Homi Bhabha Centre for Science Education, Mumbai

2. Highlights

Studies on socioscientific and development issues in science education looked beyond factual and discipline based knowledge to identify ideological biases in textbooks and patterns of fallacious reasoning in students. A MOOC platform was developed and used to deliver a course on digital literacy, in collaboration with TISS and National Service Scheme volunteers, to over 7000 students across four states. All the six students who represented India in the International Junior Science Olympiad won gold medals, setting a record in the country's Olympiad history. Out of the total 30 student team members for the International Olympiads in Physics, Chemistry, Biology, Mathematics, Astronomy and Junior Science, 28 bagged medals, including 9 gold medals.

HBCSE review: An external review of HBCSE was carried out in October, 2014. The review committee comprised of Prof. N. Sathyamurthi (Director, IISER, Mohali), Chair; Jill Adler (University of Witwatersrand South Africa); Sibel Eruduran (University of Limerick, Ireland); Paula R. L. Heron, (University of Washington, USA), B. Phondke (ex-Director, National Institute of Science Communication) and T. S. Saraswathi (Retd. M. S. University, Baroda). Prior to the external review the HBCSE faculty carried out a detailed internal review, the outcomes of which were made available to the external review committee.

3. Text

Research & Development in Science, Technology and Mathematics Education

The research projects in science, mathematics and technology education at HBCSE can be broadly grouped under three categories: Learning and Reasoning with Representations, Teaching and Pedagogy, and 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)

The Role of Manipulatives in Learning Area

An experimental study was conducted to examine how manipulatives helped in solving the area problem, and mathematics problems in general. Three groups of sixth grade students solved two area problems. One group did a manipulation based on geometric structure (a type of tangram) before solving the two area problems; a second group did general knowledge tests before solving the same problems; the third group did a manipulation task with no identifiable geometric structure before solving the area problems. The process by which the groups solved the area problems were tracked in detail, using video and an eye tracker. Analysis of the actions and eye movements, in

combination, showed a clear difference in the problem-solving process between the three groups. Based on these results, a theoretical account was proposed, explaining how manipulatives help in mathematics problem-solving. [J. Rahaman, S. Chandrasekharan, N. Srivastava (UCSD)]

Representational Competence in Chemistry

A series of studies were done to examine students' ability to integrate different representations (representational competence) in chemistry, such as equations, graphs and molecular structure. The studies combined eye tracking methods and qualitative analysis. Results from these studies showed that students who performed at expert level had more systematic eye movements, compared to students who did not perform well. This suggests eye movements could be a marker for representational competence. [P. Pande, S. Chandrasekharan]

Informal learning

An ongoing study explores how grassroots innovators develop new inventions without formal training in engineering or technology. Preliminary data from a study of five grassroots innovators shows that their solutions address mostly local problems, and their designs are based on analogical reasoning. [G. Date, S. Chandrasekharan]

Oscillation Simulation

A simulation to teach the oscillation concept to class 7 students was developed, in collaboration with the Interdisciplinary Program in Educational Technology, IIT Bombay. Students' interaction with this simulation was studied using an eye tracker. Preliminary results showed that eye movements could be used to understand how students integrate different representations. [A. Kothiyal, R. Majumdar (IDP-ET, IITB), H. Agrawal (IIT Roorkee), P. Pande, S. Chandrasekharan]

Refined Concept Mapping

As part of the re-representation of the links in concept maps, an analysis of cell biology topic from three expert level international books (Campbel, 2005; DeRobertis, 1995; Soper, 2003) was done. The objective of the study was to characterize expert's knowledge for the nature and kinds of linking words used by the subject (biology) experts, as it would provide a direction into the way they organize knowledge, their usage of technical terms, grammar, vocabulary, etc. The linking words were categorized into the appropriate dimensions such as: part-whole, class inclusion, spatial inclusion, function, attributes, etc. Results indicate a close match between the kinds of linking words used by the experts, and the re-represented linking words following the refined concept mapping approach. This not only validates the refined concept mapping method, but also confirms our hypothesis that the refined concept mapping method is closer to the expert's way of representing knowledge. The results of this study are being prepared for publication. [M. Kharatmal, G. Nagarjuna]

Learning Mathematics in a Social Context: A Chat Studio

We are exploring learning possibilities in a socially shared virtual environment for early arithmetic. Two new game applications have been developed to test the hypothesis that learning happens in children who participate in a collaborative virtual environment as opposed to a one-to-one interaction with a computer. Data has been collected through a school server over a period of 6 months to analyze learning gains. [R. Shaikh, G. Nagarjuna, R. Katkam, S. Chandrasekharan]

Physics Education Research

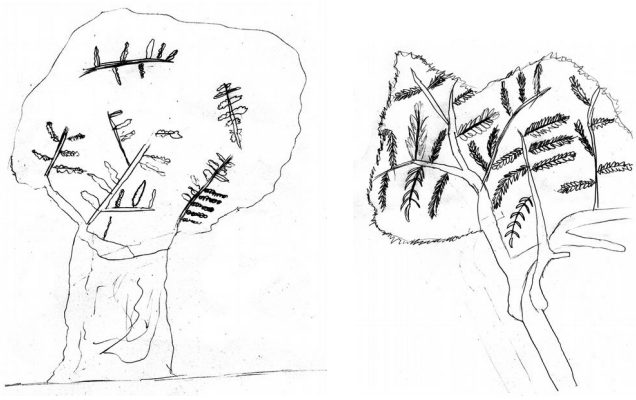
Students' alternative conceptions in elementary thermodynamics, and how to address them, was investigated, based on designing, developing and trying out demonstrations and activities to help students overcome some of the misconceptions.

Thermal Equilibrium: We built up a systematic analogous hydrostatic model of thermal equilibrium and presented it to 112 second year undergraduate students in a Predict-Observe-Explain approach. Students' active engagement with the situation about which they had the misconception led them to see that although the rate at which the final temperature is attained depends on the size and the material of the body, the final temperature attained is the same, irrespective of the size and the material, for all bodies kept in the constant temperature enclosure. The students even could apply their understanding to a new situation, namely, the method of mixtures, in which a hot metal block is immersed into a beaker of cold water and after a while both the block and the water attain a common temperature. The work was published in the journal *Physics Education* published by Institute of Physics, UK.

First law of thermodynamics: Earlier we had reported on three activities to address students' difficulties with respect to the first law of thermodynamics. This law to them is only an equation. When they have to apply the law in a concrete situation, they fail to identify the different terms in the equation. The first two activities were aimed respectively at understanding isothermal and adiabatic processes. The third was aimed at explaining the first law in a general case. These activities were presented to students using a predict-perform-observe-explain approach (PPOE) rather than just the predict-observe-explain (POE) approach. We found that a major factor that militates against students' understanding is that in their intuitive reasoning they do not distinguish between heat and temperature. [S. Pathare, H. C. Pradhan, S. Ladage]

Art and Science: Visual Learning / Teaching

The objective of this research project was to study the overlaps between the process of doing art and the process of doing science. Drawing is a type of model making: drawing is making (and simultaneously figuring out how to make) simplified, 2-d representations of processes in physical reality. Model making is an important part of the process of doing science, and we have been trying to find out how drawing and doing science can be integrated in interdisciplinary learning activities. We have also been designing and testing ways in which drawing can be used constructively. For example, we have found some activities in which students need to draw in order to find answers to questions and solve relevant problems, or in which they learn by closely observing, analyzing, and critiquing visual representations. [K. Haydock]



(a) **(b)**

(a) A child's drawing of an imli tree, made without looking at a tree. (b) The same child's drawing made while looking at an imli tree on the HBCSE campus.

II. Teaching and Pedagogy

Perceptions About the Pedagogy of Learning by Doing

This study aimed at understanding facilitators' perceptions about the pedagogy of learning by doing (LBD). Four school teachers and three science communicators, reputed for their practice and promotion of hands-on science activities were interviewed in depth on their perceptions about LBD pedagogy in school education. The study recorded the following important insights from the experienced communicators: i) While many LBD facilitators limit themselves to demonstration of activities, it is more effective for learners to carry out the activities themselves. ii) While often the emphasis is on fun and enjoyment, there is an absence of focus on concept understanding; iii) Effective implementation of LBD approach needs professional development programmes for facilitators. iv) Involvement of parents, practitioners and professionals including doctors, farmers, engineers, scientists, fitters, blacksmiths, etc. in LBD programmes is critical for motivation, support and creating a network of activities. iv) If the learning environment is cognitively and emotionally demanding children are motivated to try to correlate their observations and experiences and express them through various activities. vi) Evaluation of the impact of the LBD approach based on learners' feedback and evaluation is essential. [N.D. Deshmukh]

Teacher Professional Development

The role of specialized content knowledge (SCK) of mathematics for teaching in supporting teacher change was further explored with respect to the teaching of integers in the middle school. Teachers moved from being followers of the textbook to creating their own representations and exercises while covering the learning outcomes present in the textbook chapter on integers. Knowledge of integer representations in the form of models and contexts is critical in supporting such change in teachers. The role of SCK was explored further in the teaching of decimal fractions and operations. Case studies of classroom teaching by upper primary teachers showed that multiple representations of decimal fractions were used in limited ways, and contexts were hardly used while teaching. Teachers' participation in collaborative discussion meetings led to significant changes in teaching practice as well as in the use of representations. [R. Kumar, S. Takker, K. Subramaniam]

An on-going study investigates middle school teachers' mathematical sensibilities as reflected in their classroom teaching and through interviews. It is anticipated that such sensibilities play an important role in shaping what teachers do in the classroom. Preliminary analysis shows the prevalence of teaching that emphasizes procedures, which leads to inconsistent mathematical experiences for students. Frequently, teaching of a specific procedure ignored a range of cases, and was disconnected from students' prior experiences. Pedagogical simplicity was often achieved at the cost of mathematical inconsistency. [S. Naik]

Relating Children's Out-of-School Knowledge to School Mathematics

A teaching design experiment, based on an ethnographic study of the out-of-school knowledge of mathematics gained by children from low income families, was analyzed to identify features of a pedagogical model aimed at integrating out-of-school and school learning of mathematics. The analysis suggested that such a pedagogy must involve normative shifts that allow one to bridge out-of-school and school learning. These shifts are from oral to written mathematics, from knowledge about use of tools and artefacts to understanding, a shift towards building the identities of participants as members of a mathematical discourse community, a shift towards shared, public expression, and a shift to identities that are connected rather than separate. [A. Bose, K. Subramaniam]

Research on Science Teaching at the Middle School Level

A paper on the outcomes of inquiry teaching, as evident in students' reflective writing, was revised, with the addition of extensive data analysis and submitted for publication; it was under review during the period of this report. [J. Vijapurkar, A. Kawalkar]

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. We have initiated a project to analyze the classroom interactions, to trace in detail the development of successful pedagogy of particularly difficult but essential concepts in introductory science. [J. Vijapurkar, S. Patil, A. Sawant]

Questioning among middle school students

The main aim of this research project was to find out whether and how students in and outside of the classroom construct scientific methods of asking and answering their own questions. In other words we were asking, "How can students learn by doing investigations which are open-beginninged as well as open-ended?" We wondered whether students could learn science by defining their own questions, and even their own areas for investigation, with very little direction from a teacher. So far, our methods have included asking children and their families to list questions the children ask at home or while doing their daily work, letting students talk informally to each other in the classroom, playing certain games at school, and bringing students to a place or giving them some stuff which they may find curious. Preliminary results, from our work with Class VII-VIII students from government village schools in District Ludhiana, indicated that (1) without asking children to ask questions, an authentic context may give rise to authentic questions; (2) asking children to ask questions without providing any context may result in fewer questions; (3) students ask lots of questions upon being asked to ask questions if they have first had some time to

observe and handle some stuff.

In a related study with a group of Class VII students from a government-aided school in Mumbai, we investigated whether the students spontaneously did science or exhibited scientific temper, or how they would react when they observed a plant (*Talipariti tiliaceum*) which has not only green leaves, but also variegated and white leaves. Although the students did not raise the question as to how a white leaf could survive without chlorophyll, they did ask related questions, even without being asked to observe or ask questions. However, we found that the students also tended to hide or devalue their scientific experimentation, since they seemed to be afraid that it was not an acceptable behaviour. [G. Singh, K. Patil, K. K. Mishra, K. Haydock]

Farmers as investigators

This research is centered around the sources, construction and transmission of knowledge among farmers. Agriculture, considered as one of the first innovative technologies invented by humans, has the potential of becoming an apt context in which students begin to practice science process skills like critically observing, analyzing, questioning, hypothesizing, experimenting, testing, etc. However, agriculture is still taught in largely informal contexts and a hypothesis is that this could be one of the reasons why students in general tend to see scientists, farmers and innovators as separate categories, not having much in common. The research project is an attempt to explore this gap between formal and informal education in the context of agriculture. Case studies of 7 farmers are being constructed through semi-structured interviews. Analysis of school textbooks to understand how farmers' knowledge is included in them is initiated. [R. Varkey, G. Nagarjuna]

We studied an agricultural family from Rudrawale, District Raigad, Maharashtra to learn more about whether or how cultivators “do science”, make decisions, and learn. We observed, interviewed, photographed, videotaped and transcribed records, and collected information about the processes related to watermelon cultivation during the rabi season. Besides research data, the study provided material for children’s books on the topic, which are being written. Some songs related to the process were videotaped, and photographs of cultural items were taken for use in the books and in teaching children and teachers. [K. Sangala, A. Sawant, K. Haydock]

Income Tax, Argumentation, and Contradictions

We analyzed how students learned and changed their beliefs when they confronted contradictions which arose when they explored an interdisciplinary problem involving income tax and proportional thinking. This was done through a micro-analysis of the conversations which students had with each other when they were asked to decide which of three methods of collecting income tax was the most fair. The results indicated that the students’ beliefs on income tax collection was affected by their points of view, ideologies, and beliefs related to ethics and equality. We found three major types of argumentation they used: analogical reasoning, arguments based on observations, and deductive arguments based on a general world view, or on a moral or social value. We also observed that the students asked more questions than expected during their conversation. We categorized and analyzed the types of questions, and we found that rhetorical questions and implicit, dialogic questions to themselves were of particular significance. The analysis was used to understand the role of teaching in changing students’ beliefs. [K. Haydock, R. Shaikh, S. Shome]

Concept Mapping for Assessment

A collaborative program with Atomic Energy Central School and Junior College was conducted to study the effectiveness of concept mapping for large scale assessment at secondary (class IX) & higher secondary (class XI) levels. Two types of assessment techniques of concept mapping – open ended, & fill-in-the-concepts – were used. Chapters on “Diversity of living organisms” (Class IX) and on “Morphology of flowering plants” (Class XI) were considered. The researcher developed resource material in form of concept maps for both the chapters, which were content-validated by the teachers. Concept-mapping based assessment tools were developed in collaboration with the teachers. The concept maps developed on the related topics for class IX and class XI are available on the website: http://gnowledge.org/~meena/Concept-Map-Assessment/ [M. Kharatmal, G. Nagarjuna]

Model Based Reasoning in Biology

The data from the Collaborative Undergraduate Biology Education (CUBE) programme, is being analyzed to identify undergraduate biology students' use of model based reasoning practices in open-ended research projects. The CUBE's research-driven learning environments help us understand, facilitate and construct descriptive accounts of the production of scientific knowledge in an undergraduate research laboratory setting. Data over 2 years is being used in compiling case studies on the progress of ideas in researching model systems, aimed at understanding how research settings and associated practices lead to learning. [S. Ghumre, G. Nagarjuna, M. C. Arunan]

Participatory Action Research Project

As a part of HBCSE's School Science Research and Development program (SSRD), a long term Participatory Action Research (PAR) project has been initiated in collaboration with Nutan Vidya Mandir (NVM), a government-aided school neighbouring the HBCSE campus. The project seeks to understand and address existing challenges in science teaching and learning through day to day participation, reflection and collaborative action between researchers from HBCSE and teachers from NVM. Ground work for the project started in November 2014, with observations of environmental studies lessons of Grades 2 and 3, followed by documentation and teaching by HBCSE researchers, and reflections on both by all participants. [J. Ramadas, S. Chunawala, N.D. Deshmukh, V.C. Sonawane, M. Kharatmal, P. Nawale, K.T. Hambir, S. Bhide, R. Shaikh, S. Ayare, V. Pawar, S. Chopde, P. Gedam]

Language in Science Education

A multi-country international collaborative project is ongoing, titled 'A multidisciplinary approach to language issues in science education in multilingual contexts'. In the initial stage of the project, survey questionnaires were developed and administered in schools in South Africa. [J. Vijapurkar (HBCSE), A. Msimanga at University of Witwatersrand (Principal Investigator) and others]

III. Policy and Curriculum Redesign

Development, the Environmental Crisis, and Science Education

The objective of this project was to find out how science teachers, textbook writers, and policy makers treat the topic of the environmental crisis. Three teachers of Class X in Indore were taken as case studies. Based on our analysis of interviews, classroom observations, and textbooks we found

that a number of different ideologies were reflected in the ways environmental problems were presented. While in many cases an Environmental Modernisation (or eco-capitalist) ideology was predominant, Gandhian, Appropriate Technology, and Eco-Marxist influences were also found. Interestingly, both the textbooks and the teachers had the misconception that food chains and energy pathways are cyclical – perhaps by analogy to geochemical cycles. Furthermore, they held a misconception that the environmental crisis is due to people's disruption of the 'Balance of Nature', even though ecologists no longer believe that a 'Balance of Nature' exists – especially if long enough time periods are considered. [H. Srivastava, K. Haydock]

Aims of Social Science Education

A research project on the aims of social science education was completed. Policy documents as well as reports in the literature were studied in order to find out what the stated aims of social science education are. NCERT textbooks from Class I to XII were analyzed in order to find out what the unstated aims of social science education may be. The stated and unstated aims were compared, and discussions on the topic were carried out with other educationists. Previous personal experience in illustrating and writing material for social science books was also analyzed. This research lead to the conclusion that (1) textbooks are biased and cannot and should not be unbiased; (2) some excerpts from the present NCERT textbooks indicate unstated aims of supporting conformation and integration into the present social system; (3) one unstated aim is that capitalism should remain un-understood and un-analyzed. A paper presenting the conclusions has been accepted for publication in the *Economic and Political Weekly*. [K. Haydock]

Socio-scientific Issues

A textbook analysis of chapters on Reproductive health in the higher secondary biology curriculum (Grade XII) was conducted from a critical feminist perspective. The study revealed that the textbook endorses the patriarchal, reductionist science that propagates technologies that pose risks to the woman's body. Interviews with three teachers who teach the textbook also reveal that they view the topic as value laden. A paper on this study has been accepted in the *Indian Journal of Gender Studies*. The textbook analysis is being carried out further, employing the framework of Biopower and biopolitics (originally proposed by Foucault in 1990). This work aims to understanding the kind of subjectivities these books define for students who are being prepared to be future citizens/scientists. The topics in focus are: health, population, life and what forms of life are socially valuable.

