Homi Bhabha Centre for Science Education
Annual Report 2016-17

(April 1, 2016 to March 31, 2017)

Research & Development in Science, Technology and Mathematics Education

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

I. Learning and Reasoning with Representations (LRR)

Interactive simulations to learn concepts in physics and mathematics

The interactive simulation in Javascript, developed last year for teaching and learning vectors, was redesigned significantly, based on learner studies and guidance from an interaction designer from NID. A paper based on studies with this system was presented at the *24th International Conference on Computers and Education.* Related to this work, an extensive text-book analysis was done (NCERT, Maharashtra Board, Singapore textbooks), to understand the gaps in the current presentation of vector concepts. [H. Agrawal, D. Karnam, S. Chandrasekharan]

The simulation to teach and learn the oscillation concept was refined, both in terms of content and interaction. The results from a study based on this simulation shows that students are not able to understand the relationship between different representational elements (oscillator, equation, graphs) just by interacting with such a system; a teacher is needed. [A. Kothiyal, R. Majumdar (IDP-ET, IITB), H. Agrawal, P. Pande, S. Chandrasekharan]

The interactive piecewise oscillator simulation developed last year is now redesigned significantly, to help students understand the related concepts better, and to help tecahers teach the content better. The system will be tested at the Cochin University of Science and Technology this year, in a collaborative project with a CUSAT faculty member in educational technology. [H. Agrawal, S. Chandrasekharan]

A simulation to teach and learn volume concepts was developed, based on the Leap Motion controller, in collaboration with the Interdisciplinary Program in Educational Technology, IIT Bombay. The system allowed students to manipulate geometric structures on screen using hand movements. Preliminary results from a study based on this system showed that interacting with the simulation allowed 9th standard students to understand volume concepts better. A paper based on studies with this system was

presented at the *24th International Conference on Computers and Education*. [L. Ganesh, S. Narayana, P. Prasad, (IDP-ET, IITB), S. Chandrasekharan]

Science learning and visualization: Students with and without vision

Students with visual impairments (SVI) are at a disadvantage while learning science and technology, due to an overemphasis on the visual mode in teaching. We tried to understand and enhance the school learning of SVI through activities, and explored the role of drawings as a means of externalization. The concept of atomic structure, as it has evolved through the theories of Dalton, Thomson, Rutherford and Bohr, was approached through multiple representations, such as verbal descriptions, 3D models and drawings. Before the intervention, alternative conceptions of SVIs were elicited. The alternative ideas of SVIs were found to be related to the shape, size and location of atoms. These were present in the analogies used by the students when talking about atoms. Interestingly, these conceptions were similar to those held by sighted students. The results were presented at an international conference in Kerala and have been submitted to an international journal. [A. Sharma, S. Chunawala]

Instant sharing makes task more engaging in a computer-aided classroom

A study on the impact of shared responses on developing number sense was investigated on a sample of 44 students, grouped into experimental and control group. An analysis of data collected for 50 sessions was conducted. The results of this study show that comparable learning happened in both the experimental and control groups, though the quality of learning, depth of understanding, sustained interest in arithmetic activities, attempting alternate strategies, etc., were significantly higher in the experimental group. A paper based on the work was accepted for presentation in *Computer Supported Collaborative Learning Conference* to be held in Pennsylvania in June 2017. [R. Shaikh, G. Nagarjuna, R. Katkam, Mrunal N, H. Agarwal, A. Dhakulkar]

Knowledge construction in an undergraduate biology lab

A detailed cognitive-histographical and socio-cultural analysis of the evolution of two model systems in an engineered learning environment was conducted. The analysis first explicates the design principles underlying an experimental laboratory model and further describes the case studies that help illustrate, support and extend these design principles. The case studies pertain to the developmental trajectory of the model systems in the lab -- from the time of their introduction into the environment to the way understanding about them developed through chains of mediation. These studies also analyze the evolution and transformation of concepts, emergent research areas, models and values in relation to the affordances that act on the system, and how the new form of these components further seeds into the subsequent actions performed with and on the model system. The analysis done relates to, supports and extends contemporary ways of thinking about philosophy of biology and biological sciences. [S. Ghumre, G. Nagarjuna]

Using semantic reference set of linking words for concept mapping in biology

Inspired by semantic network studies, we proposed additional conventions for choosing linking words and arrive at a reference set of semantically well-defined linking words

drawn from the knowledge representation area of research in biology. We studied expert representations by content analysis of biology texts, at three levels of increasing subject complexity. This was followed by a comparison of the linking words used in these representations with the reference set. We found an increasing degree of proximity to the latter, indicating that experts tend to use more well-defined linking words. The work is published as a chapter in a book. [M. Kharatmal, G. Nagarjuna]

II. Teaching and Pedagogy

Knowledge demands in teaching decimal numbers

Elements of knowledge implicated in a teacher's practice was examined, in terms of responsiveness to student thinking, while teaching a specific mathematical topic as it changed over successive years. The study is based on an analysis of "paired episodes/ lessons", i.e., episodes/ lessons of classroom teaching of the same topic by a teacher over two consecutive years. The change in teaching decisions places different knowledge demands on the teacher in each year. We analysed the nature of knowledge demands posed on teachers, arising from interactions between the teacher's decisions, students' responses, and teacher's knowledge about students and mathematics. Such a principled analysis of knowledge demands helps in making sense of the complex pedagogical transformation of content during teaching of specific topics. [S. Takker, K. Subramaniam]

Alternative conceptions regarding the first law of thermodynamics

Activity-based modules were designed to address students' difficulties in understanding the first law of thermodynamics as applied to adiabatic and isothermal processes. One alternative conception identified was: since an adiabatic process corresponds to no exchange of heat, there is no change in temperature. An activity was developed to address this alternative conception, based on an analog of Joule's apparatus. In this task a stirrer is rotated not by falling weights but by a DC motor. The students observed that the temperature of the water increased as it was stirred. But the heat flow indicator showed no heat flow. The students realized that even if the net heat flow between water and surrounding was zero, the temperature of the water could be changed. This change in temperature is due to the change in the internal energy which was brought out by external work done on the water by the stirrer. [H. C. Pradhan, S. R. Pathare]

NVM Participatory Action Research (PAR) project

A long term participatory action research project with a neighbouring school, Nutan Vidya Mandir (NVM), is in its third year. The project aims to develop a model of participatory action research in school education. Its broad objectives are: understanding the teaching-learning process; preparing instructional materials (worksheets, handbooks/activity manuals); generating simple and inexpensive experiments designed to nurture resourcefulness, and teaching aids including audio-visual aids. This academic year, various activities, lesson plans and worksheets were designed by teachers and researchers together after discussion of subject content, pedagogy and possible resources. The activities and worksheets led to increased participation and questions from students. A month long summer camp was organised in May 2016 for grade 4

students, where they were introduced to sessions on design and technology, language, creative writings and other activities. A visit of students from all 4 divisions (a *Bal Mahotsav*) was organised at HBCSE on March 22, 2017. In the *Bal Mahotsav*, students performed various cultural and entertainment shows, while some shows focused on environmental conservation. Teachers and SSRD team members demonstrated interesting science activities. [J. Ramadas, S. Chunawala, N. Deshmukh (Program Coordinator), S. Bhide, V. C. Sonawane, P. Navale, A. Muralidhar, K. Hambir, V. Pawar, T. Adangale, N. Sonawane, D. Gupta and Nutan Vidya Mandir's teachers S. Jadhav, N. Patil, K. Nagvekar, R. Pawar, R. Shinde]

Mathematics teachers' understanding of teaching algebraic identities

Studies of student errors on algebraic identities, particularly equality and concepts around equality, report varied conception of the "=" sign and how that functions in students' understanding of other algebraic entities. We studied the pedagogy for algebraic identities, given that these are the equations where students are exposed to the idea of "always equal" for the first time. This study is part of a larger study on investigating teachers' knowledge to teach mathematics effectively, and presents six cases of teaching algebraic identities. These cases have been analyzed for mathematical explanations, use of representations, coherence with mathematical goals and described applications. We find that identities have become different mathematical entities in school algebra due to its preached pedagogy, and the explanations and representations used to introduce the concept are situated in the concept of algebraic identities through a pseudo—mathematical logic. A manuscript describing this result is submitted for publication. [S. Naik, Deborah Ball (University of Michigan), K. Subramaniam]

