympiads a movement, AEC School No. 3, Mumbai, December 28, 2015
5. Science olympiads a movement, Gujarat Science City, Ahmedabad, January 29, 2016
6. Role of observation in science and handling of data, Kutch University, Bhuj, February 15, 2016

## 17. POPULAR SCIENCE ARTICLES [Page 334-335]

*A. Muralidhar*

1. Think, create and test. *Teacher Plus*, 46-47, August 2015
2. The big story of everything! *Teacher Plus*, 40-41, September 2015

*H. Srivastava*

Nazar-nazar ka pher. *Sandarbh*, 43(100), 1-13, September-October 2015

*J. Vijapurkar*

This big round earth. *Teacher Plus*, 13(7), 25-29, August 2015

*K. K. Mishra*

1. Vigyan- Itihaas ke aaiyne mein, *Awishkar*, 31-37, April 2015
2. Ganga pradushan- Varanasi ke sandarbh mein, *Vigyan Ganga* 5(8), 29-34, 2015
3. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 30-35, May 2015
4. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 28-32, June 2015



5. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 27-33, July 2015
6. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 20-29, August 2015
7. Vitamin-C : Ek adbhut rasayan, *Dream 2047*, 11, August 2015
8. Vitamin-C: An Amazing Chemical, *Dream 2047*, 17(11), 26, August 2015
9. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 21-28, September 2015
10. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 19-25, October 2015
11. Vigyan - Itihaas ke aaiyne mein, *Awishkar*, 28-34, November 2015
12. Baal kendrit shiksha aur uske sarokaar, *Vigyan*, 11-13, November 2015
13. Vigyan- Itihaas ke aaiyne mein, *Awishkar*, 25-32, December 2015
14. Neurotransmitters: The chemical messengers of neurons (Cover Story), *Science India* 19(1), 6-12, January 2016
15. Naino mein simatti duniya, *Technical Today*, 1(1), 42-45, Jan-March 2016
16. Antioxidants- Swastha aur dirghjeevan ki kunji, *Awishkar*, 13-17, March 2016
17. Hindi mein vaigyaanik evum takaniki lekhan, *Hindi Garima*, 17-18, March 2016

*P. Ranadive*

Vidnyan yugat apan (Marathi), *Samna paper*, February 27, 2016

*P. Nawale*

Gharacha Abhyas Karuya Anandane (Marathi). *Jiwan Shikshan*, 23-24, October, 2015

*S. Bhide*

Modelling learning from life. *Teacher Plus*, 42-43, September 2015

## 18. RADIO AND TV PROGRAMMES [Page 335]

*A. Sule*

1. Use of space technology in daily life (interview), DD Sahyadri, September 7, 2015
2. Water on Mars (interview), Jai Maharashtra, September 28, 2015
3. Water on Mars (interview), IBN Lokmat, September 29, 2015
4. Young Tarang: Careers in astronomy (interview), DD Sahyadri, January 2016

*M. Vahia and P. Ranadive*

Water in the universe (interview), All India Radio, January 2016

*P. K. Joshi*

Gold for India in International Junior Science Olympiad 2015, Good News India, DD News, January 3, 2016