A study was conducted with 30 Indian doctoral students in their critical evaluation of a deterministic claim in a media article related to neurogenetics. Students' responses were categorized into those motivated by epistemic and ultimate values. Findings revealed that students exhibited varying levels of sophistication while critiquing foundational assumptions of the fallacious claim, with a few resorting to narrow, discipline-based frameworks. Students also harboured linear cause-effect models of genotype-phenotype relationship, drawing only from elementary disciplinary knowledge. Only few students critiqued these claims from social and ethical perspectives. A paper on this study has been accepted in *Science Education*. [A. Raveendran, S. Chunawala]

Inclusive Science Education amongst Visually Impaired Students

The work on inclusive education was extended further. A paper titled 'Attitudes of teachers towards inclusion' was presented at a two day National Seminar on 'Redefining teacher education curriculum for nation building', organized by the Council for Teacher Education (CTE), Karnataka State Centre, June 2014. The paper presented quantitative data collected from 97 teachers from 8 schools about their attitudes towards inclusive education. This paper received the Late Prof. S. R. Rohidekar Award for 'Best Research Paper' (Trophy and Citation).

Further work included in-depth semi-structured interviews with 6 teachers, 3 parents and 6 students, regarding their experiences, knowledge and perceptions about inclusive education. Transcriptions of the above interviews have been carried out and currently thematic analysis of the same is underway. Additionally, analysis of teaching-learning interactions with students in inclusive and regular settings is also being carried out. The latter involves using a variety of tools to draw diagrams and figures in science classes for students with visual challenges. [A. Sharma, S. Chunawala]

Curriculum and Material Development

E-Learning Portal and Educational Materials in Hindi

The e-learning portal in Hindi (http://ehindi.hbcse.tifr.res.in) was further enriched. The portal already has 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 Indian scientists. Edited and uploaded this year are presentations of experts at the 4th National Workshop on Development of Educational E-materials in Hindi, and presentations by faculty from HBCSE and outside. [K. K. Mishra, K. Sinha, S. Deoram, A. Sankhwar, R. Nichat]

The book, *Khanpan aur Rasayan*, was published by Vigyan Prasar, Department of Science and Technology. It is the first and unique book in Hindi which, though written as a popular book, is expected to serve as a handbook for students pursuing courses in Food and Nutrition Science or Home Science through the Hindi medium. The book deals with the chemistry of everyday foods such as cereals, pulses, edible oils, fruits & vegetables, spices, milk and milk products, food additives, etc. [K. K. Mishra]

Gyan-Vigyan - Shaikshik Nibandh, a co-curricular book was published by HBCSE in 2014. It has 16 selected essays based on the pedagogic presentations of the participating experts of the 3rd National Workshop on Development of Educational e-materials in Hindi organized by HBCSE under the auspices of Vigyan Parishad Prayag. This is the third volume in the series, of which the second volume was published in the previous year. [K. K. Mishra, V. Singh, S. Chandrakar, K. Sinha, S. Deoram]

Middle School Inquiry Science Curriculum

Transcripts of video records of classes conducted for curriculum development continued to facilitate the writing of curricular material. Additional experiments on topics such as sense organs were developed and tested. Writing up of the curricular material continued. [J. Vijapurkar, O. J. Harish, S. Patil, A. Sawant]

Marathi Vishwakosh

HBCSE continued to collaborate with the ‘Maharashtra Rajya Vishwakosh Nirmiti Mandal’ to produce the *Kumar Vishwakosh*, a junior encyclopedia series on science in the Marathi language. The encyclopedia is designed to be used as reference material by teachers and students at the secondary and higher secondary school levels. A web version is also available at www.kumarvishwakosh.maharashtra.gov.in

The *Kumar Vishwakosh* webpages have received 12,19,581 hits as of May 2015. The print version of Volume 1 of the 'Biology and Environment' series is already sold out (4000 copies). The print and web versions of Volume 2 were released last year. Volume 3 of the series is currently under preparation. [V. D. Lale, N. D. Deshmukh, K. Pednekar-Hadkar, A. Ajgaonkar, H. C. Pradhan]

Graduate Courses

Graduate courses for the Ph.D. program in science education were restructured for better alignment with the course structure followed in teacher education. Accordingly, two new courses were designed and taught to first year Ph.D. students 'Philosophy of education' and 'School teaching experience'. [K. Subramaniam, G. Nagarjuna, S. Naik, T. Khan]

MathEdu Website

The mathematics education website was redesigned and launched (mathedu.hbcse.tifr.res.in). A number of resources are now available on the website for mathematics teachers and mathematics education researchers. [K. Subramaniam, M. Nair, S. Naik, T. Khan]

“Gnowledge” Laboratory

Online Platform for Mapping Trees

As a part of the metaStudio initiative a collaborative online platform was built and launched for mapping trees across India. The core objective of such a platform is to sensitize and involve citizens, including students and teachers, in doing science; to enhance the participatory base of science; to inculcate a culture of recording, reporting and conducting research and to develop critical scientific literacy among citizens. Pilot roadshows were organized to test the platform in K. J. Somaiya College in collaboration with its Center for Experiential Learning. The project is partially funded by Marc Shuttleworth Flash Grant awarded to Nagarjuna G.. The platform is available for citizen participation at http://trees.metaStudio.org/. [G. Nagarjuna, J. Chetty, M. C. Arunan, R. Shaikh]

Micro-Weather Stations for Open and Citizen Science Initiatives

To supplement the tree mapping project, the lab is working with micro-weather stations using inexpensive microprocessor boards, such as Ardiuno (http://www.arduino.cc/) and expEyes (http://expeyes.in/). A prototype of a weather station for measuring the air quality is fabricated in collaboration with ManyLabs (http://manylabs.org). The device is polling air quality of the newly built studio at https://www.manylabs.org/tool/dataLab/?dataSet=521. International collaborations to promote Open Science have been established through visits of Mr. Puneet Kishor of Science Commons, USA, and Jenny Moiler of Open Knowledge Initiative, UK. [G. Nagarjuna, P. Kishor of Creative Commons, P. Sand of Manylabs.org, San Fransisco, USA]

Creation of a Studio Learning Environment

The green room of the V. G. Kulkarni Auditorium has been transformed into a learning studio with facilities to develop activities around software, hardware and wetware. These include maintaining simple model systems, designing and fabricating inexpensive laboratory techniques and equipment, arduino based datalogging for laboratory data collection, workshops for school and college students and building a network of students and teachers through online fora. [G. Nagarjuna, M. C. Arunan, R. Thengodkar, A. Zakaria, S. Shende, U. Shah]

Collaborative Undergraduate Biology Education (CUBE)

CUBE has been a sustained activity in Mumbai and Delhi, also spreading to other cities. The online forum has around 600 members who record, report and discuss various experimental research projects performed by students in their college labs and often in their homes. Inexpensive model systems like snails, earthworms, daphnia, fruit fly, crows, zebra fish, microworms, trees, have provided entry points for questions that lead to advanced areas of biology, ranging from plasticity studies, learning and memory, to cancer studies and evolution. An online mailing list facilitates authentic research and communication, to report ideas, experiments and feedback. Archives of these communications are at http://gnowledge.org/pipermail/cube/. The number of communications averaged 609/month in 2014. Undergraduate students' participation in science research is being sustained with minimal catalytic inputs by educationists and scientists. [M. C. Arunan, G. Nagarjuna, S. Ghumre, Aisha, R. Shaikh, and UG students from across the country]

Software Development

New features and deployments on the flagship online platform GNOWSYS-Studio are: curation of open educational resources using schema.org, an open standard for web resources, clearing house and curation workflows for contributions from the community, filtering and review resources, search logic based on MapReduce algorithm, an MIS module for enrollment of students, teachers, colleges, fellows, attendance and performance monitoring for online learning, hierarchical theme and topic maps linked to open educational resources in the eLibrary, responsive CSS using Foundation5 framework, online translation of resources and multilingual support, forum, rating of users with a customized rubric, user and group dashboard, and multiple collaboration groups with task scheduling. The software contributions by the team are regularly published at https://github.com/gnowledge/gstudio with over 6592 commits, 28 contributors, 113000 lines of code in Python, JavaScript and HTML. The online sites deployed using GNOWSYS-Studio include http://www.metaStudio.org/, http://nroer.gov.in/, http://studio.tiss.edu/ and the updated http://nroer.metaStudio.org/. [G. Nagarjuna, G. Anuja, S. Sawant, A. Nachankar, S. Chaudhari, K. Aitawdekar, R. Katkam, M. Pandey, A. Ganesh and student interns]

Accessibility for Deaf Blind (DB)

The term deafblind (DB) indicates a combination of deafness and visual challenges. Our focus is on pedagogy, including ways to enhance communication capabilities of people affected by deafblindness. In collaboration with Dr Arun Mehta (of http://bapsi.org/), a number of phone/tablet apps have been built around the vibration function which is present in all modern devices. This work has been done in partnership, including site visits, with the Helen Keller Institute for the Deaf and Deafblind (HKI) in Mumbai, led by the NGO Bapsi. HBCSE provides necessary technology

counselling service, to enable the wider take-up of digital technologies for communication and learning. Apps developed by Arun Mehta with field trials at HKI in collaboration with gnowledge lab: **Naarangi**, a slate for the DB, Showitem Picture Based Communication for the Non-Verbal, **dbtype**, Communication for the Deaf Mute with Low Vision, **Akhtar**, a communication App for DeafMute, **TellmyPhone**, English and Hindi speech recognition for the deaf and low vision. These apps are available for download from the Android Store. [V. Crishna, A. Mehta, G. Nagarjuna, K. Haydock and student interns]

Massive Open Online Courses (MOOCs)

An online course on Digital Literacy DL101 developed last year was delivered using OpenEdX platform (http://courses.metaStudio.org/) for the National University Students Skills Development (NUSSD) program. In collaboration with TISS the course is currently being delivered to over 7000 students across four states 11 universities and 33 colleges. The course is planned with the design principles of construction, collaboration, sharing and community involvement. Since the course itself will be implemented with National Service Scheme (NSS) volunteers, we found it imperative that the guiding principles of NSS should also find reflection in the course structure. The objectives of the NSS programme are strongly connected to the community around the participating students. The seven modules of the course were field tested at Talasari, including training master trainers, recording and producing 11 videos in collaboration with Comet Media, conducting Training of Trainers (TOT) workshops of all the teachers across 5 states. The course is also published as a book along with session design and self assessment cards. [G. Nagarjuna, A. Dhakulkar, H. Pakrashi, A. Ganesh, C. Mukherjee]

A course on OER101 'Teach Smarter with Open Educational Resources' is hosted and delivered in coordination with CIET of NCERT, IGNOU and ITforChange on the lab's OpenEdX platform http://courses.metaStudio.org/ starting September 5, 2014 for four weeks. Analytics of the course have been generated. The course is archived and made available online. A total of 1133 teachers from all over India registered for the course, of whom 300 participated in all the four weeks, 140 passed the course against lenient criteria and only 85 passed it under strict criteria. Being one of the first online courses targeting school teachers, this gave us experience of using online courses in Teacher Professional Development. More such courses for TPD are being developed in collaboration with NCERT. [G. Nagarjuna, J. Chetty in collaboration with CIET team]

Consultations, Collaborations and Support to External Institutions

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

HBCSE members continued to contribute to the working group on science at Balabharti. In 2014-15, Balbharati produced textbooks on environmental studies for Classes III & IV. The textbook integrates natural science, geography and social science and is being translated into eight different languages. The textbooks are distributed to students of Classes III & IV in the state of Maharashtra. Since June 2014, the committee has worked to produce a textbook on environmental studies for Class V. The final draft of this book was ready in March 2015. The book will be implemented in schools from June 2015. [V. D. Lale, J. Ramadas]

Nashik Education Society

The Nashik Education Society has motivated their teachers to conduct action research projects in the schools for which two HBCSE members are consultants. About 75 teachers were selected to conduct action research in different subjects, of whom 45 presented their work in a one day seminar at Nashik. A second set of proposals were screened in June 2014 and the teachers were mentored through their projects. [V. D. Lale, N. D. Deshmukh]

Maharashtra Knowledge Corporation Ltd., Pune

HBCSE members are members of the content committee for '*Shikshan Pandhari*' project in Pandharpur, District Solapur. The project is sponsored by the Rajiv Gandhi Science and Technology Commission (RGSTC), Mumbai and Maharashtra Knowledge Corporation Limited (MKCL), Pune. This project is aimed at developing open educational content in science and mathematics in Marathi for students at the secondary school level. [H. C. Pradhan, V. D. Lale]

YCMOU Post Graduate Research Programme

HBCSE is the study centre for Yashwantrao Chavan Maharashtra Open University (YCMOU), Nashik, Post Graduation Research Programme (PGRP) in Mumbai. The YCMOU offers post graduation courses in Subject Communication and Education Communication in a distance mode. This year, the M.A., M.Sc. and M.Com. courses on Subject Communication and Education Communication have been converted to two year courses as compared to the earlier one year programme. There are 73 students enrolled this year and 7 interactive workshops have been conducted for these students. Besides organizing these workshops and counseling the students on various subjects, HBCSE is involved in assessing student assignments and providing help to students in formulating their research problems and in developing their research projects. Admission forms for 2nd year PG courses were distributed in January 2015. [S. Chunawala-Coordinator, N.D. Deshmukh, D. Prabhu, P. Sharma, D. Gupta]

Teacher Education Institutions

A HBCSE member was a member of the National Council for Teacher Education (NCTE), the apex regulatory authority for teacher education, and contributed to the formulation of revised national norms and standards for teacher education. Through participation in its sub-committees, contributions were made to developing national level guidelines for the Teacher Eligibility Test (TET) and model curricula for the newly introduced 2 year B.Ed. programme. Members also participated in the development of the curriculum for the new integrated B.A.-B.Ed. programme at TISS, and the revised B.Ed. curriculum of SCERT, Chhattisgarh. Members also taught courses in the M.A. Education programme of TISS at the Mumbai and Hyderabad campuses. [K. Subramaniam, A. Bose, S. Takker, S. Naik]

AEES-HBCSE Junior Mathematics and Science Olympiad – 2014

The Atomic Energy Educational Society (AEES) and HBCSE continue to collaborate in several areas. The Fifteenth Junior Mathematics and Science Olympiads was conducted at HBCSE and AECS school 1 between 6-15 May, 2014, which is the first stepping stone for the National Olympiads. These draw high performing students of the Atomic Energy Schools from all over the country. HBCSE was involved in conducting several curricular (enrichment and laboratory) and co-

curricular sessions. [C. Natarajan, R. Vartak, A. Ronad, S. Pathare, P. Pathak, V. Ghanekar, S. Narvekar, I. Das (Sen), V. C. Sonawane, S. Dutta, A. Jamkhandi, D. Prabhu, P. Sharma, D. Mhatre, V. Yogaraj, S. Rajshekhar, T. Khan, H. Mishra, J. Rahaman and the academic unit of AEES]

Kishore Vaigyanik Protsahan Yojana

KVPY is a prestigious scholarship scheme for meritorious students at the Higher Secondary School and College level instituted by the Govt. of India. The Centre oversaw the conduct of the Aptitude Test and HBCSE cell members participated in the development of assessment resources, and as members of the interview committee. [V. Singh (Convenor, Physics), P. Pathak, A. Mazumdar, R. Vartak]

Nationwide Education and Scholarship Test (NEST)

HBCSE faculty has participated in NEST giving it structure and shape since its inception. Like the previous years, they were part of the academic committee [A. Sule, P. De, V. Singh]

Special session on education at the Indian Science Congress

A special session was organized on "Challenges for Education in Modern India" during the 102nd Indian Science Congress, on January 6, 2015, University of Mumbai [A. Sule (Coordinator)]

Olympiads And Related Activities

Out of the 30 student team members who represented India in the International Olympiads in Astronomy, Biology, Chemistry, Junior Science, Physics and Mathematics, 28 bagged medals and these included 9 coveted gold medals. Like the sports Olympics, nations are not officially ranked in the Olympiads. However, based on aggregate scores, India is generally among the top ten nations in the Physics, Chemistry, Biology, Astronomy and Junior Science Olympiads. Over 200 of the best students from across the nation were given experimental and theoretical training.