Biology teaching based on history of science

A project on improving undergraduate biology teaching was initiated in July 2016. One part of the project is to investigate processes and outcomes of incorporating the history of science (HOS) in the course content. Sixty students in their second year of B. Sc. in microbiology and biotechnology and three lecturers of a local college volunteered to participate in the study. Preliminary analysis of the written data is completed. In a related project, we have further administered the baseline test in three other degree colleges, whose cut-off marks for entrance span a wide range, and are working with more to gather data on a much larger number of students. We aim to investigate factors associated with their performance in the test. Analysis of the data from both projects is ongoing. [J. Vijapurkar, D. Gupta, A. Sawant, S. Patil, N. Bagban]

Pedagogy for introductory science

An analysis of classroom interactions, to trace in detail the development of successful pedagogy of particularly difficult but essential concepts in introductory science was completed. A draft report of results has been prepared. [J. Vijapurkar, S. Patil, A. Sawant]

III. Policy and Curriculum Redesign

Agriculture discourses in Indian school textbooks
An analysis of discourses around agriculture in Kerala, as documented in 25 textbooks over a period of 120 years, was conducted. Textbook discourses corresponding to the major shifts in Indian agricultural sector during the Pre-Independence, Post-independence, Green Revolution, Environmental Movements, New Economic Policies, and Organic Farming Movement phases are identified and analysed, to understand how the social body of agriculture influences textbook discourses. The results show that school textbooks are greatly influenced by the changes in the social body of agriculture. Very recent textbooks are seen participating actively in the organic farming movement. They acknowledge the changing perspectives within the discourse of science, accepting its limitations, by which it once promoted soil-degrading, disease-causing high-input agriculture. An evolution from reductionist to holistic conceptions of Nature is seen underlining these changes. [R. Varkey, G. Nagarjuna]

Study of micro-hydro turbine design to inform engineering design education
An interactive simulation to design microhydro turbines was tested with one rural innovator, one formally trained engineer and a few students (all involved in developing microhydro turbines), to understand the mental models used by each practitioner while developing microhydro turbines, and the role played by formal education in the design process. The data (simulation logs and verbal comments) are currently being analysed. [H. Agrawal, G. Date, S. Chandrasekharan]

Terrace farming in schools as a way to promote environment-oriented behavior
A terrace farm has been set up in a suburban school in Mumbai, to understand how environment-oriented actions and behavior could be promoted among urban school students by introducing them to terrace farming. Preliminary results from the study shows that the farming practice has led to students becoming more closely engaged with environmental issues. The farm is very popular with students, parents and teachers, and there is demand for setting up similar farms in other schools. [D. Dutta, A. Muralidhar, S. Chandrasekharan]

Differences in problem identification and problem solving between adults and children
Differences in problem identification and problem solving between adults and children was studied by analysing a range of innovations registered on the website of the National Innovation Foundation. Students and adults who submitted these innovative ideas had not received any design brief by an external agency and the range of problems they tackled were from diverse areas. Specific problems that were addressed by these two groups were categorised. We expected greater diversity in problems identified by students as compared to adults, because literature suggests that young children are very creative and this creativity is limited by external factors as children grow. Instead, we found a greater diversity in the problems tackled by adults. Besides, there were other qualitative differences in the kinds of problems identified by adults and children. Through this study we explored the possibility of judging creativity by identifying

diversity in large number of created artifacts. [S. Datt, S. Chunawala]

Creativity in science and technology

A survey of 12 upper primary and secondary school science teachers, focused on teachers' view about the role of creativity in science, found that teachers identified science more with the context of justification, which is about proving and validating existing knowledge, rather than the context of discovery, which is about inventing new knowledge and artifacts. [S. Datt, M. Shah, S. Chunawala].

While literature on creativity defines it as any activity that leads to creation of novel and useful artifacts or ideas, a paper on the paradox of novelty and usefulness presented diverse and alternative perspectives of viewing creativity using various examples from history of technology. Both these studies were presented at the *International Conference for Creativity and Cognition in Art and Design*, 2017, NIMHANS and NID, in Bengaluru. [S. Datt]

Environmental studies and outdoor engagement

Primary school students' engagements in outdoor activities within the context of environmental science over the past two years were analyzed. We found that being outdoors provided simple and relatable contexts for children's conversations, written/ drawing tasks, and enabled the introduction and discussion of topics while also creating opportunities for learning through avenues that might not come up during conventional indoor teaching. In these engagements, students had opportunities to connect with various aspects of both the natural and social worlds. Students showed creativity, persistence (on task) and independence during outdoor tasks. Broadly, instances observed indicated emotional and agentic dimensions of student engagement. The study was presented at the *International Organization of Science and Technology Education (IOSTE) Symposium* at Braga, Portugal in July 2016. [S. Bhide, S. Chunawala]

Exploring the possibility of transformative science education

Intensive workshops were conducted with two groups of class IX students to elicit their understanding of various aspects of waste, health and development. While both the groups had similar socio-economic status, one of the cohorts lived in the close vicinity of Asia's largest dumping ground, and bear direct consequences of various social and environmental effects of the dumping. Preliminary analysis of the workshop data shows that students do not have adequate understanding of the subject matter. They tend to invoke traditional wisdom, everyday experiences and religious beliefs to talk about technical as well as political issues. The literature on "funds of knowledge" shows that these experiences, beliefs and wisdom hold ample opportunities for building a transformative discourse. Through further analysis, we hope to point out the scope for transformative education and collective action. [H. Srivastava]

Science communication, media and scientific literacy

Modules were designed for developing critical thinking and communication in primary school students and teachers, using media articles. Workshops were conducted for two target audiences; students (9-10 year old) and teachers (primary and high school).

Students' workshop aimed to facilitate early steps towards development of scientific literacy, particularly to convey the importance of evidence and critical reasoning in decision making. With teachers, we explored the possibility of using mass media (eg, science- related newspaper articles) to promote scientific literacy as well as the learning of subject content in science classrooms. Some reasons cited by teachers for using such articles were: for extra information, for raising social issues, to generate awareness, to facilitate debate, to promote environmental values, to link concepts between different science topics, etc. [S. Bhide, A. Muralidhar, S. Chunawala]

Exploring ableism in mathematics education

A series of mathematics lessons was conducted at a school for blind children. Analysis of data from teaching-learning sessions with visually challenged students learning mathematics, from the perspective of a critique of ableism, reveals that the exclusion of certain groups of people from mathematics education is not a didactic or pedagogical issue, but a symptom of, and consequently a window into, the internal contradictions of mathematics education as a whole. [R. D'Souza]

Material and Curriculum Development

Collaboration with state government agencies

The Maharashtra Rajya Vishwakosh Nirmiti Mandal, Mumbai

The collaboration of Maharashtra Rajya Vishwakosh Nirmiti Mandal (a body of State Government of Maharashtra) and HBCSE is on going. During the period of this report, the editorial committee of the Kumar Vishwakosh worked on Vol. 3 which consists of about 250 articles. The text of Vol. 3 is about 95% complete. The Vishwakosh Mandal is working on the development of web version. Nine meetings, each spanning 5 days were held during this period to finalize the articles [H. C. Pradhan, V. D. Lale, A. Ajgaonkar and Editorial Committee, Kumar Vishwakosh].

Homi Bhabha Curriculum for Primary Science ('Small Science')

Implementation of the Homi Bhabha Curriculum for Primary Science ('Small Science') was followed up in three schools in and around Chennai. Teachers in these schools were supported to analyse, reflect on, document and share their classroom experiences, and to survey and document the flora and fauna in their school environment in a blog. The 'Small Science' website was migrated to a WordPress platform to http://smallscience.hbcse.tifr.res.in/ in which the teachers' blogs feature in the section 'View from the Classroom'. [J. Ramadas]

Mathematics resources for schools

The Class 1 textbook 'Maths for every child' developed by HBCSE has been translated to Hindi and is in press. New activities and worksheets like worksheet on PCK to teach geometry, L-game, Efficient cut have been added to the laboratory display and these are also available at the mathematics education website as digital resources (http://mathedu.hbcse.tifr.res.in/resources/). A manual on origami activities with pedagogical hints has been developed and is available in print and digital format. [H. Raval, E. Shokeen, T. Khan, S. Naik]

Consultancy
A collaboration with the mathematics education team from Connected Learning Initiatives (CLIx), TISS has led to development of a learning unit and teacher handbook on teaching proportional reasoning to grade 9 students. These resources include 4 units on proportional reasoning that involve digital as well as hands-on resources and are being implemented in schools in four states -- Chhattisgarh, Telangana, Mizoram, and Rajasthan. The handbook, TPD material and student units all will be made available as open source materials after one year of the project. [S. Naik, K. Subramaniam]

Gnowledge lab
The field work and development activities of the Gnowledge laboratory attained momentum during this period. The team was involved in two major national projects: 1. National Repository of Open Educational Resources (NROER) funded by MHRD through Central Institute of Educational Technology, NCERT, New Delhi, and 2. Connected Learning Initiative (CLIx) a multi-partner project funded by Tata Trusts and coordinated by Tata Institute of Social Sciences.