By designing conceptual and challenging problems, developing novel experiments, actively participating in book writing for Olympiads, national and state bodies, participating in assessment committees [KVPY (DST), NEST (DAE), NTSE (NCERT), etc.] among others, the cell members of the Olympiad programme have provided a benchmark for quality education at the Higher Secondary and Undergraduate level in the country. They have contributed research articles in peer reviewed technical journals. More than three hundred teachers attended resource generation and exposure camps, some from Bangladesh, Sri Lanka, and Nepal. Thus, by organizing teacher and scientist Resource Generation and Exposure Camps and further by providing meaningful 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 at HBCSE in all the six subjects (Mathematics, Astronomy, Biology, Chemistry, Junior Science and Physics) has now been standardized. Briefly, for science and astronomy Olympiads, it consists of: two theory tests conducted all over the country with the assistance of the Indian Association of Physics Teacher (IAPT), Association of Chemistry Teachers (ACT) and Association of Teachers in Biological Sciences (ATBS). This year, the National Standard *Examinations* (NSEs) were conducted in 1383 centres all over the country – an increase of nearly 500 centres (about 55%) since last few years.

The NSEs had mainly objective type questions; the second test conducted at 16 centres and by HBCSE, has subjective problems, and is of high difficulty level comparable to the international Olympiads. This constitutes the Indian National (Astronomy/ Biology / Chemistry/ Junior Science/ Physics) Olympiad Examinations (INAO, INBO, INChO, INJSO and INPhO respectively).While the participation in the first test runs into tens of thousands (the enrollment in the year 2014-15, was about 11500 in Astronomy, 15000 in Biology, 34000 in Chemistry, 47000 in Junior Science, and 38000 in Physics), the second test sees the participation of the top 300 students in each subject except Mathematics which has 850 students. We also note that in Mathematics the first stage is organized regionally and the second stage is organized by HBCSE and both stages have subjective questions. In the next phase of selection, about forty students in each subject are selected from the Indian National Olympiad examinations and are invited for orientation-cum-selection camps held at HBCSE. Students appear for several theoretical and experimental tests, leading to the selection of Indian Teams for the final international Olympiads. The selected teams for International Olympiads again go through two weeks of pre-departure training at HBCSE.

[V. Singh, National Coordinator- Science Olympiads: Biology, Chemistry, Junior Science and Physics (till July 31, 2014), A. Mazumdar, National Coordinator- Science Olympiads: Biology, Chemistry, Junior Science and Physics (from August 1, 2014 till date), M. N. Vahia (TIFR), National Coordinator, Astronomy Olympiad; R. Vartak, A. Ronad, V. Ghanekar (Biology); S. Ladage, S. Narvekar, I. Das (Sen) (Chemistry); P. K. Joshi, P. Nawale (Junior Science); V. Singh (upto January 2015), A. Mazumdar, S. Pathare, P. Pathak (Physics); A. Sule, A. Mazumdar, A. Ghaisas, P. Ranadive (Astronomy and Astrophysics); B. J. Venkatachala, P. De (Mathematics)]

A large number of teachers and scientists from across the nation were involved in this effort. A proactive attempt was made to invite faculty from Jammu & Kashmir, Uttarakhand and North-eastern states. A number of faculty members from other countries such as Nepal, Bangladesh and Sri Lanka participated in the Astronomy and Astrophysics as well as the Physics Olympiad Exposure camps.

Orientation – Cum – Selection Camps (OCSC) and International Olympiads

Astronomy

The Astronomy Olympiad Cell conducted Orientation Camp during May 1 – 6, 2014 and Selection Camp during May 27 – June 7, 2014 and pre-departure Training for the Indian team in July 2014. A total of 24 students attended OCSC. 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. The five member team was selected at the end of the camp to represent India at the International Astronomy and Astrophysics Olympiad held at Suceava, Romania in August 2014.

The five member team at the 8th International Astronomy and Astrophysics Olympiad held at Suceava, Romania in August, 2014 won four silver and one gold medal. [A. Sule (HBCSE) and A.

N. Ramprakash (IUCAA, Pune) were the team leaders and Harvinder Kaur Jassal was the Scientific Observer and V. P. Raul (HBCSE) was the Observer]

Biology

The Biology Olympiad Cell conducted OCSC during June 4 – 12, 2014 and the pre-departure Training for the Indian Team in June-July 2014. 32 students attended the OCSC. Problem solving sessions in Cell Biology, Plant Sciences, Animal Sciences, Genetics & Evolution, Ecology and Ethology were conducted. The students were given two theoretical tests and four experimental tests during the camp. Lab orientations and tests in the four lab areas namely Plant Anatomy & Physiology, Animal Physiology & Systematics, Cell Biology & Molecular Biology and Ecology & Ethology were conducted during this camp. The following experiments were standardized and given as tasks in the various lab selection tests and during the lab orientation sessions:

- Study of plant tissues by staining with different stains, Study of brown leaf pigments, Physiology of *Setcreasea pallida* leaf, Comparative study of plant tissues, Analysis of leaf pigments.
- Transport of biomolecules across a dialysis membrane, Classification using a dichotomous key, Study of glucose transport across mammalian membrane, Characterization and study of animals.
- Nucleic acid extraction from plant material, Preparation of blood smear and identification of various cells, Nucleic acid extraction and visualization from animal tissue, Observation of tissue by smear method and analysis of some clinical conditions.
- Pond ecology which involved the study of water samples from two sources, the estimation of phosphate content in both samples and interpretation of the findings, Study of the behavior of *Chironomus* larvae, Study of mate choice behavior in guppies.

On the basis of camp performance, a team of 4 students was selected. The team underwent pre-departure training camp at HBCSE in July 2014. The 4 member Indian Biology team at the 25th International Biology Olympiad held at Bali, Indonesia, from 5-13 July 2014. The team won four silver medals. [R. Vartak (HBCSE) and P. G. Kale (R. Jhunjhunwala College, Mumbai) were the team Leaders and Dharmendra Shah (Maharaja Sayajirao University of Baroda) and Anindya Sinha (NIAS, IISc. Campus, Bangalore) were the Scientific Observers]

Chemistry

The Chemistry Olympiad cell conducted OCSC during May 27 – June 12, 2014 and the PDT for the Indian Team in July 2014. 31 students attended the OCSC. The theoretical sessions at OCSC 2014 were related to chemical thermodynamics, heterocylic chemistry, chemical kinetics, spectroscopy, ionic and solubility equilibrium. The theoretical examinations at the camp were related to various carbon containing fuels and thermodynamics, age of an ancient civilization by 14C dating, functional group transformations and natural products, aromaticity and properties of aromatic compounds, Nitrogen hetero cycle, dynamics of chemical reactions, solubility equilibrium of magnesium compounds, particle in a box and chemistry of fluorine. The experiments that were developed and standardized for experimental examinations at OCSC 2014 covered the following

areas:

- Analysis of carbonate and phosphate content of a given sample,
- Synthesis of copper glycinate and estimation of its copper content,
- Synthesis of an imine and its reduction using sodium borohydride, and
- synthesis of a chalcone
- Identification of unknown metal by estimation of its oxide by complexometric titration and
- Estimation of Fe (II) and Fe(III) ions in the given mixture by redox and complex metric titrations.

On the basis of camp performance, a team of 4 students was selected. The team underwent pre-departure training camp at HBCSE in July 2014. The 4 member Indian Chemistry team at the 46th International Chemistry Olympiad held at Hanoi, Vietnam in July 2014 won two silver medals and two Bronze medals. [P. A. Sathe (Ramnarain Ruia College, Mumbai) and Prodeep Phukan (Gauhati University, Guwahati) were the team Leaders and M. Swaminathan (Annamalai University, Tamilnadu) and I. Das (Sen) (HBCSE) were the Scientific Observers]

Junior Science

The Junior Science cell conducted OCSC during May 7 – 26, 2014 and the PDT for the Indian Team was held from November 20 – November 30, 2014. 34 students attended the OCSC. The camp consisted of around 30 lectures and 22 experimental sessions. It also included 4 theory exams. Lectures were taken on advanced topics in Biology, Chemistry and Physics at the Class X level. Problems of high standards where set for theoretical and practical exams.

On the basis of camp performance, a team of 6 students was selected. The team underwent pre-departure training camp at HBCSE in December 2014. The 6 member Indian Junior Science team at the 11th International Junior Science Olympiad held at Mendoza, Argentina in December 2014 won six golds. Jogeswar S Purohit (Smt. C. H. M. College, Ulhasnagar), Prodeep Dasgupta, Sujata Haralkar (Siddharth College, Mumbai) were the team leaders and P. K. Joshi (HBCSE) was Scientific Observer]

Physics

The Physics Olympiad cell conducted OCSC during April 10 - 21, 2014 and the pre-departure Training for the Indian Team in July 2014. 28 students attended the OCSC. Lectures were taken on advanced topics such as Special Relativity and Quantum Physics. Theoretical problems in the test were of high standard and included topics such as the Central force, Landau theory of phase transition, Bohr model and Weizsaker's optical fiber. A theoretical problem related to the semi empirical mass formula was set. This problem was selected for the Indian Physics Association award for theory. A set of four experiments were designed and developed. These experiments were:

- Mechanical Black Box: A closed rectangular box of square cross section with two co-axial cylindrical cavities was provided. With the data provided, using non-destructive procedure the students were supposed to find the dimensions of the cavities.

- Refractive Index of two prisms of different material using a laser pointer.
- Inductance of a coil with ferromagnetic core: The students were given two coils and studied the dependence of inductance of the coil with ferrite core for alternating current and the mutual inductance between the two coils for different values of DC current.
- Liquid drops formed under horizontal surfaces: In this experiment students were given rods of same material but different diameters. Each rod was wetted with given liquid falling from the burette and drops were formed at its base. The students had to study the relation between the diameters of the drops and the different parameters responsible for the drop formation.

On the basis of camp performance, a team of 5 students was selected. The team underwent pre-departure training camp at HBCSE in July 2014. The 5 member Indian Physics team at the 45th International Physics Olympiad held at Astana, Kazakhstan in July 2014 won two gold and three silver medals. [P. Pathak (HBCSE) and C. K. Desai (Pune), were the team Leaders and V. Singh, A. Mazumdar and R. Khaparde (all from HBCSE), were the Scientific Observers]

Forty sixth International Physics Olympiad (IPhO) 2015 in India

India will host the 46th International Physics Olympiad (IPhO) in Mumbai from July 5-12, 2015. HBCSE is the organizer of this event which will involve about 400 high school student contestants and 300 teacher mentors from 86 countries from around the globe. Preparations for IPhO on both academic and organizational aspects began in early 2014.

Nearly 100 teachers and researchers from all over India participated in several preparatory workshops at HBCSE during March 4-5, 13-15 and April 4-6, 23-25, 2014. Smaller meetings were held in Chennai, Bengaluru and Delhi. A 15-member Academic Committee worked round the year on selecting and developing theoretical and experimental tasks for the competition. Four full-fledged meetings and multiple smaller meetings of the committee members and other faculty from across the country have been held in Mumbai and elsewhere.

Design and development of the experimental component was carried out in HBCSE laboratories. Several different proposals of the experimental task were shortlisted and exhaustive design and development of prototypes were undertaken. Based on this exercise, the experimental component was finalized by the Academic Committee. More than 400 copies of the apparatus for the selected experimental problem are being assembled, checked and calibrated at HBCSE with the help of nearly 50 teachers and researchers from across the country.

A large number of theoretical problems were developed based on the ideas proposed in the resource generation camps. Subsequently a selection of the tasks of the theoretical component was made and several short workshops involving the academic committee and about 15 resource persons were held to finalize the problems.

On the organizational front, HBCSE staff have carried on an intensive effort to prepare for different aspects of IPhO including accommodation, catering and transport arrangements during 9 days of the event, covering academic programme of the competition, as well as excursions and ceremonies.

[Numerous faculty, scientific and administrative staff are contributing to the academic and organizational aspects of the event.]

Mathematics

The Mathematics Cell conducted IMOTC during April 21 to May 19, 2014 and pre-departure Training for the Indian team during June 26 to July 14, 2014. A total of 37 students attended IMOTC. The six member team was selected at the end of the camp to represent India at the International Mathematical Olympiad.

The six member team at the 55th International Mathematical Olympiad held at Cape Town, South Africa in July, 2014 won one silver medal and three Bronze medals and two Honourable mentions. [B. J. Venkatachala (HBCSE) and K. Barve (Central Water and Power Research Station) were the leaders. P. De (HBCSE) and. V. M. Sholapurkar (S. P. College, Pune) were the Scientific Observers]

Resource Generation Camps (RGC)

Several Resource Generation Camps in Biology, Chemistry, and Junior Science were held, in which teachers and scientists from across the nation gathered for development of Olympiad resource material, both theoretical and experimental.

There was one Resource Generation Camp for Chemistry during September 24-27, 2014, for 11 participants. For Biology, there were 5 Resource Camps: September 11-12, 2014 for 5 participants on Cell and Molecular Biology; September 17, 2014 for 5 participants on Plant Sciences; October 16-17, 2014 for 4 participants on Genetics & Evolution; November 13-14, 2014 for 5 participants on Animal Sciences; and November 27-28, 2014 for 5 participants on Ecology and Ethology. There were six Resource Generation Camps for Junior Science: on April 26, 2014 for 13 participants; on August 24, 2014 for 19 participants; between September 27-28, 2014 for 33 participants; on November 16, 2014 for 36 participants; between March 7-8, 2014 for 34 participants and between March 14-15, 2014 for 39 participants.

Olympiad Exposure Camps

Several shorter 3-4 day exposure camps were held where a large number of school and college teachers were invited. 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 exposure camp was held between November 10-13, 2014 for 83 participants. The Biology exposure camp was held between October 14-16, 2014 for 37 participants. The Chemistry exposure camp was held between November 13-15, 2014 for 33 participants. Lastly, the Physics exposure camp was held between November 26-28, 2014 for 35 participants.

Other Workshops

Apart from the above mentioned camps, there were several other workshops, camps and sessions that were organized over the last one year, namely, two workshops for Master Trainers in Chemistry were organized by Royal Society of Chemistry (RSC-HBCSE) from September 29 to October 3, 2014 and from November 23 to 29, 2014; nurture camp organized for NTS Awardees, in November, 2014. About 60 students from all over Maharashtra attended the program consisting of motivational lectures and laboratory sessions. The programs were funded by NCERT.

Further, nurture camp was organized for Homi Bhabha Young Scientist Awardees on April 16-17, 2014 for class VI students and April 22-23, 2014 for class IX students. The program included lectures by members of HBCSE and experimental sessions which included demonstrations and hands-on experiments. Teacher training program for Mumbai Science Teachers Association was held on 12-13 June, 2014 at HBCSE. Three other teacher training programs were held at New Delhi on 29 October-1 November, 2014, December 23- 24 2014 at HBCSE for the Atomic Energy school teachers, and from January 12-16, 2015 at Goa Science Centre for the teachers of Goa.

The Olympiad effort was also supported by the Department of Science and Technology, the Ministry of Human Resource Development and the Department of Space.

National Initiative on Undergraduate Science (NIUS)

The National Initiative on Undergraduate Science programme (NIUS) of HBCSE (initiated in 2004) primarily aims at promoting undergraduate research and has been contributing towards R&D in laboratory training and training of students and teachers in experimental science, development of theoretical and laboratory courses and preparation of pedagogical material. Till date, about 1140 undergraduate students have been exposed to the NIUS programme (under the aegis of exposure-cum-enrichment camps). The administrative responsibilities of the programme involve co-ordination with scientists and students, organization of nurture camps, purchase of instruments/equipments, etc. Supporting college teachers to set up modest research programs at their own institutions is yet another important facet of the NIUS programme which further helps in mentoring undergraduate students at local levels.

This year about 210 undergraduate students were invited to attend the NIUS exposure-cum-enrichment camps. A fair fraction of the students were from non-metropolitan colleges. In these camps, leading scientists and researchers interacted with students and delivered lectures on diverse interdisciplinary topics. Some of the project work carried out by NIUS students were of high standards and were published in international journals.

Physics

The NIUS camp for physics (XI.1) was conducted at HBCSE from June 10-20, 2014 and had participation of 77 first year undergraduate students. These students were from three streams i) regular B.Sc.; ii) integrated M.Sc. and iii) B.Tech./B. E. The areas covered at the camp were solitons and waves, introduction to quantum mechanics, relativity, stellar structure, evolution and stellar oscillations, interferometry and solar radio astronomy, overview of particle physics, introduction to experimental physics, introduction to nanostructures, polarization of light, cosmology, neutron stars, quantum foundation and quantum information.

The speakers for the camp were A. Kumar (IIT, Delhi), A. Mody (Nashik), D. Oberoi (NCRA, Pune), K. Srinivasan (S.N. Bose Centre, Kolkata), N. Kanekar (NCRA, Pune), P. K. Panigrahi (IISER, Kolkata), S. Konar (NCRA, Pune), S. Raychoudhuri (TIFR, Mumbai) and T. Roy Choudhury (NCRA, Pune). After the project discussions and evaluation sessions at the camp, 31 students were selected for projects to be carried out at different institutions. In addition, 21 students from X.1 batch continued their projects at HBCSE in June and December. [HBCSE resource

persons included A. Mazumdar, A. Kumar, D. P. Roy, P. Pathak, R. B. Khaparde, S. M. Roy, V. Singh]

With the organizational responsibilities of the forthcoming Forty sixth International Physics Olympiad to be held in Mumbai in July 2015, the first camp for batch XII of NIUS (Physics) was advanced by six months. Thus, the camp (XII.1) was held at HBCSE from December 16 - 24, 2014 and 46 first year undergraduate students participated in the camp.

The speakers for this camp were B. Nath (RRI, Bengaluru), B. Paul (RRI, Bengaluru), D. Banerjee (IIA, Bengaluru), P. Panigrahi (IISER, Kolkata) and S. Jain (BARC, Mumbai). [HBCSE resource persons included A. Mazumdar, A. Kumar, D. P. Roy, P. Pathak, S. M. Roy, V. Singh]

The short courses at the camp were related to astrophysics, cosmology, nanophysics, particle physics and quantum computing. Towards the end of the camp, 20 students were selected and allocated projects with mentors in different research institutes.

This year, under the project entitled as *Development of Instruments and Experimental setups for the Undergraduate Physics Teaching Laboratories*, complete experimental setups and laboratory instruments related to polarization of light, Maxwell's wheel, rolling motion, velocity measurement (system using laser photogates), regulated DC power supply for laser modules with USB power output, etc. were designed and developed at HBCSE. User manuals related to these experimental setups have also been completed. Soon this material will be uploaded on the HBCSE website for wider dissemination to teachers and students. Several NIUS students have been involved with this project and have contributed significantly towards the developmental work. [R. Khaparde]

Chemistry

The NIUS camp for chemistry (X1.1) was held at HBCSE from December 23-31, 2014 and 54 students from regular B.Sc./BS or integrated M.Sc. courses participated in the camp. The theoretical sessions at the camp were related to quantum chemistry, organic synthesis and mechanisms of organic reactions, catalysis, overview of surfactant science, solid state chemistry, overview of research areas in inorganic chemistry, bio-inorganic chemistry and computational chemistry, chemical thermodynamics and spectroscopic techniques for structural elucidation. The camp also conducted workshops related to a) use of Process oriented Guided Inquiry Learning (POGIL) instructional material to understand concepts related to redox reactions, chemical equilibrium and kinetics, Lewis structure, formal charges, resonance and carbocation stability b) reading of scientific papers and c) introduction to experimental project areas at HBCSE chemistry laboratory.

The laboratory sessions at the camp were related to synthesis of azo dye and synthesis and analysis of coordination complex. A pair of students were given unique task-sheet related to one parameter that is significant for the experiments mentioned above. After the laboratory activity, different pairs of students came together and discussed their work. The discussion helped students to identify various parameters and their role in the given experimental task.

During the computational chemistry laboratory sessions, students performed short computational calculations related to different conformations of molecules such as hydrogen molecule, water, ammonia, ammonium ion, formamide, ferric chloride and copper chloride and were expected to

determine the energies of their stable structures. The students were also asked to note down the IR frequencies obtained for certain molecules. The aim of computational laboratory, which involves the use of GAUSSIAN-09 and Guassview, is to introduce students to computational package and calculations.

Towards the end of this camp, 29 students were selected for the project work and currently these students are in the process of completing assignments related to their prospective projects. In addition, 16 students from earlier batches of NIUS Chemistry visited HBCSE to complete their projects and prepare their project reports.

The speakers for the camp were A. Kumbhar (University of Pune), D. Jain (BARC, Mumbai), G. Carneiro (Sophia College, Mumbai), M. Sundararajan (BARC, Mumbai), P. A. Sathe (Ruia College, Mumbai), R. Jayaram (ICT, Mumbai), S. D. Samant (ICT, Mumbai), T. Ghanty (BARC, Mumbai), T. Parulekar (SIWS College, Mumbai) and G. Shridhar (V. K. Menon College, Mumbai). [HBCSE resource persons included A. Kumar, S. Ladage, I. Das (Sen), S. Narvekar]

Biology

The NIUS camp for Biology (X1.1) was conducted at HBCSE from October 27- 31, 2014 and 26 students from regular B.Sc. or integrated M.Sc. courses attended the camp.

The theoretical sessions at the camp were related to basic concepts of biology, holistic approach to studies on traditional medicine, molecular studies on *Chlamydomonas*, and planning for research projects. The laboratory sessions covered experiments related to biochemistry, molecular biology, genetics and ethology.

From this batch, 5 students have been selected to pursue NIUS projects. In addition, 12 students from earlier batches of NIUS Biology also visited HBCSE to complete their projects and prepare manuscripts for publications and conferences. The resource persons for the camp were B. B. Nath (Pune University), J. D'souza (Centre for Excellence in Basic Sciences, Mumbai), P. G. Kale (Jhunjhunwala College, Mumbai), S. Menon (Therapeutic Drug Monitoring Lab, Mumbai). [HBCSE resource persons included R. Vartak, A. Ronad, V. Ghanekar]

NIUS Workshop on Designing Undergraduate Physics Curriculum

HBCSE in collaboration with the University of Mumbai conducted a one day workshop on April 28, 2014 for 38 physics teachers from various colleges affiliated to the University of Mumbai. The workshop covered sessions related to analysis of current structure of the UG syllabus of University of Mumbai and some other Indian universities, contents of various physics courses, problems faced by teachers during the teaching and assessment etc. The task of redesigning the first year B.Sc. was initiated in small groups of teachers during the workshop. [R. Khaparde]

Study Circle in chemistry

A weekly study circle for senior college/university level students was initiated in May 2014 and conducted till March 2015 at HBCSE. It is aimed at promoting understanding of key concepts/topics in Physical Chemistry. The sessions were conducted by Prof. Arvind Kumar and covered quantum chemistry and chemical thermodynamics. Undergraduate students from colleges of Mumbai and Pune participated in the study circle.

Workshop on Chemistry Education Research

A two day workshop about Chemistry Education Research (CER) was organized by HBCSE for Executive council members of Association of Chemistry Teachers (ACT) on April 5-6, 2014. This was a curtain raiser event for the forthcoming the 2nd International Conference on Education in Chemistry (ICEC 2014) to be held in December 2014 at HBCSE. The sessions at the workshop were conducted mainly by resource persons from HBCSE. The talks at the workshop were related to trends in chemical education, research based practice of science education, students' misconceptions in chemical thermodynamics, understanding students' alternative conceptions in elementary thermodynamics through laboratory activities and designing meaningful multiple choice questions for assessment. [A. Kumar, C. Natarajan, S. Ladage, S. Pathare]

2nd International Conference on Education in Chemistry (ICEC-2014)

The 2nd ICEC was jointly organized by HBCSE and Association of Chemistry Teachers (ACT) at HBCSE from December 12-14, 2014. The academic programme of ICEC was with chemistry cell of HBCSE. The conference had invited talks, oral and poster presentations, workshops and exhibition related to chemistry books, handy analytical instruments and glassware. Conference participants visited various laboratories at HBCSE and were exposed to different domains related to science, mathematics and technology education. The conference had 4 invited speakers from USA and UK, 3 speakers from India and 4 speakers from HBCSE. Some of the areas covered at the conference were i) research based teaching methodologies like Process oriented Guided Inquiry Learning (POGIL) Peer-Led Team Learning (PLTL), ii) role of massive open online courses in higher education, iii) use of technology for constructive teaching and learning of chemistry, iv) assessment in chemistry teaching and learning v) integrating research and chemistry education, vi) designing undergraduate organic chemistry curricula in India, vii) history of science and science education, viii) designing teaching learning resources in Indian context, ix) learning from Chemistry Olympiad laboratory, x) NIUS chemistry programme and xi) overview of research and development activities in chemistry education at HBCSE. 95 teachers teaching chemistry at undergraduate/post-graduate level participated in these events. [S. Ladage, I. Das (Sen), S. Narvekar]

Pre and post conference workshops (each with participation of 25-30) were also organized as satellite events to the ICEC-2014. These were hosted at Institute of Chemical Technology (ICT, Mumbai) and Indian Institute of Science Education and research (IISER, Pune) respectively. External members involved were S. Lancaster (University of East Anglia, UK), R. Moog (Franklin & Marshall College, USA), N. Pienta, (University of Georgia, USA), P. Varma-Nelson (Center for Teaching and Learning, Indiana University-Purdue University Indianapolis, USA).

Teacher Professional Development & Teacher Orientation

HBCSE has been conducting workshops in teacher education as and when there have been requests from schools and organizations. Some of these workshops have been for the schools run by *Brihanmumbai Municipal Corporation* (*BMC*), Tribal Welfare Department, Rayat Education Society (Satara), Shri Shivaji Education Society (Amravati), Maharashtra Prathamik Shikshan Parishad (MPSP), *Sarva Shiksha Abhiyan* (SSA), *Rashtriya Madhyamik Shiksha Abhiyan* (*RMSA*), Bharatiya Vidya Bhavan Society, Atomic Energy Education Society (AEES), Kendriya Vidyalaya

(KV). Apart from these, there have been workshops for District Institute Of Education and Training (DIET) faculty from various regions and states (Bihar, West Bengal, Gujarat, Uttarakhand) as well as for varied individual schools/teacher education colleges of Mumbai and Maharashtra.

However, currently HBCSE has proposed to have regular workshops for teacher professional development (TPD), capacity building of school teachers/student teachers and/or teacher educators. These workshops would cater to the in-service or pre-service teacher training. The yearly calendar for TPD is available at HBCSE's teacher education website (http://teacher-ed.hbcse.tifr.res.in/project/tpd-program).

In the academic year 2014-15, HBCSE members actively participated by organizing or conducting sessions in following workshops- (i) Shri Shivaji Shikshan Sanstha, Amravati & HBCSE jointly organized the 2nd Shivaji Vidnyan Parishad on 'Let us understand Inquiry Based Learning and Constructivism' from December 20-22, 2014 at Shri Shivaji College of Arts, Commerce and Science, Akola. Around 70 science teachers participated in this workshop. (ii) Ambuja Cement Foundation Programmes and HBCSE had organized a science teachers workshop (*Shikshan Mitra*), on September 25-26, 2014, for more than 50 Zilla Parishad school teachers of 5 talukas of Chandrapur District. (iii) Shri Babubhai Chavan High School & Jr College Chandrapur organized a science teachers workshop on September 22-23, 2014. (iv) Shri Vithal Education & Research Institute (SVERI) and HBCSE organized a workshop for science teachers of Lotus English Medium School, Pandharpur at HBCSE from July 7-12, 2014. (v) A science teacher's workshop was organized by Tata Capital at Vikramgad School from July 25-26, 2014, in which around 40 science teachers participated. (vi) Kotak Education Foundation sponsored and organized a science teacher's workshop at HBCSE, between July 2-9, 2014 (vii) The Akola District Science Teachers Association had organized a one day workshop for teachers at New English School, Akola, on September 27, 2014. More than 100 science teachers from the district participated in the workshop. vii) The Mahad Taluka Science Teachers Association had organized a workshop for science teachers on preparing exhibits for science exhibitions on November 29, 2014 at Mahad High School. [N. D. Deshmukh, V. C. Sonawane, K. T. Hambir, S. Ayare, R. Shaikh]

Apart from the above mentioned workshops, HBCSE members have contributed to the Nashik Education Society (NES) & Hemendra Kothari Foundation (HKF) activities. They are involved in HKF teacher fellowship schemes. In this regard, a workshop was held on August 25-26, 2014, to select good action research proposals from among 456 proposals received. Another workshop was held on September 13, 2014, on research methodology and a third workshop was conducted on January 2-3, 2015, to review the action research projects. The Wildlife Conservation Trust of HKF and Eklavya, Bhopal, organized an Annual Peer Learning Meet-3, at Panchmarhi, Hoshangabad, Madhya Pradesh, from March 13-15, 2015, where HBCSE members conducted sessions for teacher educators [V. D. Lale, N. D. Deshmukh, S. Chunawala]

The Chembur Education Society's Chembur *Sarvankash Shikshanshastra Mahavidyalaya* organized a two days state level workshop on 'Blended Learning- Pathways to Success'. This workshop was organized jointly with HBCSE, the Department of Educational Technology, SNDT Women's University, Mumbai & Baha'i Academy, Panchgani from March 17-18, 2015 at HBCSE. More than

86 teacher educators & student-teachers participated in this workshop [N. D. Deshmukh, G. Nagarjuna, S. Chunawala, J. Ramadas]

A Kendriya Vidyalaya in-service teacher training programme was organized in June 2014, by the KV Mumbai Regional Office at Panvel, in which HBCSE collaborated by conducting few sessions. Additionally, Kendriya Vidyalaya Sanghatan's Zonal Institute of Educational Training (KV-ZIET) organized a teacher professional development workshop for their principals and teachers (25 teachers) from March 2-4, 2015. The theme of the workshop was "Innovations in Education". HBCSE prepared a concept note with the details of the objectives, framework for the module, tentative schedule, which is available on the teacher education website. Sessions on nature of science, assessment, inquiry based science teaching and learning were held. The focus of the workshop was developing worksheets and modules on teaching and learning science through investigation at the middle school level. The details of the KV-DIET workshop are available on http://teacher-ed.hbcse.tifr.res.in/news/workshop-on-module-development-for-kv-ziet-mumbai [J. Ramadas, C. Natarajan, S. Chunawala, K. Haydock, M. Kharatmal, N. D. Deshmukh, V. C. Sonawane, R. Shaikh, S. Bhide, K. T. Hambir, S. Aayre]

HBCSE had organized an in-house workshop to provide academic feedback on a course on Science Education on the units on Nature of Science, Food and Matter. The course is part of the 2 year D.Ed. syllabus, developed by Rashtreeya Vidyalaya Educational Consortium (RVEC), Bangalore, SCERT Karnataka. The workshop was held at HBCSE between 12-14 August 2014. The course review report is available on the teacher education website- http://teacher-ed.hbcse.tifr.res.in/documents/rvec-report [C. Natarajan, S. Chunawala, M. Kharatmal, N. D. Deshmukh]

Teachers workshops on Small Science Curriculum teaching and its implementation were conducted in Chennai schools; at Al Qamar Academy, on March 27 and at Vedavalli Vidyalaya on March 28. [J. Ramadas, M. Kharatmal]

In the context of mathematics teacher education, a workshop was designed with teachers focusing on the doing of mathematics in May 2014. Teachers solved problems, discussed and analyzed their own and their peers' solutions, as well as solutions given by experienced mathematicians. The aim of the workshop was to identify and describe processes that went into doing mathematics. In another workshop organized in November, 2014, for B.Ed. students, the emphasis was on observation of and reflection on the live teaching of middle school students by an experienced researcher/teacher. [S. Naik]

HBCSE members also contributed as resource persons in workshops for teachers and teacher educators organized by reputed institutions like Eklavya, in Hoshangabad, July, 2014, by conducting investigatory projects and providing inputs on the nature of science, teaching and learning of algebra and decimals. [H. Srivastava, S. Takker]

As a part of the Royal Society of Chemistry - Yusuf Hamied Inspirational Chemistry Programme, the Royal Society of Chemistry (UK) conducted two 5-day workshops for teacher developers at HBCSE. These workshops were organized in collaboration with HBCSE and the master trainers

were from both RSC-UK and HBCSE. Around 40 teacher developers from different parts of country participated in these workshops, which were conducted between September 29-October 3, 2014 and November 24-28, 2014. The workshops exposed the teacher developers to various ways that can be adapted to introduce constructivist learning in regular school chemistry classrooms. Laboratory sessions demonstrating laboratory activities feasible in schools were also conducted as a part of these workshops. The second workshop was focused on discussion of the practical difficulties faced by the teacher developers when they conducted the pilot workshops for teachers at the zonal level. [S. Ladage, V. D. Lale, S. Narvekar, I. Das (Sen) and project staff of Chemistry group]

A four day Astronomy Olympiad Exposure Camp was organized from November 10-13, 2014 at HBCSE for 83 teachers selected from all over India. [A. Sule, A. Mazumdar, A. D. Ghaisas, S. Chopde, G. Narvankar]

HBCSE members have also conducted sessions at the High School Teachers' Orientation Programme, held at the new Indian Institute of Science (IISc) campus at Challakere, for teachers of Chitradurga district, which are jointly organized by DSERT, Karnataka Government, and IISc, Bangalore. There were such programmes in June, August, September, October, November, December, 2014 and January, February, 2015. [B. J. Venkatachala]

Workshops and camps for school and college teachers were also conducted as part of the Olympiad and NIUS programmes. These are described in the respective sections.

Science Popularization

Over the years, HBCSE has developed a variety of materials aimed at disseminating science among the public, some of which have been listed under curricular and material development section. Last year, HBCSE members have contributed over 70 articles, talks, radio and TV programmes as part of their science popularization and outreach efforts. Articles on science and education have featured in the columns of leading popular magazines, regional newspapers and newsletters.