An online course developed for school students, 'Invitation to Connected Learning Environment (i2c)' was deployed in the field through numerous workshops conducted in three different states. The course was developed in three languages, English, Hindi and Telugu and in collaboration with the CLIx team, was implemented in about 200 schools where about 300 teachers were trained as well as about 35 technical field support personnel. The successful run of this online course using the GStudio server led to the use of GStudio for courses developed by other partners of CLIx. As a result it has transformed into CLIx Course Platform for all courses. This process and the collaboration with the Office of the Digital Learning at MIT Boston, which is a core partner of the CLIx project, has led to an agreement that the MIT team will develop Open Assessment Tool for authoring questions as well as Open Assessment Player to administer them. These components were successfully integrated with GStudio environment using an open standard interface called DLKIT (Digital Learning Kit) which is a Python binding for OSID (Open Service Interface Definitions). MIT provided the DLKIT and test cases supporting the integration process. These developments have provided GStudio the ability to embed assessments and generate analytics to track learners performance. During this period team members from HBCSE and MIT visited each other's labs for face to face coordination and made regular conference calls to constantly update the platform https://clixplatform.tiss.edu/, and the code is published at https://github.com/gnowledge/gstudio as a DLKIT branch.

The National Repository for Open Educational Resources (NROER) which was developed and deployed by the gnowledge lab is arguably the largest curated OER repository of the country. The repository published about 7000 resources and the number is constantly increasing every month. The platform is published at http://nroer.gov.in/.

A significant technical innovation achieved during this period was the development of

an installer packaged into an USB pen drive that includes GStudio, NROER, offline version of Khan Academy, PHET simulations and several educational tools. A cutting edge technology called docker was used which was developed using a data center grade GNU/Linux distribution called Core Linux. This helped populate a single machine as host to multiple servers. Using this technology a model installation of school servers was created on a 32GB pendrive (that holds some of the data and a few core docker containers). The technology makes it possible to not only install a cluster of servers using a single pendrive, but also the server can generate the installer into a USB pendrive. This bootstrapping model is a boon to resource-constrained schools of the country. Since all the resources are pre-packaged as containers these could be distributed and an 'Internet-like' environment created in schools without Internet. This model is called the ABCD MOOCs, Activity Based Collaborative Distributed Massive Open Online Courses. [G. Nagarjuna, S. Shende, U. Shah; and A. Dhakulkar, M. Nachankar, K. Aitawdekar, R. Katkam, S. Bharswadkar, Keerthi K. R. D. from TISS, along with the CLIx technology team at TISS and NROER team at CIET Delhi]

Collaborative Undergraduate Biology Education

The CUBE initiative continues to receive encouraging feedback from various quarters as larger numbers of students and teachers are joining the project from various places across the country. New ideas and model organisms have also entered the engagement. As a group cognition project that uses new media to sustain dialogues among participating students and teachers, durable engagement was witnessed through the year. Over 2000 members from different parts of the country are on groups that are included in mailing lists, Facebook, WhatsApp and Telegram groups, of which we estimate about 40 are teachers.

The CUBE lab at HBCSE has turned into an incubation hub for not only a number of model organisms, but also for budding scientists. The lab at any point can provide model organisms like Drosophila, Daphnia/Moina, Rotifers, soil microbes, Earthworm, Snail, Hydra and C. Elegans. The team has successfully bred Cardamine hersuta, as a replacement model for Arabidopsis. Through these model organisms, not only are topics in biology education discussed with students and teachers but also frontier areas of research. Some of the topics engaged in include regeneration studies, cell signalling, stem cell research, epigenetics, biochemistry, behavioural studies, neurobiology, instrumentation, bio statistics, phenology studies, biorythmic pattern, and others.

Unlike other sophisticated biology labs, innovation is focussed on ensuring that the organisms can be maintained with resources available in any school/college lab. For example, Chloro-Hydra is maintained in dechlorinated water with the hydrophytic plant Chlorella occasionally fed with a fresh water flea (Daphnia) in place of marine arthropod, thus reducing the need for constant attention. The innovation of robust model organisms that could survive in school/college labs in Indian weather conditions and resources constrained by limited schools and colleges budgets has become an important feature of the CUBE project. Eventually this could be a solution to the formalin preserved specimens of dead animals and plants that have defined how a biology lab has appeared in decades.

A notable theme that was introduced in CUBE conferences is the report of goof-ups and not merely success stories of a research study. We use failures (which may happen often) as occasions to reflect, reason and remedy. Two meets held during this year celebrated goof-ups. A research meet was organized exclusively focusing on the theme of goof-ups in science. About 70 participants, that included school and college students as well as teachers from Mumbai, Delhi, Gujarat, Kerala, participated in the workshop.

In a nation-wide CUBE Citizen Science program, phenological study of Mango tree is being carried out since January 2017. Cubists from all over the country shared pictures, locations and descriptions on social media. The objective of this activity is to study the effect of latitude on the variations in flowering and fruiting in the Indian subcontinent. Eventually this pilot study will be integrated with the upcoming portal for citizen science and mobile apps, which are under development.

The use of indelible ink applied on a finger after participating in the voting process was used by the cubists from across the country in nail growth studies, as a model for regeneration and growth. A simple instrument using graph paper was developed for recording nail growth. Varied results were recorded such as age and gender differences in nail growth.

The CUBE team was invited by the Department of Biotechnology, Government of India to participate in their BLIS (Biotech Laboratories in Senior Secondary Schools) project in the North Eastern States aimed at encouraging young students in biology. True to the spirit of CUBE, attempts were made to promote the doing of biotechnology in a jugaad way and yet preserve the rigor of inquiry by extracting DNA using substances and chemicals available in a kitchen. The participants were expected to record and edit a video of their activities. About 16 groups, involving collaborators from one of the North Eastern school/college and other states conducted the activity of DNA extraction from banana, tomato, onion, and documented the process via videos. All the clips were reviewed using the new media tools and finally uploaded on CUBE's MetaStudio website. [Nagarjuna G., M. C. Arunan, R. Thengodkar, S. Ghumre, M. Kharatmal, J. Advani, V. Sawant, A. Gavande, M. Gaikwad]

Development of POGIL instructional material in organic chemistry

A project aimed at development of Process Oriented Guided Inquiry Learning (POGIL) instructional material for undergraduate organic chemistry has been going on at HBCSE since August 2015. This project is in collaboration with teachers from colleges of Mumbai and Pune and with Prof. Kelly Butler from Chestnut Hill College, Philadelphia, USA. This year, activity sheets related to structure and bonding, formal charge, intermolecular forces were developed further. Some of these activities were tested in classrooms for feedback from students attending NIUS camp at HBCSE in December 2016. These inputs were used to standardize the developed activity sheets and material is being developed on topics like hybridisation, resonance, dipole moment, etc. Several teachers from various colleges are participating in the project: G. Carnerio (Sophia college), S. Kale (Garware College, Pune), T. Parulekar (SIWS college), L. Ravishankar

(Vaze college), G. Shaikh (St. Xavier's college) and G. Shridhar (Menon college) [S. Ladage]

National E-Hindi workshop
HBCSE organized a 3-day national workshop on Development of Educational E-materials in Hindi during November 12-14, 2016 at Allahabad under the auspices of Vigyan Parishad Prayag. This workshop is an important biennial program of the Centre and the 5th event in the series. The aim of the program is to develop educational electronic contents in science and mathematics for the Hindi medium students of secondary and higher secondary level in the country. Forty experts and 50 students participated in the program. Students were from Class 9 to Class 12, and were from different schools and colleges of the city of Allahabad [K. K. Mishra, Coordinator]

Digital educational materials
The e-learning portal in Hindi (http://ehindi.hbcse.tifr.res.in) was upgraded by addition of a variety of educational materials. The Web version of the expository science presentations of HBCSE's fifth national e-Hindi workshop was also developed. The portal has a variety of curricular, co-curricular, as well as popular science materials that include expository science presentations, books, lectures, magazines, articles, reports, miniglossaries and documentary in digital form. [K. K. Mishra, K. Sinha, D. Mishra, A. Sankhwar, R. Nichat]

Olympiads and Related Activities

The Olympiad programmes in Astronomy, Biology, Chemistry, Junior Science, Mathematics and Physics in India continued to flourish in 2016-2017 thanks to the dedicated hard work of the HBCSE Olympiad cell members, the teacher associations and many resource persons from across the nation. The programme continued to provide a benchmark for high achievement in science and mathematics at the secondary, higher secondary and, by extension, even at the undergraduate level in the country. Out of the 35 students who represented India in the International Olympiads, 13 won gold medals, 13 silver, 7 bronze and 1 honourable mention. All the students in the science subjects returned with either a gold or a silver medal. Over 200 of the best students from across the nation were given experimental and theoretical training.

The Olympiad programme has provided a platform for school, college and university teachers as well as researchers in esteemed institutions to meet and interact with each other. Nearly 300 teachers and researchers attended resource generation and exposure camps held at HBCSE. Members of the Olympiad programme were involved in designing conceptual and challenging problems, developing novel experiments, actively participating in book writing for Olympiads, national and state bodies, participating in several national assessment committees [KVPY (DST), NEST (DAE), NTSE (NCERT), etc.], thus extending the fruits of the Olympiad programme to different layers of the national education scene. They have also contributed to research articles in peer-reviewed technical journals.

The Olympiad selection procedure in all the subjects (astronomy, biology, chemistry, junior science, mathematics and physics) followed the standardized routine. The first level tests in science subjects (the National Standard Examinations, NSEs) were held in November, 2016 at 1328 centres spread all over the country. These were conducted by the Indian Association of Physics Teachers (IAPT), with the assistance of Association of Chemistry Teachers (ACT) and Association of Teachers in Biological Sciences (ATBS). The NSEs had mainly objective type questions. The participation in the NSEs for the year 2016-17 was as follows: 16220 in Astronomy, 20050 in Biology, 41396 in Chemistry, 32110 in Junior Science, and 44174 in Physics. This amounts to an average increase of 20% in all subjects over last year, except Junior Science. The second level examination, the Indian National (Astronomy / Biology / Chemistry / Junior Science / Physics) Olympiad Examinations (INAO, INBO, INChO, INJSO and INPhO, respectively) were conducted by HBCSE at 18 centres nationwide. These tests had subjective problems, and were of high difficulty level, somewhat comparable to the international Olympiads. The top performers in NSE, numbering between 300 and 630 in each subject, participated in these examinations. In the next phase of selection, about 35 students in each subject were invited for Orientation-Cum-Selection Camps (OCSC) at HBCSE. Students (from the previous cycle, during the period of report) appeared for several theoretical and experimental tests in these camps, leading to the selection of Indian teams for the international Olympiads.

In mathematics the first stage (Regional Mathematical Olympiad) was organized regionally and the second stage (Indian National Mathematical Olympiad) was organized by HBCSE and both stages had subjective questions. The selected teams for international Olympiads went through two weeks of Pre-Departure Camp (PDC) at HBCSE.

The Indian National Olympiad exams were organized during January 2017. The number of students selected were as follows: 314 students in Biology, 349 students in Physics, 373 students in Chemistry, 310 students in Junior Science, 531 students in Astronomy and 900 students in Mathematics. The number of students selected for Orientation-cum-Selection Camps (OCSC) were as follows: 36 students in Biology, 42 students in Physics, 38 students in Chemistry, 35 students in Junior Science and 48 students in Mathematics. The OCSCs were organized during April-June 2016 and were attended by: 24 students in Biology, 34 students in Physics, 19 students in Chemistry, 29 students in Junior Science and 48 students in Mathematics.

10th International Olympiad on Astronomy and Astrophysics

The 10th International Olympiad on Astronomy and Astrophysics (IOAA) was hosted by NISER in Bhubaneswar between 9 and 19 December, 2016. The entire academic preparation over more than a year was led and hosted by the Astronomy Cell of HBCSE, and during the event, HBCSE members were involved in key roles in the execution of the academic programme as well as practical organisation of the event. A. Sule was overall co-convener for the event and A. Mazumdar was the chair of the academic committee for 10th IOAA. M. N. Vahia (DAA, TIFR) chaired the international board meetings during the event. A. Mazumdar, A. Sule and P. Ranadive were involved

in major roles for over a year in question setting as members of the academic committee. S. R. Pathare, K. Raodeo and V. Kurmude participated as graders during the event. In addition, A. Sule, S. Amin and V. Ghanekar took key organisational responsibilities before and during the event. A total of 221 students and 113 mentors from 43 different countries participated in the event. About 70 teachers, researchers and undergraduate students from all over India were involved in the academic programme.

Orientation – cum – Selection Camps (OCSC)

Astronomy
Since HBCSE members were involved in the organisation of the International Olympiad on Astronomy and Astrophysics (IOAA) in 2016, the responsibility of OCSC and PDC in Astronomy was handed over to UM-DAE Centre for Excellence in Basic Sciences, Mumbai for this year.

Biology
The Biology Olympiad Cell conducted OCSC during June 1 - 10, 2016 and the PDC for the Indian Team in 1- 14 July, 2016. Problem solving sessions in cell biology, plant sciences, animal sciences, genetics & evolution, ecology and ethology were conducted. Lab orientations and tests in the four lab areas namely plant anatomy & physiology, animal anatomy, systematics & evolution, microbiology and biochemistry, molecular & cell biology were conducted during this camp. The four-member team to represent India at the international Olympiad was selected on the basis of two theoretical tests and four experimental tests during the camp. The four member Indian team at the 27th International Biology Olympiad held at Hanoi, Vietnam from July 16-24, 2016 won one gold and three silver medals. R. R. Vartak (HBCSE), D. Shah (Maharaja Sayajirao University of Baroda) were the team leaders while A. Ronad (HBCSE) and V. Ghanekar (HBCSE) were the scientific observers. [R. R. Vartak, A. Ronad, V. Ghanekar]

Chemistry
The Chemistry Olympiad Cell conducted OCSC during April 13 - 22, 2016 and the PDC for the Indian team in June 2016. Thirty eight students were selected for the camp out of which 19 students attended the camp. The theoretical sessions at OCSC 2016 were related to chemical thermodynamics, spectroscopy, chemical kinetics, phase equilibria, biochemistry and fluorescence. The theoretical examinations at the camp were related to chemical kinetics, aromaticity in organic compounds, thermodynamics and metallurgy, estimation of calcium and magnesium in a sample, chemistry of phosphorus, chemistry of aldehydes and ketones, chemistry of aluminium and colligative properties of water.
The experiments that were developed and standardized for experimental examinations at OCSC 2016 covered the following areas:

1. Analysis of oxalate and oxalic acid content of a given sample
2. Synthesis of chalcone derivative (2–benzoyl–3–phenyloxirane)
3. Kinetic study of the acid catalyzed reaction between acetone and iodine in aqueous solution

4. Identification of inorganic compounds by qualitative analysis
5. Synthesis of a 2, 4-dinitrophenylhydrazones and its characterization
6. Synthesis and analysis of a double salt of Fe (III) and Zn (II) ions

Based on the performances in the tests held during the camp, 4 students were selected to represent India at the international Olympiad. A. A. Natu (IISER, Pune) was the chief guest for the OCSC valedictory function. The four member Indian chemistry team at the 48th International Chemistry Olympiad held at Tbilisi, Georgia from July 23 to August 1, 2016 won two gold medals and two silver medals. A. A. Natu (IISER, Pune) and A. Kumbhar (University of Pune) were the team leaders and A. Dutta (IIT, Mumbai) and A. Gupta (HBCSE) were the scientific observers.