Science popularization and outreach activities also took the form of exhibitions, workshops and enrichment camps for students that were conducted at several educational institutions. These include (i) 2 day camp at Chinmaya School Tarapur (ii) 3 day science exhibition at Guru Nanak College Sion-Koliwada (iii) one day workshop on Hands on Biological Experiments at Nehru Planetarium, Mumbai. (iv) 2 day workshop at J N Paliwal Science College, Pali, Raigad organized by Sahyadri Adivashi Thakur Samaj (v) 3 day Jidnyasa Science Fair, Thane and (vi) Science Utsav 2015 organized at Gujarat Samaj Bhavan, Vashi, Navi Mumbai. Staff members also participated in the 102nd Indian Science Congress held at University of Mumbai and set up hands-on experiments for visitors. [N. D. Deshmukh, V. C. Sonawane, K. T. Hambir, S. Ayare, T. Khan, S. Naik, H. Mishra, R. Shaikh, V. Pawar, M. Kharatmal, Design and Technology Cell, Chemistry Olympiad Cell]

MSTA-HBCSE Dr. Homi Bhabha Young Scientist Camp

HBCSE and Mumbai Science Teachers Association (MSTA) organized two day nurture camp on April 16-17, 2014 for class VI students and April 22-23, 2014 for class IX students, who were Dr

Homi Bhabha Young Scientist Awardees. The program included lectures by members of HBCSE and experimental sessions which included demonstrations and hands-on experiments. [N. D. Deshmukh-Coordinator, P. K. Navale, V. D. Lale, V. C. Sonawane, P. K. Joshi, A. Sule, A. D. Ghaisas, K. T. Hambir, S. Ayare, V. Bansode, R. Diwakar, P. Gedam, T. Khan]

Visits to HBCSE

Each year, numerous students, pre-service and in-service teachers from many schools and colleges visit HBCSE. Lectures, demonstrations, hands-on experiments in science were organized for them. Apart from NSD visitors, HBCSE had about 300 student visitors during the last academic year [Integrated Laboratory members]

National Science Day 2015

As every year, the National Science Day (NSD) was celebrated at the centre by having an "open house" that witnessed over 1600 visitors that included students, teachers, teacher educators and parents. Rocket science demonstration, making your mathematics game, botanical walk, creativity corner at Design and Technology Laboratory, were some of the main attractions of the day. The Centre also organized a contest on innovative ideas in teaching-learning of science & mathematics for B.Ed/D.Ed. students. HBCSE publications, books, toys and resources on science and maths were displayed as well as kept for sale on NSD. [V. C. Sonawane (Coordinator), and all HBCSE staff members]

STEAM Lab conducted several activities for students and teachers on National Science Day at HBCSE. These include (i) Answer some questions on how watermelon is grown and sold; (ii) Compare a similar lesson on musical instruments and sound in the Small Science Class IV textbook and the NCERT Class IV textbook; (iii) Observe, compare, classify, and identify some seeds of common monocots and dicots; (iv) Design a science or maths teaching activity using given materials, and (v) Draw a cauliflower plant before and while observing it. [G. Singh, K. Sangala, A. Sawant, K. Haydock]

The Design & Technology Lab also took active part in NSD 2015 and in a science exhibition organized at the Guru Nanak Khalsa College, Mumbai, from 9-11 September 2014, where they set up some design related activities and demonstrations which included do-it-yourself activities, puzzles, illusions, and robotics etc. [S. Chunawala, B. Abbas, D. Prabhu, S. Bhide, A. Muralidhar, P. Sharma, D. Gupta, S. Sawant]

TIFR Founder's Day

More than 20 HBCSE members took active part in the Science Festival Programme at TIFR campus on occasion of its Founder's Day on November 2, 2015. Members from the Integrated Laboratory, Mathematics group, Cognitive Lab, Design and Technology Laboratory and Chemistry Cell set up stalls which comprised of demonstrations, hands-on experiments and creative activities. The HBCSE Publication Cell also set up a stall to display and sell publications and resources developed by HBCSE [T. S. Shirodkar (Coordinator) and HBCSE members]

Activities of the Hindi Cell and Rajbhasha Samiti

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. An exhibition on

educational posters was prepared for visiting students and teachers. In '*Aaj ka Shabd*' interesting and educational poems, cartoons and other information were displayed throughout the year. [K. K. Mishra, S. Chandrakar, K. Sinha, S. Deoram]

HBCSE members have been making weekly visits to a nearby school for visually impaired children. Without using textbooks, they tried teaching maths and science (size, weight, mass, density, sound, vibration, length, area, measurement, force) to about 20 children of varying ages and degrees of impairment. This exercise threw light on challenges faced by tutors in teaching school science and maths to visually challenged students as it requires a lot of visual processing by students. [G. Singh, R. D'Souza, J. Rahaman, S. Takker]

Other information

Computer facility of HBCSE

The computer facility of HBCSE has worked towards providing users with faster and uninterrupted access to Internet by rewiring of whole computer network at HBCSE, adding new LAN points and installing new WiFi routers across the centre. Several servers have been reconfigured and installed. In the new computational facility lab of the NIUS programme, Gaussian 9.0 has been installed on 29 machines. A dedicated website for the International Physics Olympiad (IPhO 2015) was designed and developed to handle the complex logistics where an estimated 500 student participants are expected to participate. [R. Nichat, A. Sankhwar, N. Kothekar, M. Nair, A. Das, P. Sawant]

4. PHOTOS (**High res versions separately sent**)

NIUS Chemistry Camp

Students at the Design and Technology Education Lab on National Science Day 2015

NIUS Physics Camp

Students at the Design and Technology Education Lab on National Science Day 2015

5. STAFF LIST

Members
J. Ramadas (Centre Director), C. Natarajan (Dean, HBCSE Faculty) (upto 09/03/2015), K. Subramaniam, V. Singh (upto 31/01/2015), B. J. Venkatchala, 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, S. Chandrasekharan

N. D. Deshmukh, V. D. Lale, V. C. Sonawane, S. R. Pathare, A. Das, A. D. Ghaisas, 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 (Sen), A. Sankhwar, V. S. Ghanekar, P. Ranadive, A. T. Mavalankar (upto 17/04/2014)

Visiting Fellows
A. Jamakhandi (upto 13/02/2015) P. Birwatkar (upto 30/04/2014), S. Dutta (30/06/2014), S. Bhide, R. Thengodkar, S. Krishnan

Research Scholars
A. Bose (upto 31/07/2014), Mashood K. K. (upto 31/07/2014), S. Shome (31/07/2014), B. J. Ramrao (upto 31/08/2014), A. Srivastava, S. Ghumre, S. Takker, J. Rahaman, R. Shaikh, P. Pande, R. Varkey, G. Singh, R. D'Souza, H. Srivastava, G. Date, S. Kabir, K. Mishra, D. Karnam, D. Dutta

PhD students (external)
A. Raveendran, A. Sharma, A. Dhakulkar, R. Kumar, S. Shome, A. Kawalkar

Raja Ramanna Fellow
H. C. Pradhan

INSA Senior Scientists
S. M. Roy, D. P. Roy

Administration
M. D. Gaitonde (Sr. A. O.), V. P. Raul, M. M. Mastakar, 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, S. Sawant (upto 08/09/2014), R. N. Sawant

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

Auxiliary
J. B. Waghmare, U. V. Shenoy, R. G. More, N. K. Kadam, B. L. Valvi, N. S. Thigale, G. V. Mestry, J. J. Tambe, B. S. Bhagit

Consultants
P. K. Balakrishnan, M. C. Arunan

6. NATIONAL AND INTERNATIONAL INVOLVMENT (PROFESSIONAL AND ACADEMIC), MEMBERSHIPS OF EDITORIAL, ACADEMIC AND NATIONAL COMMITTEES, OFFICE BEARERSHIP OF PROFESSIONAL SOCIETIES

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) Reviewer for the Focus Group Paper on Gender Issues in Education, Department of Gender Studies, NCERT; 5) Member of the Sub Committee constituted to draft regulations and norms and standards for Open and Distance Learning (ODL) Teacher Education programmes i.e D.El.Ed., B.Ed., M.Ed. courses in ODL mode, NCTE; 6) Reviewer for papers, *ICSSR Sponsored Two Day National Seminar on Innovations in 21st Century Education*; 7) Member, Board of University Teaching and Research, YCMOU; 8) Member, Revision of Syllabus for B.Ed. course on Gender, School & Society, University of Mumbai; 9) Member, Board of Studies, SNDT University, Marine Lines, Mumbai.

S. Chandrasekharan was Member, Conference Program Committee for the following: 1) Annual Meeting of the Cognitive Science Society, 2015, Pasadena, USA; 2) Model-Based Reasoning conference, Sestri Levante, Italy, 2015; 3) The 15th IEEE International Conference on Advanced Learning Technologies, 2015, Hualien, Taiwan; 4) The 23rd International Conference on Computers in Education, Hangzhou, China; 5) Technology for Learning of Thinking Skills, The 22rd International Conference on Computers in Education, 2014, Nara, Japan; 6) Technology for Education (IEEE), 2014, Kollam, India; 7) is Co-Convener, EpiSTEME 6.

N. D. Deshmukh was 1) Executive Committee Member of Asian Association of Biology Education (AABE) and Convener for 26th AABE 2016; 2) Editorial Board Member of *Asian Journal of Biology Education* (AJBE); 3) Corporate Social Responsibility (CSR) Committee Member (educational expert member), Government of Maharashtra; 4) School Council Member for YCMOU Nashik B.Sc. course; 5) Advisory Member, *Shikshan Sankramann Journal*.

K. Haydock was 1) Independent Reviewer for the course package for 'Teaching Science: the Upper Primary Years' to develop course materials for teacher education, The Rishi Valley Education Centre, in collaboration with Azim Premji University, 2013-2015.

P. K. Joshi was 1) the Vice-President (Asia) of the Junior Science Olympiad.

R. B. Khaparde was 1) Member of Board of Studies in Physics, University of Mumbai, Mumbai; 2) An Associate Editor of the *Physics Education*, a journal published by University of Pune in association with IAPT; 3) Member of the Advisory Committee for the Jawaharlal Nehru National Science, Mathematics and Environment Exhibition (JNNSMEE), NCERT, New Delhi; 4) Member of the Academic Advisory Committee for 'The Story of Light' Science festival, January 14-18, 2015, Goa, India.

S. Ladage was 1) Co-opted Member, Executive Council of Association of Chemistry Teachers (ACT).

A. Mazumdar was National Coordinator, Science Olympiads (Biology, Chemistry, Junior Science and Physics (from August 1, 2014).

K. K. Mishra was 1) Member, Executive Council, Lok Vigyan Parishad, Delhi; 2) Joint Secretary, Peoples Council of Education, Allahabad; 3) Member, Vigyan Parishad Prayag, Allahabad; 4) Member, Advisory Board, Vigyan-Ganga, Banaras Hindu University, Varanasi; 5) Member, Editorial Board, *Vigyan Prakash, World Hindi Foundation*, Oswego, New York, USA.

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 Commitee, National Board of Higher Mathematics.

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

C. Natarajan was 1) Member, Editorial Board of *International Journal of Technology and Design Education*, Springer, Netherlands; 2) Editorial Board, *Design and Technology Education: An International Journal*, Trentham Books Ltd., UK; 3) Member of Executive Council of the Indian Physics Association; and 4) Member, Academic Advisory Committee of Kendriya Vidyalaya Sangathan

P. Pathak was 1) Member, International Advisory Committee of International Physics Olympiad.

J. Ramadas was 1) Member, IUPAP International Commission on Physics Education (ICPE) for the period 2014-16; 2) Member, Governing Council of the Atomic Energy Education Society (AEES).

A. Ronad was 1) Member, Executive Committee, Association of Teachers in Biological Sciences (ATBS)

V. Singh was National Coordinator, Science Olympiads (Biology, Chemistry, Junior Science and Physics (till July 31, 2014).

K. Subramaniam was 1) Member, National Council for Teacher Education (NCTE); 2) Member, NCTE sub-committee on developing guidelines for *Teacher Eligibility Test*; 3) Member, NCTE sub-committee on teacher education through ODL mode; 4) Member, NCTE sub-committee on developing norms for faculty for B.El.Ed. Programme; 5) Member, Academic Committee, NCERT, New Delhi; 6) Country representative for India, International Commission for Mathematics Instruction; 7) Member, Journal Editorial board, *Contemporary Education Dialogue*; 8) Member, Journal Editorial board, *At Right Angles*; 9) Member, Advisory board, Information Age Publishing: International Sourcebooks in Mathematics and Science Education.

A. Sule was 1) Regional Coordinator (Asia-Pacific) for the International Olympiad in Astronomy and Astrophysics (IOAA) from 1-1-2012 to 31-12-2016; 2) Member of Coordination Committee for National Entrance Screening Test 2014.

R. Vartak was 1) Member, Interview Board of Kishore Vaigyanik Protsahan Yojana 2) Member, Executive Committee, Association of Teachers in Biological Sciences (ATBS)

7. VISITS

A. Bose visited 1) UNISA, South Africa, August 12-23, 2014 2) School of Liberal Studies and School of Educational Studies, Ambedkar University, Delhi, March 9-12, 2015

A. Mazumdar visited Max Planck Institute for Solar System Research in Gottingen, Germany from 5th May to 25th May, 2014

8. AWARDS AND DISTINCTIONS

F. Ara
TAA - B. M. Udgaonkar Best Thesis Award in Science Education

A. Ghaisas
Prof. M. V. Chiplonkar Memorial Award 2014, Indian Physics Association, Pune

S. Padalkar
TAA - B. M. Udgaonkar Best Thesis Award in Science Education

A. Sharma and S. Chunawala
Late Prof. S. R. Rohidekar Award for 'Best Research Paper', Council for Teacher Education (CTE), Karnataka

9. INVITED TALKS

A. Bose
Mathematics outside classrooms (Plenary Session), *One-day seminar-cum-workshop on Innovative Practices to Enliven Mathematics Classrooms,* Department of Education (C.I.E), University of Delhi, March 9, 2015

S. Chandrasekharan
Cognition, education, technology: A learning sciences perspective, *Sixth IEEE International Conference on Technology for Education*, Kollam, Kerala, December 19, 2014

S. Chunawala
1. Quality in higher education (Keynote address), UGC sponsored *National Conference on Quality, Equality and Innovation in Higher Education,* organized by Gokhale Education Society's Shri Bhausaheb Vartak Arts, Commerce and Science College, Mumbai, January 21, 2015
2. Collaborative learning (Invited talk), *Teachers' Conference of Science Utsav,* conducted by Navi Mumbai Science Foundation (NMSF), February 21, 2015

I. Das (Sen)
National Initiative on Undergraduate Studies (NIUS) chemistry: Towards meaningful learning in chemistry, *Second International Conference on Education in Chemistry,* organized by Association of Chemistry Teachers and Homi Bhabha Centre for Science Education, Mumbai, December 2014

R. B. Khaparde
Can we improve the quality of physics laboratory training in India (Inaugural talk), *National level Laboratory Workshop on Physics for Undergraduate Teachers,* Shri Shivaji Science College, Amravati, Maharashtra, June 27, 2014

S. Ladage
1. Chemistry education research: What is it all about?, *National Convention of Chemistry Teachers*, organized by IIS University, Jaipur, October 2014
2. Research and development in chemistry education at HBCSE: An overview, *Second International Conference on Education in Chemistry* (ICEC-2014) organized by Association of Chemistry Teachers and Homi Bhabha Centre for Science Education, Mumbai, December 2014

A. Mazumdar
Computing stellar models, *Third National Workshop on Computational Physics,* K. J. Somayia College of Science and Commerce, Mumbai, February 11-14, 2015

K. K. Mishra
1. Teaching and learning of science and mathematics in Hindi, *National Hindi Science Conference,* organized by M. P. Council of Science & Technology, Vigyan Bharati, M.P., and Atal Bihari Vajpayee Hindi University, Bhopal, August 1, 2014
2. Development of an educational e-learning portal in Hindi: HBCSE's Initiative, *Bhasha Sangoshthi on Rajbhasha Hindi ka Vaishvikaran*, organized by Bharatiya Bhasha Pratishthapan Rashtriya Parishad, Lucknow Chapter, under the auspices of Regional Science Centre, Lucknow, March 22, 2015

S. Narvekar
Learning from the chemistry olympiad laboratory, *Second International Conference on Education in Chemistry,* organized by Association of Chemistry Teachers and Homi Bhabha Centre for Science Education, Mumbai, December 2014

H. C. Pradhan

1. Scientific temper (Keynote address), *Intercollegiate Seminar on Scientific Temper,* PVDT Polytechnic, Juhu, Mumbai, August 8, 2014
2. Redefining quality in the context of higher education in India with focus on teaching and learning (Keynote address), *Seminar on Quality Sustenance: Aspects and Initiatives,* sponsored by National Assessment and Accreditation Council, Ramnarain Ruia College, Mumbai, January 10, 2015
3. Students' alternative frameworks – Examples from physics (Inaugural Talk), *National Science Day Seminar for Teachers (Western zone),* Regional Institute of Education, NCERT, Bhopal, February 28, 2015