Junior Science

The Junior Science Cell conducted OCSC during May 5 - 22, 2016 and the PDC for the Indian team was held from November 23 to December 1 2016. Twenty nine students attended the OCSC. The camp consisted of around 30 lectures and 22 experimental sessions in advanced topics in biology, chemistry and physics at the class X level. Problems of high standard were set for theoretical and practical exams. A. Kakodkar, (Chairperson, Rajiv Gandhi Science & Technology Commission) was the chief guest for the OCSC valedictory function.

On the basis of camp performance, a team of 6 students was selected for the international event. The Indian team at the 13th International Junior Science Olympiad held at Bali, Indonesia from December 3 to 10, 2016 won five gold and one silver medal. P. K. Burma (University of Delhi), A. K. Rajarajan (BARC, Mumbai) and D. V. Prabhu (Retd. Wilson College) were the team leaders.

Physics

The Physics Olympiad Cell conducted OCSC during May 24 to June 6, 2016 and the PDC for the Indian Team was from June 27 to July 10, 2016. Thirty four students attended the OCSC. Lectures were taken on advanced topics such as special relativity and quantum physics. Theoretical problems in the test included topics such as the Yukawa potential, Landau theory of phase transition, Bohr model and Weizsaker's optical fiber. The experimental component included:

1. Coupled torsion pendulum: A coupled torsion pendulum system is studied by observing its normal modes of vibration. The experiment gives a simple arrangement of coupled pendulum system which is suitable for the undergraduate laboratories. The experiment covers different aspect of the coupled systems such as normal modes of vibration, coupling constant between two oscillating systems.
2. Refractive index of prism using laser: In this experiment, the angle of prism and refractive index of the material of the prism using a laser pointer were determined. Various methods like minimum deviation method, critical angle method, Brewster's law method were used in the determination of the refractive index.

3. Magnet-Solenoid interaction: In this experiment the forces between two magnets in repulsive mode and the force between a magnet and a solenoid was experimentally investigated.

The five-member team was selected at the end of the camp to represent India at the international Olympiad. T. Souradeep (IUCAA, Pune) was the chief guest for the OCSC (Physics) valedictory function. The five member Indian team at the 47th International Physics Olympiad held at Zurich, Switzerland from July 11 to 17, 2016 won three gold and one silver medal. A. Mazumdar (HBCSE), S. Pathare (HBCSE) were the team leaders while P. K. Jena (Ravenshaw University, Cuttack) and R. Ghorpade (Jhunjhunwala College, Mumbai) were the scientific observers.

Mathematics

The Mathematics Cell conducted IMOTC during April 18 to May 16, 2016 and PDC for the Indian team during June 30 to July 6, 2016. A total of 48 students attended IMOTC. A six-member team was selected at the end of the camp to represent India at the 57th International Mathematical Olympiad held at Hong Kong in July, 2016. The six-member team won one silver medal and five bronze medals. P. De (HBCSE) and U. Prajapati (St. Xavier's College, Ahmedabad) were the team leaders. B. Sury (ISI, Bangalore) and A. Kumar (DPS, Faridabad) were the observers.

Resource Generation Camps (RGCs)

Several Resource Generation Camps in which teachers and scientists from across the nation gathered for development of curriculum and Olympiad material were held in all the subjects. The RGCs in Biology were held between August to December 2016. RGC in Chemistry was held during September 17-21, 2016. Several RGCs in Junior Science were held during February 6-7, 2016; March 12-13, 2016; April 9-10, 2016; April 23-24, 2016; August 20-21, 2016; October 1-2, 2016; November 5-6, 2016; February 11-12, 2017; March 25-26, 2017. Physics RGCs were held during September 26-28, 2016; December 27-29, 2016; February 3-10, 2017.

Exposure Camps (ECs)

Several short 3-5 day exposure camps were held in different subjects 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 exposure camps for astronomy was held during May 5-7, 2016 (Srinagar) and March 2-4, 2017 (Jaipur); for biology during November 16-18, 2016; for chemistry during November 21-24, 2016; for junior science follow up workshop during January 9-12, 2017 and for physics during February 20-24, 2017.

Other activities

Members were also involved in numerous Teacher Professional Development workshops at the centre and took sessions on several topics such as students' difficulties in chemistry, problem designing [S. Ladage, S. Narvekar, I. Das, A. Gupta]. Several student and teacher workshops on science demonstrations were handled by JSO cell [P.

Joshi, P. Nawale, S. Mukherjee, B. Chemate]. A workshop on 'Low cost Michelson Interferometer' was conducted at the WFPhC meeting held at Banten, Indonesia from September 26-30, 2016 [S. R. Pathare and V. V. Kurmude], and an astronomy Olympiad workshop was held at Garware college for students on May 28, 2016 [A. Sule, P. Ranadive].

A large number of Olympiad books (HBCSE publications) have been sold throughout the year and disbursed during several events. Around 50 talks on the Olympiad programme and higher secondary school science were delivered in different parts of the country by the members of the Science and Mathematics Olympiad Cells. Several were given in DST sponsored INSPIRE camps.

National Initiative on Undergraduate Science (NIUS)

The National Initiative on Undergraduate Science (NIUS) programme of HBCSE has its thrust on content enrichment and development of general scientific competencies needed for research in science. For the same, promising undergraduate students engage in proto-research projects/research like activities and are mentored on a sustained basis. Such involvement helps students to develop serious interest in various domains of science. Exposure and training of students and teachers primarily in experimental science is yet another important facet of the NIUS programme. Along with the student programmes, this year, various teacher workshops were also conducted. Thus, the NIUS programme is now gearing up further to impact the teaching-learning scenario at the undergraduate level within the country. Till date, about 1480 undergraduate students have been exposed to the NIUS programme of HBCSE (as part of exposure-cum-enrichment camps).

This year about 170 undergraduate students were invited to attend the NIUS exposure-cum-enrichment camps. During these camps, students had intense interactions with scientists, researchers and passionate teachers and have engaged with workshops and laboratory activities that demand comprehension of scientific literature along with planning and designing of experiments. Such an exposure is crucial, particularly for students coming from regular bachelor courses and from non-metropolitan areas. Some of the project work carried out by NIUS students were of sufficiently high standards and were published in international journals.

Biology

The NIUS camp for biology (XIII.1) was conducted at HBCSE from November 7-11, 2016 and 38 students from regular B.Sc. or integrated M.Sc. courses were selected for the camp. Thirty students attended the camp. The resource persons for the camp were J. D’souza (UM-DAE CBS, Mumbai), K. Ray (TIFR, Mumbai), S. M. Menon (Therapeutic Drug Monitoring Lab, Mumbai) and S. Patankar (IIT Mumbai). The resource persons from HBCSE were R. R. Vartak, A. Ronad and V. Ghanekar. The theoretical sessions at the camp were related to proteins and their structures, complexes, specificity and randomness, chronicle of life inside a cell: congested tracks, tug-of-war, traffic jam and holistic approach to studies on traditional medicine. The laboratory

sessions covered experiments related to biochemistry, molecular biology and investigations in biology. From this batch, 3 students have been selected to pursue NIUS projects in different areas of biology. In addition, 13 students from earlier batches of NIUS biology visited HBCSE to continue their projects and some are in the process of completing their project. [R. R. Vartak, A. Ronad, V. Ghanekar]

Chemistry

The NIUS camp for chemistry (XIII.1) was held at HBCSE from December 21-31, 2016 and 54 students from regular B.Sc. /BS or integrated M.Sc. courses were selected for the camp. Forty seven students attended the camp. The speakers for the camp were A. Dutta (IIT, Mumbai), A. B. Pandit (ICT, Mumbai), D. Dutta (BARC, Mumbai), M. Sundararajan (BARC, Mumbai), N. Mahadevan (IIT, Mumbai), N. Dashputre (IISER, Pune), R.V. Jayaram (ICT, Mumbai), R. Chakraborty (IIT, Mumbai), S. D. Samant (ICT, Mumbai), S. S. Bhagwat (ICT, Mumbai), S. Gharpure (IIT, Mumbai), S. V. Joshi (ICT, Mumbai), T. Parulekar (SIWS College, Mumbai), T. Ghanty (BARC, Mumbai), G. Carneiro (Sophia College, Mumbai), G. Shaikh (Xavier's College, Mumbai) and G. Shridhar (V. K. Menon College Mumbai). The resource persons from HBCSE were A. Gupta, S. Ladage, S. Chunawala, A. Muralidhar, I. D. Sen, S. Narvekar, S. Varadarajan and C. Ursekar.

The theoretical sessions at the camp were related to introduction to pharmaceutical sciences, spectroscopic techniques for structural elucidation, cavitationally induced physical, chemical and biological transformations, molecular engineering, quantum and computational chemistry, organic synthesis and mechanisms of organic reactions, catalysis, overview of interfacial science, society and chemical industry and introduction to nano-materials. It also had sessions related to gender issues in science and technology, case study of antibiotics as growth promoters-historical/social/economical factors, understanding the chemical basis of composting and a discussion session using a documentary on excessive material consumerism and promotion of sustainability. The workshops at the camp were: a) using Process Oriented Guided Inquiry Learning (POGIL) instructional material to understand concepts in organic and physical chemistry, b) reading of scientific papers from peer-reviewed journals, and c) abstract writing.

The laboratory sessions at the camp covered the following experiments i) analysis of vitamin-C in different samples using different methods of analysis; ii) synthesis of dyes and testing their dyeing property; iii) investigation of chemical properties of syrups containing enzymes and iv) synthesis of inorganic complexes and developing feel for binding strength of ligands. The laboratory sessions were group activities and involved a) discussion and developing an experimental plan; b) assessment of safety and risk; c) understanding stoichiometry and quantitative aspects of experiments; d) reflections on data; e) arriving at appropriate inferences; e) reporting of problems faced during trials; f) listing possible sources of errors that affected the data and g) presentation of work in written and oral modes.

At the computational chemistry laboratory sessions, students were introduced to

GAUSSIAN-09 and Guassview. Students did computational calculations related to different conformations of hydrogen molecule, solvation effects, proton affinity of water molecule, the potential energy surface of ethane, dispersion energy of gases and C-60 fragments. Towards the end of this camp, 23 students were selected for the project work. In addition, 20 students from earlier batches of NIUS Chemistry visited HBCSE for their project work. In total, 17 students have completed their projects and have submitted their project reports to respective mentors. Of these, 5 projects were carried out at HBCSE while 12 projects were done at other research laboratories. [A. Gupta, A. Kumar, S. Ladage, I. D. Sen, S. Narvekar]

Physics and Astronomy

The NIUS camp for physics (XIII.1) was conducted at HBCSE from June 8-17, 2016 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 speakers for the camp were A. Gopakumar (TIFR, Mumbai), A. Suman (IISc Bengaluru), A. Kumar (Formerly, HBCSE), D. Ghosh (IIT Mumbai), D. Banerjee (IIA, Bengaluru), K. Rustogi (RRCAT/TIFR, Mumbai), P. Pal (SINP, Kolkata), S. Roy Mullick (IISER, Kolkata), S. Jain (BARC, Mumbai), S. Chakraborti (BVM, Kolkata) and V. Singh (Formerly, HBCSE). The resource persons from HBCSE were A. Mazumdar, D. P. Roy, P. Pathak, R. B. Khaparde and S. M. Roy.

The areas covered at the camp were gravitational waves, introduction to quantum mechanics, relativity, stellar structure and stellar oscillations, statistical mechanics, nano-biosensors and physics, non-linear dynamics, optics, constituents of matter and their interactions, overview of particle physics, introduction to experimental physics, quantum foundation and quantum information and introduction to sun and sun-earth connections.

After the project discussions and evaluation sessions at the camp, 42 students were selected for projects to be carried out at different institutions. Around 36 students continued their projects in physics and astronomy in summer and winter of 2016. Some of them are in the process of completing their projects and preparing their final project reports. [A. Mazumdar, D. P. Roy, P. Pathak, R. B. Khaparde, S. M. Roy]

Summer Course in Experimental Physics (SCEP)

The Summer Course in Experimental Physics is designed as an enrichment course and is based on experimental problem solving approach for undergraduate students and teachers. This approach is designed to encourage students' independent thinking in physics laboratory and foster their procedural understanding along with enhancing their conceptual understanding. The discussion and presentation sessions at the camp helps in active participation of students. For the course, this year, 32 experimental setups were arranged in four physics training laboratories at HBCSE. The experimental problems were related to soft massive spring, physical pendulum, Newton's laws, projectile motion, thermal expansion of metals and bending of beams, magnetic physical pendulum, electromagnetic damping, Fourier analysis, magnetic circuits,

electromagnetic induction, coupled coils with ferrite core, coupled coils and transformers, black box, efficiency of LED, diffraction of light and formation of rainbow. This course was held at HBCSE from May 9-20, 2016 and was attended by 41 second year B.Sc./BS/Integrated MS/MSc students studying in various colleges/institutions. Experiments and demonstrations in optics, optical characterization, electricity and magnetism, electronics, microcontroller based instrumentation and computer interfacing using PHOENIX system are also being developed on continual basis. [R. B. Khaparde]

NIUS Workshops

Exposure cum preparatory workshop for teachers in physics

Teachers, educators and researchers who are involved in physics laboratory courses at the undergraduate level were invited to attend an 'Exposure cum preparatory workshop for teachers' and subsequently be a resource person/mentor during the Summer Course in Experimental Physics. This workshop was held at HBCSE during May 6 - 8, 2016. Nine teachers teaching at undergraduate level across India were invited to participate in the workshop and further in SCEP 2016. The workshop consisted of sessions on training in experimental physics, procedural understanding, experimental problem solving in physics, design and development sessions.

Workshops in POGIL

An introductory workshop on Process Oriented Guided Inquiry Learning (POGIL) approach was conducted at Baburao Gholap College, Pune for 40 participants, during November 2016. The sessions conducted were related to a) exposure to POGIL instructional material and understanding its structure; b) implementation of POGIL in a classroom; c) understanding the learning cycle based approach for development of POGIL activity sheets and d) assessment of POGIL activity. Resource persons for this workshop were S. Ladage (HBCSE), G. Shridhar (V. K. Menon College, Mumbai) and T. Parulekar (SIWS College, Mumbai).

Workshop on central forces

A four day workshop on 'central forces' for undergraduate physics teachers was held at HBCSE from February 28 - March 3, 2017. The workshop consisted of lectures on formulating the theory of motion under central forces and related problem solving sessions. Concept of force, energy and work with vectorial formulation, conservation laws, classification of orbits, Kepler's laws and orbital dynamics were some of the areas covered during the workshop. Critical discussions about misconceptions and subtle points related to the topics were conducted as part of the workshop. Resource persons were drawn from IISER Kolkata, ICTS, Bengaluru, UM-DAE CBS and HBCSE. Around 68 participants were selected for the workshop and 32 have attended it.

Workshops on physics and mathematics education research

Corinne Manogue and Tevian Dray from Oregon State University, USA conducted three half-day workshops at HBCSE (March 15-17, 2017). These workshops were open to HBCSE members and also to physics teachers. These workshops were related to 1)

Using geometric reasoning to teach vector calculus; 2) Active engagement: Lessons from education research; and 3) Activities in introductory quantum mechanics.

Professional Development of Teachers and Teacher Educators

The Homi Bhabha Centre for Science Education is actively involved in working with in-service teachers and in designing activities that would help in their professional development at school and college levels. At the same time, HBCSE has also worked with teacher educators who are involved in the conduct of such courses for school teachers, to facilitate them in their training and orientation activities for and with the teaching community. Additionally a few workshops address pre-service (B.Ed and D.Ed) teachers. Requests for workshops are received all year-round and details are provided at http://teacher-ed.hbcse.tifr.res.in/

Several faculty, scientific and project staff at HBCSE are involved in Teacher Professional Development (TPD) at various levels. The School Science and Research and Development (SSRD) programme of HBCSE is one such team that aims to integrate research, material development and outreach for students, teachers and teacher educators. This collaborative programme entails working closely with schools and teachers to study and improve the quality of science and environmental studies in a participatory mode, for elementary and middle school levels, with the aim of developing resource materials for the same and is actively involved in TPD.