K. Subramaniam

1. Conceptualizing knowledge-how for education theory and practice, (Invited talk), *Second International Philosophy of Education Seminar*, Azim Premji University, Bangalore, May 2014
2. Resources to build capability of mathematics teachers (Keynote address), *Consultative National Seminar-cum-Workshop on Enhancing Mathematics Potential Through Facilitative Resource Material*, Central Institute of Education, University of Delhi, July 2014
3. The construct of identity: Is it useful in mathematics education (Invited talk), *National Meet on Mathematics Education*, NCERT, Bhopal, December 2014
4. Towards quality in teacher education: Reflections on the Justice Verma Commission (Invited talk), *National Conference on Skill Development in Teacher Education,* Government College of Education, Panvel, January 2015
5. Teacher education: Building a foundation for professionalization (Keynote address), *Seminar on New Perspectives in Teacher Education*, Department of Education, University of Mumbai, March 2015

10. CONFERENCES/WORKSHOPS ORGANIZED BY THECENTRE

4TH NATIONAL WORKSHOP ON DEVELOPMENT OF EDUCATIONAL E-MATERIALS IN HINDI

Allahabad, November 26-28, 2014

HBCSE organized the 4th National Workshop on 'Development of Educational E-materials in Hindi' from November 26-28, 2014, under the auspices of Vigyan Parishad Prayag. This biennial workshop, launched in 2008, aims at developing educational content in Hindi for students, teachers and teacher educators up to +2 levels in science and mathematics. 55 experts and 27 students participated. For the first time students of science and mathematics were allowed to participate as student participants. The conference had 7 technical sessions for pedagogic presentations, evening lectures by eminent speakers and an open session followed by a feedback. [Coordinator: K. K. Mishra]

2ND INTERNATIONAL CONFERENCE ON EDUCATION IN CHEMISTRY (ICEC-2014) IN COLLABORATION WITH ASSOCIATION OF CHEMISTRY TEACHERS

HBCSE, December 12-14, 2014

WORKSHOPS FOR STUDENTS

Open-Beginninged Workshop for Grade VIII students (HBCSE, April 2014); **An experimental workshop with Class VII students from Nutan (**HBCSE, April 30 to May 2, 2014); **Nurture Camp for Grade VI and IX students** (HBCSE, April 22-23, 2014); **CUBE Summer Workshops**

(Vivekanand Education Society's College of Arts, Science & Commerce College, Mumbai, June 1- July 6, 2014; Chandibai Himatlal Manshukhani College, Ulhasnagar, April 20- April 21, 2014; Royal College of Science, Arts and Commerce, Mira Bhayandar, June 22- July 6, 2014); **Three-day Workshop on decimal learning and maths lab (with Eklavya)** (Hoshangabad, July 28-31, 2014); **A workshop- 'Decoding DNA: Model building & Model dissection' for biology undergraduate students** (HBCSE, October 5, 2014); **Four-day Workshop for students and teachers on 'Fun with Ratio and Proportion!' and 'Learning to Teach Mathematics'** (St. Xavier's Institute of Education, Mumbai, November 5-8, 2014); **CUBE Workshops** (KBP and VES college, December 27, 2014- January 3, 2015); **Phylogenetic Analysis: A One Day Workshop (faciliated by Prof. R. Geeta, Department of Botany, University of Delhi)** (CUBE Lab, HBCSE, January 5, 2015)

WORKSHOPS FOR AND PRE/ IN-SERVICE TEACHERS

NIUS Workshop on Designing Undergraduate Physics Curriculum (with University of Mumbai) HBCSE, April 28, 2014; **Workshop of Mathematics Problem Solving** (HBCSE, May 29- 31, 2014); **Workshop with Jidnyasa Trust (Ganit Yatra Programme) on making of mathematics laboratory activities** (HBCSE, July 25, 2014; Aurangabad, August 8, 2014; Nashik and Dhule, September 24-25, 2014); **One-day Workshop on 'Learning to Demonstrate Mathematics Laboratory' for in-service teachers** (HBCSE, July 10, 2014); **One-day workshops on 'Learning to Solve Mathematical Problems' for pre-service teachers** (St. Xavier's Institute of Education, Mumbai, July 11; August 20; September 13, 2014); **Workshop for IWSA teachers: 'Becoming a resource person'** (HBCSE, October 11, 2014); **Workshop for teachers on Module Development for KV-ZIET** (KV-ZIET, Mumbai, March 2-4, 2015); **Two Workshops for Science Teachers on Implementing Small Science Curriculum** (Al Qamar Academy & Vedavalli Vidyalaya, Chennai, March 27-28, 2015)

WORKSHOPS FOR RESOURCE PERSONS/ TRAINERS/ TEACHER TRAINERS

Workshop on Chemistry Education Research (HBCSE, April 5-6, 2014); **Workshop for Course Developers NUSSD** (HBCSE, Mumbai, May 17, 2014) ; **A one-day workshop on visuospatial reasoning in astronomy education** (HBCSE, May 23, 2014); **STEAM: Integrated Learning Modules, First meeting and workshop** (HBCSE, May 24-25, 2014); **Digital Literacy Master Trainer's Workshop** (TISS Mumbai, June 2-3, 2014); **Workshop to Review Course on Science Education (for D.Ed. syllabus, developed by RVEC, Bangalore, SCERT Karnataka)** (HBCSE, August 12-14, 2014); **A workshop for Master Trainers in Chemistry (with Royal Society of Chemistry)** (HBCSE, September 30 to October 3, 2014); **Digital Literacy Trainer's Workshops** (Bhilai Institute of Technology, Durg, Chhattisgarh, September 27, 2014; Narayan Guru College, Chembur, Mumbai, October 11, 2014 – October 13, 2014; Kejriwal Institute of Management, Ranchi, Jharkhand, November 9, 2014 – November 11, 2014); **Two 5-day workshops for teacher developers (with Royal Society of Chemistry, RSC-UK)** (Workshop I- September 29-October 3, 2014; Workshop II: November 24-28, 2014); **Special Session on Challenges for Education in Modern India (for 102nd Indian Science Congress** (University of Mumbai, January 6, 2015); **State Level Workshop on Blended Learning & Pathways to Student Success (along with Chembur Sarvankash Shikshanshastra Mahavidyalaya, Chembur)** (HBCSE, March 17-18, 2015); **Workshop on Turtle Blocks (facilitated by Walter Bender, MIT Media Lab)** (CUBE Lab, HBCSE, March 25, 2015)

11. NON-DAE RESEARCH PROJECTS

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

J. Vijapurkar (with A. Msimanga, University of Witwatersrand [P. I.] and other collaborators)
A multi-country collaborative project titled *"A multidisciplinary approach to language issues in science education in multilingual contexts"* aimed at understanding the language issues in science education in multilingual contexts.

12. PUBLICATIONS

12 a) IN JOURNALS

Bose, A., & Kantha, V. K. (2014). Influence of socio-economic background and cultural practices on mathematics education in India: A contemporary overview in historical perspective. *ZDM – The International Journal on Mathematics Education,* **46**(7), 1073-1084.

Bose, S., Sengupta, A., & Ray, A.K. (2014). Nonlinear variations in axissymmetric accretion. *Physical Review D*, **89**(10), 103011.

Dhakulkar, A., Gadiraju, N., & Dhurde, S. (2015). Measuring the mustard seed: An exercise in indirect measurement and mathematical modelling. *School Science Review,* **356,** 63-68.

Joshi, P. K. (2014). Role of IJSO experiments in learning process. *Bulletin of Indian Association of Physics Teachers,* October 2014, 259.

Joshi, P. K., & Nawale, P. (2014). Basic colorimeter. *Bulletin of Indian Association of Physics Teachers,* October 2014, 260.

Metcalfe, T. S. and 41 co-authors, including Mazumdar, A. (2014). Properties of 42 solar-type kepler targets from the asteroseismic modeling portal. *The Astrophysical Journal Supplement Series,* **214**, 27.

Mishra K. K. (2014). Prathamik shiksha- ateet ke aiine mein. *Anaupacharika*, **39**(4), 11-12.

Naik, S., & Ball, D. (2014). Professional development in a laboratory setting: Examining evolution in teachers' questioning and participation. *Journal of Mathematics Education,* **7**(2), 40-54.

Pathare, S., Huli, S., Lahane, R., & Sawant, S. (2014). Low cost timer to measure the terminal velocity of the magnet falling through a conducting pipe. *The Physics Teacher,* **52**(3), 160-163.

Verma, K., Faria, João 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. (2014). Asteroseismic estimate of Helium abundance of a solar analog binary system, *The Astrophysical Journal,* **790**(2), 138.

Verma, K., Antia, H. M., Basu, S., & Mazumdar, A. (2014). A theoretical study of acoustic glitches in low-mass main-sequence stars. *The Astrophysical Journal*, **794**, 114.

Vijapurkar, J., Kawalkar, A., & Nambiar, P. (2014). What do cells really look like? An inquiry into students' difficulties in visualising a 3-D biological cell and lessons for pedagogy. *Research in Science Education,* **44**(2), 307-333.

Vijapurkar, J., & Konde, P. "Omne vivo ex vivum?" (2014). A study of middle school students' explanations of the seemingly sudden appearance of life forms. *Research in Science Education,* **44**(6), 885-902.

Datta, A., Mazumdar, A., Gupta, U., & Hekker, S. (2015). Automated determination of g-mode period spacing of red giant stars. *Monthly Notices of the Royal Astronomical Society,* **447**(2), 1935-1950.

Gupta, R., Ladage, S., & Ravishankar, L. (2015). One-pot synthesis of 1,8-Dioxooctahydroxanthenes catalyzed by Mg-Al Hydrotalcites. *Chemistry Journal, Public Science Framework*, **1**(1), 1-4.

Gupta, R., Ladage, S., & Ravishankar, L. (2015). Mg-Al Hydrotralcite catalyzed efficient one-pot synthesis of 4-H-Benzo[b]Pyrans, 2-Aryl Benzimidazole and 2-Aryl-4,5-Dihydro-1H-Imidazole Derivatives. *Chemistry Journal, Public Science Framework*, **1**(1), 5-9.

Pathare, S., Huli, S., Nachane, M., Ladage, S., & Pradhan, H. (2015). Understanding thermal equilibrium through activities. *Physics Education,* **50**(2), 146-158.

12 b) IN PROCEEDINGS

Birwatkar, P., & Chunawala, S. (2014). An innovative strategy for addressing diversity in a science class. In S. Nath (Ed.), *Proceedings of the ICSSR Sponsored Two Day National Seminar on Innovations in 21st Century Education* (pp. 73-86). Mumbai: K. J. Somaiya Comprehensive College of Education, Training and Research, Vidyavihar.

Birwatkar, P., & Natarajan, C. (2014). Using design and technology task to foster learning through the joy of making among students of class VII. In S. Nath (Ed.), *Proceedings of the ICSSR Sponsored Two Day National Seminar on Innovations in 21st Century Education* (pp. 121-133). Mumbai: K. J. Somaiya Comprehensive College of Education, Training and Research, Vidyavihar.

Bose, A. (2014). Revisiting transfer of learning in mathematics: Insights from an urban low-income settlement. In P. Liljedahl, C. Nicol, S. Oesterle & D. Allan (Eds.), *Proceedings of the Joint Meeting of PME 38 and PME-NA 36*, Vol. 2 (pp. 177-184). Vancouver, Canada: PME.

Date, G., & Chandrasekharan, S. (2014). Beyond interfaces: Understanding the process of designing grassroots technologies, to develop sustainability case studies for engineering education. In S. Murthy & Kinshuk (Eds.), *Proceedings of IEEE Sixth International Conference on Technology for Education,* December 18-21, 2014 (pp. 40-43). Amrita University, Kerala: IEEE Conference Publications/ Conference Publishing Services.

D'Souza , R. (2014). Ableism and disability oppression through schooling. Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 365-367). Delhi: CESI.

Goldin, S., O'Neill, M., & Naik, S. (2014). Re-thinking engagement and participation: The development and co-construction of student learning practices. In J. L. Polman et.al (Eds.), *Proceedings of the Eleventh International Conference on Learning Sciences,* June 23-27, 2014, Vol. 3 (pp. 1505-1506). USA: University of Colorado Boulder .

Haydock, K. (2014). Stated and unstated aims of social science education, according to NCERT. Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 178-181). Delhi: CESI.

Khaparde, R. B. (2014). It is never too late to introduce procedural understanding: A case of Physics laboratory course for undergraduate students. In L. Dvořák & V. Koudelková (Eds.), *Proceedings of ICPE-EPEC 2013: The International Conference on Physics Education* (pp. 736-741). Prague: Matfyzpress.

Kothiyal, A., Majumdar, R., Pande, P., Agarwal, H., Ranka, A., & Chandrasekharan, S. (2014). How does representational competence develop? Explorations using a fully controllable interface and eye-tracking. In Liu, C.-C. et al. (Eds.), *Workshop Proceedings of the 22nd International Conference on Computers in Education*, November 30- December 4, 2014 (pp. 738-743). Nara, Japan: ICCE 2014 organizing committee/Asia-Pacific Society for Computers in Education.

Majumdar, R., Kothiyal, A., Pande, P., Agarwal, H., Ranka, A., Murthy, S., & Chandrasekharan, S. (2014). The enactive equation: Exploring how multiple external representations are integrated, using a fully controllable interface and eye-tracking. In S. Murthy & Kinshuk (Eds.), *Proceedings of the Sixth IEEE International Conference on Technology for Education*, December 18-21, 2014 (pp. 233-240). Amrita University, Kerala: IEEE Conference Publications/ Conference Publishing Services.

Marcone, R. & Bose, A. (2014). Platform 3: Where foreground meets background. In P. Liljedahl, C. Nicol, S. Oesterle & D. Allan (Eds.), *Proceedings of the Joint Meeting of PME 38 and PME-NA 36*, Vol. 6 (p. 165). Vancouver, Canada: PME.

Naik, S., & Khan, T. (2014). Developing mathematical practices: building teachers' capacity to solve mathematics problems. Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 432- 435). Delhi: CESI.

Pande, P., & Chandrasekharan, S. (2014). Categorization of multiple external representations by chemistry undergrads: An eye-tracking study. In Y.-J. Lee, N. T-L. Lim, K. S. Tan, H. E. Chu, P. Y. Lim, Y. H. Lim & I. Tan (Eds.), *Proceedings of the International Science Education Conference 2014* (pp. 1393-1415). Singapore: NIE.

Pande, P., & Chandrasekharan, S. (2014). Integration of multiple external representations in chemistry: A requirements-gathering study. In Liu, C.-C. et al. (Eds.), *Workshop Proceedings of the 22nd International Conference on Computers in Educatio*n, November 30- December 4, 2014 (pp. 732-737). Nara, Japan: ICCE 2014 organizing committee/Asia-Pacific Society for Computers in Education.

Pande, P., & Chandrasekharan, S. (2014). Eye-tracking in STEM education research: Limitations, experiences and possible extensions. In S. Murthy & Kinshuk (Eds.), *Proceedings of the Sixth IEEE International Conference on Technology for Education*, December 18-21, 2014 (pp. 116-119). Amrita University, Kerala: IEEE Conference Publications/ Conference Publishing Services.

Pathare, S. R., Huli S., Ladage S., & Pradhan H. C. (2014). Students' understanding of first law of thermodynamics. *Conference booklet of GIREP-MPTL International Conference,* July 7-12, 2014 (pp 330-331). University of Palermo, Italy.

Raveendran, A., & Chunawala, S. (2014). Reflections on bringing in social justice concerns into science education: A study of higher secondary students negotiating a socioscientific issue. Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 58-60). Delhi: CESI.

Srivastava, H., & Haydock, K. (2014). Environment issues in a few secondary science classrooms: Do larger questions of political economy enter? Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 148-151). Delhi: CESI.

Takker, S. (2014). Bridging the gap between research & teaching through sensitive research methodology.

Conference Abstract Booklet of the *Fifth International Conference by Comparative Education Society of India: Education, Politics and Social Change,* November 16-18, 2014 (pp. 416- 419). Delhi: CESI.

Date, G., & Chandrasekharan, S. (2015). Characterizing the grassroots innovation process, to develop value-driven case studies for engineering pedagogy. Conference Abstract Booklet of *Third International Conference on Creativity and Innovations at Grassroots [ICCIG III],* January 19-22, 2015 (pp. 130-131). Ahmadabad: Indian Institute of Management.