The SSRD group addressed teachers through topics based on design and technology, bio-inspired design, nature of science (NOS), learning science with toys, inquiry and cooperative learning (pedagogical strategies), and science practice (process) skills. The sessions showcased how learning in schools can be made interesting and relevant to learners through the use of design and technology tasks. Activities involved designing for specific needs, making of designed artefacts using available resources and/or evaluation of existing technologies with reference to desired (eg. sustainability) contexts. Use of such tasks supported an integrated approach to learning and promoted application of knowledge (e.g., understanding design by examining unfamiliar artefacts, evaluating artefacts for design appropriateness, acquiring, abstracting and applying design inspiration from structures/ forms, processes and systems in the natural world etc). Sessions on NOS included hands on activities to emphasize fundamental ideas about how scientific knowledge is created and understood. Sessions on pedagogical strategies highlighted and demonstrated use of the inquiry and cooperative learning approaches in science classrooms. Some of the major teacher programmes that took place this year are:

Second course for science teachers and education officers of Sri Lanka: This 2 week residential course was jointly organised by Science Branch, Ministry of Education, Government of Sri Lanka and HBCSE from July 17-31, 2016 at HBCSE. The objectives of this short course were to expose Sri Lankan participants to science education research and literature; to create awareness of models of learning and teacher professional development; to design worksheets for teaching and assessment in classroom; and to

have a sharing and comparison of the Indian and Sri Lankan education systems. Twenty teachers and education officers from Sri Lanka participated in this course, which had sessions on; research readings in science education, nature of science, socio-cultural aspects of science education, learning and constructivism, textbook analysis, hands-on-science and activity based science as well as design and technology components and laboratory work with addition of field visits to schools and education colleges and science centres. [A. Kumar, A. Muralidhar, A. Sawant, A. Sule, D. Gupta, D. Karnam, G. Nagarjuna, G. Singh, H. C. Pradhan, H. Raval, H. Srivastava, J. Ramadas, J. Vijapurkar, K. T. Hambir, K. Haydock, K. Subramaniam, N. D. Deshmukh (Program Coordinator), P. Joshi, P. Randive, S. Bhide, S. Chandrasekhran, S. Chunawala, S. Naik, S. Patil, S. Rajshekhar, S. Shende, S. Varadrajan, T. Adangale, T. Khan, V. Pawar, V. Sonavane]

Third course for science teachers and education officers of Sri Lanka: This course too was a result of the joint organisation by Science Branch, Ministry of Education, Government of Sri Lanka and HBCSE and was held from November 13-27, 2016 at HBCSE. This course titled 'Assessment and Evaluation of Science Learning' aimed to present the theoretical bases of assessment in schools settings as well as the practical processes involved in the same. Participants were exposed to types of assessment, formative and summative assessments, diagnostic assessment, development of criteria for assessment and testing, assessment for learning sciences, creative methods for assessment in science education and relevance of multiple-choice testing in assessing science understanding. The understanding of basic concepts of evaluation and the design of different tools and modules for assessment and evaluation were discussed by the instructors and the thirty teachers and education officers from Sri Lanka participating in this course. Assessment of projects and project-based learning involving individual and groups as participants was also presented. [A. Dhanvijay, A. Gupta, A. Mazumdar, A. Muralidhar, D. Gupta, G. Nagarjuna & CUBE team, H. C. Pradhan, H. Raval, J. Tharu, K. T. Hambir, K. Subramaniam, M. C. Arunan, M. Kharatmal, N. D. Deshmukh (Program Coordinator), N. Sonavane, P. K. Joshi, P. Pande, P. Pathak, R. Ghodke, S. Bhide, S. Chunawala, S. Datt, S. Rajshekhar, S. Rawool, T. Adangale, V. Deshmukh, V. Pawar, V. C. Sonawane]

Second workshop for elementary teachers: A workshop was organised from June 20-24, 2016 at HBCSE for 39 elementary teachers of the Rayat Shiksahan Sanstha. The aim of this workshop was to involve the teachers in preparing worksheets for science and maths topics taught in class IV. The processes involved in this material development involved exposing teachers to available resources and collaboration and sharing amongst the teachers for developing materials for use in classroom teaching and learning. [D. Gupta, K. T. Hambir, K. Subramaniam, M. Kharatmal, N. D. Deshmukh (Program Coordinator), P. Nawale, P. Randive, S. Bhide, S. Chunawala, S. Naik, S. Narvekar, S. Shende, T. Adangale, V. Pawar, V. C. Sonawane].

Collaboration with Gujarat Council of Educational Research and Training (GCERT): A two day workshop was organised under the aegis of the Rashtriya Madhyamik Sarva Shiksha Abhiyan for GCERT on September 29-30, 2016 at HBCSE titled "Module

Development workshop for Science & Mathematics Teachers". A total of 109 teachers participated in this workshop. A second workshop was organized for GCERT on October 17-18, 2016 at HBCSE. A workshop was organised in collaboration with the District Institute of Education Training, (DIET) Navsari, & GCERT, Gujarat on 'Design Training Programme for Lecturers of DIET' from February 13-17, 2017 at HBCSE, Mumbai. This residential workshop was attended by 26 DIET faculty. [A. Gupta, A. Kumar, H. C. Pradhan, D. Karnam, H. Raval, H. Srivastava, K. T. Hambir, K. Subramaniam, N. D. Deshmukh (Program Coordinator), N. Sonawane, P. Nawale, S. Bhide, S. Chunawala, S. Naik, T. Adangale, T. Khan, V. Pawar, V. C. Sonawane, P. K. Joshi, S. Narvekar.]

Kendriya Vidyalaya science teachers' workshops: Two workshops for the same set of secondary science teachers from the western zone were held in a span of 3 months so as to ensure a follow-up and allow teachers to try out the interventions in their settings. These residential workshops made deeper interactions possible and were conducted on the request of Zonal Institute of Education & Training (KV-ZIET). The first workshop on 'Enhancing pedagogical skills to impact classroom transactions' was held in the third week of November, (21-25) 2016 and the second on 'Designing learning strategies' was held in the second week of February (7-9), 2017 at HBCSE for 30 teachers. In the intervening months between the 2 workshops, email interactions were maintained with the teachers. [A. Muralidhar, CUBE Team, H. C. Pradhan, J. Ramadas, K. T. Hambir, K. Subramaniam, N. D. Deshmukh (Program Coordinator), N. Sonavane, P. Nawale, S. Bhide, S. Chunawala, S. Datt, S. Narvekar, T. Adangale, V. D. Lale, V. Pawar, V. C. Sonawane]

Short visits and workshops at HBCSE: In December 8-9, 2016 a workshop was organised for elementary BMC teachers on 'Activity Based Learning & the Participatory Action Research Project'. This workshop was organised in collaboration with the Nutan Vidya Mandir school. Thirty-four pre-service teachers or D. Ed students of Rayat Shikshan Sanstha visited HBCSE for a day long interaction on January 16, 2017. Fifty-seven pre-service teachers studying in D.Ed who were part of Swami Vivekanada Youth Movement from Karnataka visited HBCSE on February 10, 2017. [D. Gupta, H. Raval, K. Nagvekar, K. Subramaniam, K. T. Hambir, N. D. Deshmukh (Program Coordinator), N. Patil, N. Sonavane, P. Nawale, R. Pawar, R. Shinde, S. Bhide, S. Chunawala, S. Chandanshive, S. Jadhav, T. Adangale, T. Khan, V. Pawar, V. C. Sonawane]

Workshops organised elsewhere: A workshop on 'An amazing educational tool: Microscope' was organised for 36 science teachers at the National English School Virar, Thane on April 30, 2016. A workshop titled 'Teaching biology- The missing link' was organised by Seth Anand Jaipuria School, Kanpur, from July 2-3, 2016, in collaboration with HBCSE, the Asian Association of Biology Education and St. Ann's College for Women, Hyderabad. The workshop attended by 20 participants aimed to bring together practitioners engaged in biology education to exchange ideas on best practices and pedagogical strategies for effective teaching-learning. Every year Akola District Science Teachers Association invites HBCSE members to organize a a science

exhibition and workshop for science teachers on various themes of science education. This year the events were organised on September 6, 2016 at New English School Akola. A workshop was conducted in collaboration with Deepshikha Gurukul Sainik School, Chikhaldara, Amravati from October 3-5, 2016 for science and mathematics teachers of Amravati region at Chikhaldhara. [H. Raval, K. T. Hambir, N. D. Deshmukh, S. Rawool, T. Adangale, V. C. Sonawane]

26th AABE International Conference: The 26th Biennial conference of Asian Association for Biology Education (AABE) was organized by the AABE, India Chapter and Vidya Prabodhini College of Commerce, Education, Computer & Management, Goa in collaboration with HBCSE; Rayat Education Society, Satara; Shri Shivaji Education Society, Amravati, Association of Teachers in Biological Sciences, India; St. Ann's College for Women, Hyderabad and The International Centre, Goa, India. This conference was held at *The International Centre* Goa from September 20-24, 2016 under the theme: Trends in Biology Education & Research: Practices & Challenges (www.26aabe2016.com). The sub-themes of the conference were; Learning biology through enquiry; Impact of local issues relevant to biology in global scenario; Strategies for awareness of community health through biology; Ecological approach to learn biology; Educational technology for biology education; Classroom teaching learning and assessment; Current challenges and new approaches for biology teachers; and Practices and challenges in biology research and education.