12 c) WEB PUBLICATIONS

Kharatmal, M. (August, 2014). Report of a workshop to review a course on science education, SCERT, Karnataka, RVEC, Bangalore. http://teacher-ed.hbcse.tifr.res.in/documents/rvec-report

Kharatmal, M. (September, 2014). A proposal to extend concept mapping to concept lattices for representing biology. http://www.mn-summerschool2014.math.tu-dresden.de/

Kharatmal, M. (October, 2014). Science through investigation for teacher professional development. http://teacher-ed.hbcse.tifr.res.in/documents/science-through-investigation-for-teacher-professional-development

Kharatmal, M. (March 2015). Report of a workshop on module development on science through investigation, KV-ZIET, Mumbai. http://teacher-ed.hbcse.tifr.res.in/documents/hbcse-kvs-ziet-workshop-report

12 d) IN BOOKS

Chandrasekharan, S. (2014). Becoming knowledge: Cognitive and neural mechanisms that support scientific intuition. In L. M. Osbeck & B. S. Held (Eds.), *Rational Intuition: Philosophical Roots, Scientific Investigations* (pp. 307-337). New York: Cambridge University Press

Haydock, K. (2014). Cover illustrations for the book *"Never a dull moment"* by Sushil Joshi. Bhopal: Eklavya

Mishra K. K. (2014). Development of an innovative e-learning portal for science education in Hindi. In S. K. Jindal and P. Kumar (Eds.), *Information and Society* (pp. 25 – 30). New Delhi: Defence Scientific Information and Documentation Centre (DESIDOC), Defence Research and Development Organization (DRDO)

Haydock, K. (2015). Illustrations for the book *"Kandal ka kamal."* by Anu Gupta. Bhopal: Eklavya

12 e) BOOKS

Dhakulkar, A., Mukherjee, C., Gadiraju, N., & Pakrashi, H. (2015). *Information booklet for digital literacy.* Mumbai: Tata Institute of Social Sciences

Dhakulkar, A., Mukherjee, C., Gadiraju, N., & Pakrashi, H. (2015). *Digital literacy course.* Mumbai: Tata Institute of Social Sciences

Mishra K. K. (2014). *Khanpan aur rasayan.* New Delhi, Vigyan Prasar (DST)

Mishra, K. K. (2014). *Gyan-vigyan: Shaikshik nibandh* (Book-3) (ed). Mumbai: HBCSE

Natarajan, C. & Kumar, A. (2014). *Atom and development* (V. D. Lale, Marathi Trans.). Mumbai: HBCSE

Pradhan, H. C., & Lale, V. D. (Coordinating Eds.). (2014). *Kumar vishwakosh – Jeevshastra and paryavaran (Junior encyclopedia – Biology and environment)* (Hard-bound edition), *Part II*. India: Maharashtra Rajya Vishwakosh Nirmiti Mandal

Singh, V. (Ed.). (2014). *The Olympiads, an invitation (Olympiads, ek aamantran)*- Bilingual Booklet (English – Hindi). Mumbai: HBCSE

Sule, A. (2014). *A problem book in astronomy and astrophysics.* Romania: Cygnus Publishing House

BOOK REVIEW

Mishra, K. K. (2014). Review of *Digital madhyam aur Hindi mein vigyan sanchar* (Editors: Om Vikas, Oum Prakash Sharma, Kinkini Dasgupta Misra, Manish Mohan Gore, published by Vigyan Prasar (DST) New Delhi), *Vigyan Ganga (BHU),* **3**(7), 97

12 f) TECHNICAL REPORTS/ INTERNAL REPORTS

Dutta, S., & Natarajan, C. (2014). *Report on 'fun with boxes' workshop.* Mumbai: HBCSE

Sule, A., & Chopde, S. (2014). *Report of the Indian astronomy olympiad programme.* Mumbai: HBCSE

13. LECTURES / LECTURE COURSES GIVEN ELSEWHERE

M. C. Arunan, S. Ghumre & R. Shaikh
Revamping undergraduate research and teaching using simple model systems, St. Xavier's College, Mumbai, February 27, 2015

A. Bose

1. Revisiting transfer of learning in mathematics: Insights from an urban low income settlement, University of South Africa (UNISA), Pretoria, August 21, 2014
2. Revisiting transfer of learning in mathematics: Insights from an urban low income settlement, Azim Premji University, Bengaluru, February 18, 2015
3. Exploring out-of-school measurement knowledge: Implications for school mathematics learning?, School of Liberal Studies, Ambedkar University, Delhi, March 10, 2015
4. Can exposure to work-contexts create opportunities for mathematics learning? – A case of out-of-school measurement knowledge, School of Educational Studies, Ambedkar University, Delhi, March 12, 2015

S. Chunawala

1. Research methods, K. J. Somaiya Comprehensive College of Education, Training and Research, Vidyavihar, January 2015
2. Nature of science, *Workshop on Module Development on Science through Investigation,* KV-ZIET, Mumbai, March 2, 2015
3. Reflections from Diagnostic Learning in Primary Science (DLIPS) project. *Annual Peer Learning Meet-3,* organized by Wildlife Conservation Trust and Eklavya, Bhopal, Panchmarhi, Hoshangabad, MP, March 14, 2015

P. De

1. Mathematics (M101), Lecture Course for First Year students at CEBS, October- November, 2014
2. Differential equations and dynamical systems (M604), Lecture Course for Third Year students at CEBS, January-April, 2015
3. Graph theory (M1009), Lecture Course for Fifth year students at CEBS, January-April, 2015

N. D. Deshmukh

1. Understanding students' conceptions, KV Panvel, June 13, 2014
2. Study of students' conceptions & misconceptions, Pushpanjali College of Education, Vasai, August 16, 2014
3. Understanding students' conceptions & misconceptions, The Lord Universal College of Education, Malad, August 20, 2014
4. Students' conceptions & misconceptions, Gokhale Education College, September 6, 2014
5. Use of technology in classroom for implementing remedial module to overcome school students' misconceptions. Paper presented at the *25th Asian Association for Biology Education (AABE) Conference*, University of Malya, Kuala Lumper, Malaysia, October 13-16, 2014
6. Why do school students' have misconceptions about life processes? Paper presented at the *25th Asian Association for Biology Education (AABE) Conference*, University of Malya, Kuala Lumper, Malaysia, October 13-16, 2014
7. 5E lesson plan approach & constructivism, Govt. B. Ed. College Akola, December 21, 2014
8. Constructivist approach in education, K M Azhar Husain B. Ed. college Akola, December 22, 2014
9. Constructivism, 5E lesson & students' conceptions, *Workshop organized by Rayat Education Society, Satara,* D. G. College Satara, January 17, 2015
10. Constructivism, 5E lesson & students' conceptions, *Workshop organized by Rayat Education Society, Satara,* Shri Shahu Maharaj Kolhapur, January 18, 2015
11. Constructivism, 5E lesson & students' conceptions, *Workshop organized by Rayat Education Society, Satara,* Sadhana High School Hadapsar, January 20, 2015
12. Dnyanrachanawad ani NCF 2005, *Raigad District Science & Mathematics Teachers Association Workshop,* English High School Jawali, Mangaon, Raigad, January 28, 2015
13. Constructivism, 5E lesson & students' conceptions, *Workshop organized by Rayat Education Society, Satara,* New English High School, Kamothe, February 6, 2015
14. My Ph.D research experiences, Smt K K College of Education, February 13, 2015
15. Constructivism, 5E lesson & students' conceptions, *Workshop organized by Rayat Education Society, Satara,* Rayat's Regional Office, Nagar, February 14, 2015
16. Collaborative learning as a teaching-learning method, *Science Utsav 2015*, organized by Vidnyan Parishad, Vashi, Gujarati Samaj Bhavan Vashi on February 21, 2015
17. Role of literature review, *Workshop organized by Somaiya College,* Mumbai, March 9, 2015
18. Learning & assessment in EVS, *Annual Peer Learning Meet-3*, organized by Wildlife Conservation Trust and Eklavya, Bhopal, Panchmarhi, Hoshangabad, MP, March 14, 2015
19. Research methodology, *Workshop organized by Department of Chemistry, Amravati University*, University of Amravati, March 19, 2015

R. D'Souza

Vectors and analytic geometry, organized by Azim Premji Foundation, Dehradun, September 19-21, 2014

R. D'Souza, S. Takker and H.Mishra

Divisibility, Vivek Education Foundation, School for Blind Children, February 2014

S. Godse & N. D. Deshmukh

Survey of undergraduate students' misconceptions about molecular biology. Paper presented at the *25th Asian Association for Biology Education (AABE) Conference*, University of Malya, Kuala Lumper, Malaysia, October 13 – 16, 2014

K. Haydock
Constructivism, *Workshop Session for KV Teachers and Principals,* ZIET, Powai, Mumbai, July 16, 2014

K. Haydock, S. Kabir, G. Singh, R. D'Souza
The either sides of wonderment: Art in science and science in art, St Xavier College, Mumbai, January 16, 2015

P. K. Joshi
1. International Junior Science Olympiad (IJSO), Satara, October 1, 2014
2. International Junior Science Olympiad (IJSO), Bhuj, November 14, 2014

R. B. Khaparde
How to foster experimental abilities and skills in students?, *Science Academies refresher course in foundation of Physics,* organized by Indian Women Scientist's Association, IWSA, Navi Mumbai, December 23, 2014

M. Kharatmal
1. A POE (predict-observe-explain) approach for science activities. *Workshop for In-service Teachers TGT (Science),* Kendriya Vidyalaya, Panvel, June 12, 2014
2. Concept mapping and Vee diagrams, The Lord Universal College of Education, Malad, October 31, 2014
3. Science through investigation for teacher professional development. *KV-ZIET* Mumbai, March 2, 2015

S. Ladage

1. Introduction to chemical education research, *Workshop on Chemistry Education Research,* organized by SRM University (Ramapuram campus), Chennai, August 2014
2. Introduction to POGIL, *Workshop* organized by Ruia College, Mumbai, February 2015

A. Mazumdar

1. Asteroseismology of red giants, 32nd Meeting of the Astronomical Society of India, IISER Mohali, March 20, 2014
2. Measurement of helium abundance in 16 Cyg, Max Planck Institute for Solar System Research in Gottingen, Germany, May 16, 2014
3. Physics 303: Electricity and Magnetism, course taught at UM-DAE Centre for Excellence in Basic Sciences, Mumbai, August-November 2014

K K Mishra
1. An introduction to HBCSE's e-learning portal in Hindi, *National Workshop on Development of Educational E-materials in Hindi,* organized by HBCSE at Vigyan Parishad Prayag, November 26, 2014
2. Atomic structure (special lecture), *National Workshop on Development of Educational E-materials in Hindi,* organized by HBCSE (TIFR) under the auspices of Vigyan Parishad Prayag, November 27, 2014

H. C. Pradhan
1. The history of the concepts of inertia and gravity up to the scientific revolution, C. K. Mazumdar Summer School, jointly organized by Indian Association of Physics Teachers and S.N. Bose Institute of Physics, Kolkata, June 26, 2014
2. Axiomatic approach to thermodynamics, C. K. Mazumdar Summer School, jointly organized by Indian Association of Physics Teachers and S.N. Bose Institute of Physics, Kolkata, June 27, 2014
3. Relation between mathematics and physics, *Workshop for post-graduate students in Physics,* IAPT Centre for Scientific Culture, Midnapore College, Midnapore, June 28, 2014

4. Mechanics of rotational motion, *BASE Workshop for Physics Teachers,* K. J. Somaiya College of Science, Mumbai, July 5, 2014
5. Science and mathematics education – Perspectives and prospects, Session on Challenges to Education in Modern India, *102nd National Science Congress* (organized by University of Mumbai), Nehru Centre, January 6, 2015
6. History of the concept of gravity up to Newton, *Students Seminar,* Regional Institute of Education, NCERT, Bhopal, February 27, 2015

S. Naik

1. Constructivism in teaching middle school mathematics, *Annual Teacher Education Program at Zonal Institute for Education of Teachers* (ZIET), Kendriya Vidyalaya Sanghathan, April 16, 2014.
2. Constructivism in practice of teaching mathematics, *Annual Teacher Education Program,* Kendriya Vidyalaya, Uran, June 1, 2014
3. Specialized Content Knowledge (SCK) for teaching mathematics, *SSA Training Program for Primary Mathematics Teacher*, Vikramgarh, Thane, July 24, 2014
4. Using special cases to solve mathematics problem, *Workshop on Mathematics Problem-solving for Pre-service Teachers,* St. Xavier's Institute of Teacher Education (XITE), Mumbai, August 20, 2014
5. Making conjectures and solving mathematics problems, *Workshop on Mathematics Problem-solving for Pre-service Teachers*, St. Xavier's Institute of Teacher Education (XITE), Mumbai, August 20, 2014
6. Two Units on: Pedagogy of mathematics education course, Course Lecture for M.A. Elementary Education students, Tata Institute of Social Sciences, Mumbai, Fall, 2014
7. Learning to teach mathematics, *4-day Workshop* including live teaching to 5th graders for pre-service teachers, St. Xavier's Institute of Teacher Education (XITE), Mumbai, November 5-8, 2014
8. Learning fractions and ratios, *4-day Teaching Workshop* for students of grade 5 from the schools affiliated with St. Xavier's Institute of Teacher Education (XITE), Mumbai, November 5-8, 2014

J. Ramadas

Visuospatial learning in school science, TIFR Centre for Interdisciplinary Sciences, Hyderabad, May 9, 2014; BARC Special Colloquium, March 20, 2015

J. Ramadas & S. Padalkar

Visuospatial reasoning in elementary astronomy, Workshop for teacher educators at the Centre for Cognitive and Neural Sciences, University of Hyderabad, May 8, 2014

A. Sharma & S. Chunawala

Attitudes of teachers towards inclusion. Paper presented in *Council for Teacher Education (CTE) Seminar,* Bengaluru, June 6 -7, 2014

G. Singh

Research methods in education: Using qualitative methods to investigate student questioning, Lecture for M.Ed. students, K. J. Somaiya Comprehensive College of Education, Training and Research, Mumbai, March 23, 2015

K. Subramaniam

1. Understanding and using vectors (Set of 3 lectures), for teacher educators and curriculum designers of Uttarakhand DIETs and Azim Premji Foundation, Dehradun, September 2014
2. What is pedagogical content knowledge? Why is it needed to teach maths?, PVDT College, Mumbai, February 2015

A. Sule

1. Introductory mathematics – 2 (M200), Lecture Course at UM-DAE CBS, January-April, 2015
2. Use of computers in physics and astronomy, Refresher Course for UG teachers organized by D. G. Ruparel College, Mumbai, September 2014
3. Introductory mathematics – 1 (M100), Lecture Course at UM-DAE CBS, August-November, 2014
4. Use of technology in mathematics Teaching, P. V. D. T College of Education For Women, SN.D.T.

University, Mumbai, March 2015
5. Fun with celestial orbits, Astronomy Club, IISER (Mohali), Mohali, March 2015

A. Sule & A. Ghaisas

NCSM capacity building workshop for olympiads (Four lectures), organized by Nehru Science Centre, Mumbai, April 2014

S. Takker

1. Confluence of research and teaching: Case study of a mathematics teacher, *Congress of European Research in Mathematics Education (CERME-9)*, Prague, Czech Republic, February 2015
2. Introduction to education research, Course lecture for students of M. A. Education course, Institute of Social Sciences, Hyderabad, February-March, 2015
3. Understanding teacher knowledge and practice: Focus on mathematics education research, Tata Institute of Social Sciences, Mumbai, March 2015

R. Vartak

International biology olympiads as well as innovation and experimentation in biology. Refresher Course organized by Zonal Institute of Education and Training (ZIET), Mumbai, December 30, 2014

B. J. Venkatachala

1. Inequalities in olympiad problems, Manipur University, Imphala, December 1-2, 2014
2. Polynomial equations in olympiad problems, NEHU, Shillong, Meghalaya, December 8-10, 2014

LECTURES, COLLOQUIA, SEMINARS
14. LECTURES BY VISITORS

Savitha Moorthy (*Centre for Technology in Learning SRI International*), How media can support early science: Lessons from Sid, the science kid!, July 10, 2014

Butool Abbas (*CEO, Thinking Threads Design*), Towards a ‘thinking and innovation' climate in Indian schools: Experiences, methodologies and the road ahead, August 7, 2014

Anju Saigal (*Founder-Director, Centre for Equity and Quality in Universal Education*), With teachers, for teachers: Creating video artifacts on teaching practices, September 25, 2014

T. S. Saraswathi (*Retd. Professor and Chair, Department of Human Development and Family Studies, Maharaja Sayajirao University of Baroda*), Culture as context for development: Perspectives from cultural developmental sciences, October 18, 2014

Paula Heron (*Department of Physics, University of Washington*), Designing and evaluating new approaches to science instruction, October 22, 2014

Jill Adler (*School of Education, University of the Witwatersrand, South Africa*), Mathematical discourse in instruction (MDI): A socio-cultural framework for describing and studying mathematics teaching, October 22, 2014

Sibel Erduran (*University of Limerick, Ireland*), Nature of science revisited: Towards a holistic account of nature of science in science education, October 22, 2014

Neeraja Raghavan (*Azim Premji University, Bangalore*), Emergence of the reflective practitioner from the in-service teacher, November 5, 2014

Aneshkumar Maharaj (University of KwaZulu- Natal), Mathematics e-learning and diagnostics. December

18, 2014

Helen Longino *(Professor, Stanford University),* Pluralism in the sciences of behaviour, January 1, 2015

Jean Michel Delire *(Lecturer, Haute Ecole de Bruxelles & at the University of Brussels),* Classroom activities based on ancient India mathematics, January 2, 2015

Sundar Sarukkai (*Professor and Director, Manipal Centre for Philosophy and Humanities*), Indian experiences with science: Considerations for history, philosophy, and science education, March 27, 2015

V. G. Kulkarni Memorial Lecture

Ranjan R. Kelkar (*Former Director of Indian Meteorological Department, New Delhi; Currently the Chair of the Science Committee of Bal Bharati, Pune*), Climate change and the new generation (lecture in memory of Shri V G Kulkarni, its founder director), HBCSE, September 18, 2014

Lectures at Olympiads Valedictory Functions and Infosys Functions

Ramana Athreya (*Physics Olympiad Valedictory Function*), The universe of diversity, April 21, 2014
Anish Ghosh (*Mathematics Olympiad Valedictory Function*), Equidistribution of sequences, May 19, 2014
A. Raghuram (*Mathematics Olympiad Valedictory Function*), Arthmetic mysteries, May 19, 2014
Ravi Raghavan (*Chemistry Olympiad Valedictory Function*), The chemical industry and society, June 6, 2014
Jayaram Chengular (*Astronomy Olympiad Valedictory Function*), Frontiers of radio astronomy, June 7, 2014
S. Shivaji (*Biology Olympiad Valedictory Function*), Exobiology: Search for extraterrestrial life, June 12, 2014
Rohini Godbole (*Infosys Awards Function*), Higgs discovery and after, December 22, 2014
Sanjeev Galande (*Infosys Awards Function*), From genome to epigenome, December 22, 2014

NIUS Seminars

Avinash Deshpande *(Raman Research Institute, Bangalore),* Fascinating life stories of pulsars, February 21, 2015

LECTURES, COLLOQUIA, SEMINARS
LECTURES BY TIFR MEMBERS (HBCSE, Mumbai)

K. Haydock, Vision-presentation on work done in the STEAM lab, HBCSE Review, October 19, 2014

S. Chunawala, Problem solving & real-life situations, Nurture Programme organized for NTS scholars, November 2014

R. D'Souza, Critical ethnography, January 29, 2015; Critical ethnography in education, March 12, 2015

Seminars At Annual Research Meet, November 12-14, 2014

N.D. Deshmukh, My experiences about 25th AABE conference
R. D'Souza, Building theory on ableism & disability oppression
K. Haydock, Constructionism
M. Kharatmal, Analyzing links in concept maps: A conceptual change approach
M. Kharatmal, A proposal to extend concept mapping to concept lattices for representing biology

S. Naik, Investigating teachers' engagement with mathematical practices: A study of mathematics teachers' problem solving
P. Pande et.al, How does representational competence develop? Exploration using a fully controllable interface and eye-tracking
P. Pande, Categorization of multiple external representations by chemistry undergrads: An eye-*tracking study*
D. D. Pednekar, Implementation of KOHA: Free open source Library Management software in HBCSE library from November 2014
J. Rahaman, Action based analysis of students' strategies during area measurement
J. Ramadas, Visuospatial learning in school science
R. Shaikh, Chat Studio: Learning arithmetic in social-virtual environment
A. Sharma, Exploring attitudes of students, parents, teachers toward inclusive education
G. Singh, Question generation by students in science classroom
H. Srivastava, Exploring the ecology economy discourse in high school science
S. Takker, Characterizing teaching practice: A case study
S. Varadarajan, Understanding the age/class appropriateness of the students to internalize the various phases of inquiry effectively

In-House talks at workshops organized in collaboration with HBCSE

N.D. Deshmukh
Role of OER in teacher education, *State Level Workshop on Blended Learning- Pathways to Success*, organized by Chembur Sarvankash Shikshanshastra Mahavidyalaya, HBCSE, March 17, 2015

S. Chunawala
1. Introduction to Research methodology and its framework, *YCMOU Workshop*, August 3, 2014
2. Research methods and preparing for research proposal, *YCMOU Workshop*, September 14, 2014
3. Research method and frameworks, *YCMOU Workshop*, September 28, 2014
4. Guidance to write a research proposal, *YCMOU Workshop*, December 28, 2014
5. Statistical methods and the experimental designs, *YCMOU Workshop*, January 18, 2015

S. Ladage
Trends in chemical education research, *Workshop on Introduction to Chemistry Education Research*, organized by Homi Bhabha Centre for Science Education (HBCSE), Mumbai, April 2014

S. Naik
Learning to solve mathematics problems for middle school and secondary school teachers, *A four-day Residential Workshop*, HBCSE, Mumbai, May 28-31, 2014

H. C. Pradhan
Introductory biostatistics, *International Biology Olympiad Orientation-cum-Selection Camp 2014*, June 8, 2014

15. GRADUATE COURSES

HBCSE Graduate School

GRADUATE COURSES FOR SEMESTER I

Cognition, Cognitive Development and Learning *(Sanjay Chandrasekharan)*

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

History of Science *(Arvind Jamkhandi)*

Introduction to Science, Technology and Mathematics Education Research *(Sugra Chunawala)*

GRADUATE COURSES FOR SEMESTER II

Advanced Topics on Cognition *(Sanjay Chandrasekharan)*

Reading Course on Motivation *(Sanjay Chandrasekharan)*

Introduction to Mathematics Education *(K. Subramaniam, Shweta Naik, Shikha Takker, Rossi D'Souza)*

School Teaching Experience *(K. Subramaniam, Shweta Naik, Tuba Khan)*

Methods of Science, Technology & Mathematics Education Research *(Sugra Chunawala, Aniket Sule, Shubhangi Bhide)*

Philosophy of Science *(G. Nagarjuna)*

PhD THESES

Mashood K. K : Developing a comprehensive concept inventory in rotational kinematics: A diagnostic tool to probe misconceptions and pitfalls in reasoning. *(Supervisor: Vijay Singh)*

TRAINING
National Initiative in Undergraduate Science, HBCSE

Physics

Debashis Saha (IISER, Kolkata); Quantum communication protocol; (Prasanta Panigrahi, IISER, Kolkata)

Sourav Sarkar (IISER, Kolkata); Atmospheric neutrino and mixing angles in 2-neutrino and 3 neutrino oscillation formalisms; (D.P. Roy, HBCSE, Mumbai)

Leya Lopez L (IISER, Kolkata); Electronic properties of semiconductor nanostructures; (Vijay Singh, HBCSE, Mumbai)

Subrata Mandal (IISER, Kolkata); Geometric measures and applications of quantum entanglement; (Prasanta Panigrahi, IISER, Kolkata and Vijay Singh, HBCSE, Mumbai)

Virendra Ranga (Hansraj College, New Delhi); Solar and reactor neutrino oscillation in two and three neutrino mixing formalism; (D.P. Roy, HBCSE, Mumbai)

Renita Benjamin Saldanha (V.G. Vaze College, Mumbai); Solar and reactor neutrino oscillation in two and three neutrino mixing formalism; (D.P. Roy, HBCSE, Mumbai)

Sachin Grover (Shri G.T.B. Khalsa College, New Delhi); Soliton solutions of non-linear schrodinger equation with periodic boundary conditions; (Vivek Vyas, IMS, Chennai and Vijay Singh HBCSE, Mumbai)

Umang Gupta (IIT, Delhi); Asteroseismology of red giant stars; (Anwesh Mazumdar, HBCSE, Mumbai)

Bhakti Chitroda (MSU, Vadodara); Behaviour of soft springs; (Rajesh Khaparde, HBCSE, Mumbai)

Sohitri Ghosh (IISER, Kolkata); Studies on the characteristics of light emitting diodes and studies on thermal properties of incandescent bulb; (Rajesh Khaparde, HBCSE, Mumbai)

Chemistry

Athulya Ram S (IISER, Thiruvananthapuram); Influence of electrolytes and crown ether on physicochemical properties of Triton X-100 solutions; (P A Hassan, BARC, Mumbai and Indrani Das Sen, HBCSE, Mumbai)

P. Shubham Parashar (IISc, Bangalore); Towards the exact factorization of the molecular wavefunction; (Swapan Ghosh, BARC, Mumbai)

Soumav Nath (IISER, Kolkata); To study the effect of annealing and acid treatment on nafion thin film using 4pbi as the fluoroscent dye; (Anindya Datta, IIT, Mumbai)

Aakash Kumar Sinha (Hindu College, New Delhi); Green synthesis of 2,3-Diphenyl Quinoxaline using reusable lewis acid catalysts. (Lakshmy Ravishankar, KET's Vaze College, Mumbai; Gomathi Shridhar, V K Menon College, Mumbai and Savita Ladage, HBCSE, Mumbai)

17. POPULAR SCIENCE LECTURES

N. D. Deshmukh

1. Science & mathematics for a sustainable world, Maharashtra Vidyalaya, Goregaon, November 8, 2014
2. How to prepare for Homi Bhabha bal vaidnyanik examination? Safe Hands Institute, Akola, December 19, 2014
3. Hands on experiments, Guru Nanak School, Akola, December 19, 2014
4. Collaborative learning, Pethe High School, Nashik, February 28, 2015

A. Ghaisas

1. Indian space program with Chandrayan and Mangalyan, Lecture for first year students of Ruia College, organized by Madyamumbai Marathi Vidnyan Parishad, Ruia College, November 21, 2014
2. The size of our known universe, Public Lecture, Chandur Railway Station Region - near Amarawati, organized by an NGO "Amhi Sare", February 21, 2015
3. *Antaralatil Manav (Man in Space, in Marathi),* Public Lecture, Chhatrapati Shiwaji Auditorium, Amarawati, organized by an NGO "Amhi Sare", February 22, 2015
4. Astronomy for the beginners; The size of our known universe; Astronomy olympiad activities at HBCSE, *Full day workshop for Students, Teachers and Parents*, organized by an NGO "Amhi Sare", Achalpur, February 23, 2015
5. Astronomy for the beginners; Antaralatil Manav, *Full day Workshop for Students, Teachers and Parents,* organized by an NGO "Amhi Sare", Amarawati, February 25, 2015
6. Antaralatil Manav; Session of night sky observation with Telescopes, Public Outreach Program for Students, Teachers and Parents, organized by an NGO "Amhi Sare", Warud, February 25, 2015
7. Astronomy for the beginners; Our solar system, Astronomy olympiad activities at HBCSE, *Full day workshop for Students, Teachers and Parents*, organized by an NGO "Amhi Sare", Anjangaon, February 24, 2015
8. Astronomy for the beginners; The size of our known universe; Astronomy olympiad activities at HBCSE, *Full day workshop for Students, Teachers and Parents*, organized by an NGO "Amhi Sare", Chikhaldara, February 26, 2015
9. The size of our known universe, Public Lecture for Students, Teachers and Parents, organized by an NGO "Amhi Sare", Ner, near Akola, February 26, 2015
10. Antaralatil Manav; Astronomy olympiad activities at HBCSE, Half-day Workshop for Students, Teachers and Parents, organized by Saraswati Vidya Prasarak Mandal and an NGO "Amhi Sare", Saraswati college, Akola, February 27, 2015
11. Antaralatil Manav, Public lecture organized by Rajarshi Shahu Maharaj Engineering College in collaboration with an NGO "Amhi Sare", Buldana, February 27, 2015

A. Ghaisas & K. Hambir
Astronomy for the beginners, *Hands-on Science Workshop*, Radhabai Memorial Centre, Kurchorem, Goa, November 11, 2014

A. Ghaisas &. A. Vaishampayan
The small and the big of the universe and mathematics laboratory activity, *One-day Workshop* for St. Xavier's High School for boys, Mumbai, December 5, 2014

S. Ghumre
Simple model systems based research activities, National Science Day, February 27, 2015

V. D. Lale
1. Chemistry activities for teachers, Dhaygude Activity Centre, Solapur on September 6, 2014
2. Chemistry activities for teacher developers, RSC Programme, HBCSE, Mumbai on October 4, 2014

H. C. Pradhan
1. Opportunities for research in physics (Marathi), *Vocational Guidance Camp for Students*, Joint Initiative of Daily Loksatta and Marathi Vidnyan Parishad, Chunabhatti, Mumbai, April 5, 2014
2. What can we learn from science education in Israel? Address by the Chair, *Seminar on Education in Israel*, organized by the Consulate of Israel and Observer Research Foundation, Sathaye College, Parle, Mumbai, April 28, 2014
3. Exciting careers in science, *Workshop for National Science Talent Search Scholars*, November 6, 2014
4. Face to face with scientists, Question and answer session, National Children's Science Congress, Bengaluru, December 27, 2014
5. Rise of the scientific method – Concept of gravity as an exemplar (Marathi), *National Science Day Seminar,* Marathi Vidnyan Parishad, Thane, March 18, 2015

J. Ramadas
How and Why of Learning Science, "Chai and Why", Prithvi Theatre, March 1, 2015

R. Shaikh
1. Activity on approximate number sense, FOS, TIFR, Mumbai, November 23, 2014
2. Sugar learning platform demonstration and tree mapping activity, National Science Day, February 27, 2015

R. Shaikh & J. Rahman
How many? "Chai and Why?", Ramnarain Ruia College, July 20, 2014

K. Subramaniam
1. How children learn, Junoon's "Mumbai Local" Programme, Mumbai, July 2014
2. Scientific temper: Some issues and questions, the *Fourth Research Scholars' Confluence*, IIT Bombay, March 2015

A. Sule
1. Telescopes of the future (Marathi), Aseemit Astro Club, Pune, August 23, 2014
2. India's mars mission (English), Cathedral and John Cannon School, Mumbai, October 17, 2014
3. Astronomy, astrology and scientific temper (English), *NTSE nurture camp* organized by HBCSE (TIFR), Mumbai, November 4, 2014
4. Astronomy, astrology and scientific temper (Marathi), Kaivalya Hospital, Thane, November 23, 2014
5. Telescopes of the future (Marathi), Skywatchers Astro Club, Pune, December 21, 2014

17. POPULAR SCIENCE ARTICLES

J. Advani & D. Karnam
Tribute to Obaid Siddiqi: Bringing science to society, *eSS Tribute*, July 27, 2014

P. Birwatkar & S. Chunawala
Science teaching with a difference, *Teacher Plus*, February Issue, 24-26, February 3, 2015

P. De
A golden maximum, *Mathematical Spectrum,* **46**(3)*,* 132-133, May 2014

N. D. Deshmukh
1. Tata Institute of Fundamental Research (TIFR) , *Mitra,* August 2014
2. The Indian Space Research Organization (ISRO) , *Mitra,* November 2014
3. Article Series on: Constructivism and inquiry-based learning. *Shri Shivaji Education Society Souvenir*, December 2014
4. Council of Scientific & Industrial Research (CSIR), *Mitra,* January 2015

R. D'Souza & S. Takker
Learning mathematics through puzzles, *At Right Angles*, **3**(2), 18-22, July 2014

A. Ghaisas
1. Prashna mazya manatla (Set of 31 articles answering questions asked by students in rural areas near Pune), Column in Marathi Newspaper *Prabhat* (Pune), April 15 to June 15, 2014
2. Antaralatil manav (Marathi), Media Watch (Special Deepavali Issue), 171- 184, October 2014
3. Sasaa ani kaasav; Shahaamrug; Shahana unta; Vaghiniche doodh; Manjari dole mitoon doodh pite; Kabootarachi andi (Set of 6 articles), Column in Marathi bi-monthly *Aksharshilpa,* October 2014 to present.

K. K. Mishra
1. Nanoscience and its applications. *Dream 2047*, **17**(6), 32-34, March 2015
2. Ativilakshan hai Graphene, *Avadh-Archana,* 27-28, May-July 2014
3. Udaarmana Dr Subodh Mahanti, *Vigyan,* 39-41, August 2014.
4. Jeevan mein Nano-takaneek kii Upadeyata, *Electroniki Aapke Liye*, **28**(9), 21-23, September 2014
5. Vedic Saraswati ki Khoj, *Vigyan,* 5-7, September 2014
6. Dr. Prafulla Chandra Ray- Bharat mein rasayan vigyan ke janak, *Avadh-Archana,* 28-30, November 2014
7. Vigyan-Ateet ke Aaiiye mein January, *Avishkar,* 39-42, January 2015
8. Vigyan-Ateet ke Aaiiye mein February, *Avishkar,* 15-20. February 2015
9. Vigyan-Ateet ke Aaiiye mein March, *Avishkar,* 19-24, March 2015
10. Shiksha ke liye portal ka vikas: Homi Bhabha Kendra ki pahal, *Hindi Garima,* 45-46, March 2015

D. Prabhu
The lingering effect of labels, *Teacher Plus*, February Issue, 40-41, February 3, 2015

H. C. Pradhan
1. Obituary of Professor B.M. Udgaonkar – Moolbhoot Vaidnyanik ani Shikshantadnya, *Marathi Vidnyan Patrika,* February 2015
2. Pavlopavli vidnyan (in Marathi), *Lokprabha*, January 9, 2015

A. Srivastava
Drawing out the structure of DNA, *Teacher Plus*, November Issue, 46-49, November 3, 2014

18. RADIO/ TV PROGRAMMES

H. C. Pradhan

1. A discussion on Kumar Vishwakosh (Marathi), *Amrutvel*, Sahyadri Vahini, Doordarshan, Mumbai, June 12, 2014 (with Vijaya Wad)
2. Vidnyan–tantradnyan ani vikas, Mahacharcha, A live discussion programme on current topics (Marathi), Sahyadri Vahini, Doordarshan, Mumbai, February 19, 2015

K. K. Mishra

1. Nanotechnology se laabh, All India Radio, Mumbai, July 4, 2014.
2. Mangalyaan, All India Radio, Mumbai, September 24, 2014.
3. Antariksha ki kahaani, All India Radio, Mumbai, October 4, 2014
4. Saurmandal ke grahon ki kahani, All India Radio, Mumbai, January 10, 2015

A. Sule

1. Interview, DD Sahyadri, May 2014 [International Technology Day]
2. Interview, DD Sahyadri, August 2014 [Thompson birth anniversary]
3. Interview, Z24 Taas, September 2014 [Mangalyaan]
4. Interview, DD Sahyadri, September 2014 [Mangalyaan]
5. Interview, Mi Marathi, September 2014 [Mangalyaan]
6. Interview, Mi Marathi, January 2015 [Indian Science Congress]
7. Interview, ABP Majha, January 2015 [Indian Science Congress]

M. Vahia & A. Sule

Interview, All India Radio, Mumbai, October 2014 [Mangalyaan]