The five day programme was packed with several scientific sessions, poster sessions, hands on workshops and workshops on teaching methodologies. Plenary sessions by eminent scientists from India from CSIR, IISERs and IITs, IISC, TIFR and universities was the prime attraction among participants for gaining updates and insight into Life sciences. The conference also had Open House sessions for networking and interaction among teachers and researchers from various Asian countries. More than 120 participants from four countries participated in this conference. [N. D. Deshmukh]

CUBE laboratory organized a full day pre-conference workshop (September 20, 2016) for 30 biology teachers at the AABE conference. CUBE introduced several model systems- daphnia, drosophila, earthworm, micro-organisms, hydra, chlorophyll containing fruits. A follow-up of the workshop was also conducted on September 22, 2016. The CUBE-AABE workshops resulted in forming 3 CUBE hubs at Kanpur, Hyderabad and Goa. In addition to HBCSE members, S. Ghaskadbi (*Agharkar Research Institute*, Pune) and T. Nakamichi (Japan) were invited resource persons. [G. Nagarjuna, M. C. Arunan, R. Thengodkar, M. Kharatmal, J. Advani, M. Gaikwad]

Teacher Professional Development in mathematics education: This year, the collaboration with Kendriya Vidyalaya Sanghathan continued. Two residential workshops for KV teachers were conducted focusing on lesson design and enactment. The first workshop was held in November 2016, after which teachers tried the problems, contexts, models and representations discussed during the workshop in their school set-up and brought back the evidence from the classroom activities in the next workshop that took place in February 2017. The evidence involved videos of student

responses or activities, students' written and oral work and set of designed tasks. The teachers reported that they were positive about the intervention and requested similar extended help on other topics.

Several other workshops were organized around mathematics laboratory and problem solving where teachers engaged with designing, making and using of mathematics activities, games, puzzles and problems. Tasks around area and measurement, algebraic thinking, proportional reasoning, geometric relationship, and number systems were the core topics of these sessions. Interactions took place with pre-service teachers from St. Xaviers College of Education, Gokhale College of Education, students of MA education programme of TISS, YCMOU post graduate students; DIET faculty members from GCERT; and in-service teachers from Kendriya Vidyalayas, Sri Lankan primary and secondary school teachers and education officers, as well as from Chatrapati Raja Sambhaji school and Mankhurd Ward municipal schools.

The mathematics education group is involved in research around teachers' professional development and in many of the workshops, an attempt was made to bridge the learning from research with the actual practice of teacher education. Pedagogical content knowledge was used to help teachers improve their mathematical noticing. Video materials, students' actual work and curriculum analysis (available at mathedu@hbcse.tifr.res.in) were used to develop teachers' understanding of mathematics. [K. Subramaniam, S. Naik, H. Raval, T. Khan]

TPD workshops under Olympiad and NIUS initiatives: As part of Olympiad programmes, TPD workshops are conducted for teachers teaching sciences primarily at higher secondary and undergraduate levels. These workshops, titled as Resource Generation Camps (RGCs) and Exposure Camps are conducted annually in Physics, Chemistry and Biology. The camps are generally of 2 to 4 days duration and sessions range from designing context based problems in theoretical areas, to laboratory experiments and involve critical discussions regarding concepts in textbooks. The Olympiad section presents the details about these camps.

TPD workshops are also conducted as part of NIUS and are primarily for teachers teaching at undergraduate level. Along with content enrichment, such workshops cover sessions related to a) conceptual pitfalls in core topics of the discipline, b) experimental problem designing, c) research informed teaching/learning practices and d) development of instructional material. The details of such camps conducted in Physics and Chemistry are presented in the NIUS section.

Consultations, Collaborations and Support to External Institutions

Bombay Association for Science Education

The Bombay Association for Science Education (BASE) is a voluntary organization run by TIFR scientists in collaboration with school and college teachers from Mumbai

region. During the period of this report, BASE jointly with HBCSE organized the following workshops: 'Forces in science' (TIFR, Mumbai, June 25, 2016), 'How to frame questions' (NSC, Mumbai, July 23, 2016), and 'Syllabus based experimental workshop' (HBCSE, August 12-13 and 26-27, 2016) [P. K. Joshi]

YCMOU Post Graduate Research Programmes in collaboration with HBCSE

HBCSE is the study centre for Yashwantrao Chavan Maharashtra Open University (YCMOU), Nashik, Post Graduation Research Programme (PGRP) in Mumbai. The YCMOU offers a two year post-graduation course (M.A, MSc) in Subject Communication and Education Communication through distance mode. The batch of 2015-17 has 58 students and the batch 2016-18 has 55 students. Fifteen workshops have been conducted for both batches between October 2016 to March 2017. Besides organising these workshops, students are counseled on various subjects, such as Research Methodology, Instructional System Design and Communication modes in education. HBCSE is involved in the assessment of student assignments and providing help to students in formulating their research problems and in developing their research projects. [S. Chunawala- Coordinator, N. D. Deshmukh, D. Gupta, P. Sharma, A. Dhanvijay, R. Shinde]

AEES-HBCSE collaboration

The Atomic Energy Educational Society (AEES) and HBCSE continue to collaborate in several areas. The junior mathematics and science Olympiads, which is the first stepping stone for the National Olympiads, draw some of the best students of the Atomic Energy Schools from all over the country. The camp was conducted from October 17-22, 2016 at Atomic Energy School- 3 under the guidance of the Olympiad faculty at HBCSE [P. K. Joshi, S. Chunawala, A. Sule, P. De, V. Ghanekar, S. Mukherjee, P. Nawale, S. Mukherjee, P. Ranadive, K. Raodeo, V. Kurmude, B. Chemate, H. Raval, T. Khan and the academic unit of AEES]. Additionally, members of HBCSE have served on key committees of AEES [K. Subramaniam, V. D. Lale, P. K. Joshi] and have served as judges in science exhibitions. [K. K. Mishra]

Support to national level assessment

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

Support to other organizations, schools and academic activities

HBCSE members have also collaborated with a number of grass-root agencies and NGOs and have provided their expertise on issues related to science education. Some of the collaborating agencies include; Grammangal, an NGO in Pune [V. D. Lale]; Vidyarthi Vidnyan Manthan by Vidnyan Prasar [P. K. Joshi]; State Institute for Science Education, Nagpur [P. K. Joshi]. HBCSE members actively participated in various capacities (reviewers, chairs, chief guest, project guide) in academic and school events. In this endeavor, S. Chunawala chaired sessions at the *XIII Triennial Conference of the Indian Women Scientists' Association* on "*Sustainable Development in India: Role of Science and Technology*", IWSA Campus, Navi Mumbai (December 2-4, 2016) and at

the *Two Day National Level Researchers' Meet*, organized by Internal Quality Assurance Cell, Department of Education, University of Mumbai, in collaboration with HBCSE, Kalina Campus of University of Mumbai (January 5-6, 2017). N. D. Deshmukh was a team member for inspection of 3 National Institute of Open Schooling Centers at Shivaji Nagar, Govandi; Malad and Goregaon (Mumbai, May 7, 2016); was invited as a Reviewer for Exciting Science Group (science club activities), an initiative by a group of scientists from National Chemical Laboratory and IISER Pune. (Pune, July 21, 2016); was deputed by National Council for Teacher Education as a visiting team member for inspection of a Jamnagar B.Ed college (Gujarat, April 4 - 5, 2016).

Additionally as evaluators and judges, A. Muralidhar was invited to Amulakh Amichand Bhimji Vividhalakhshi Vidyalaya School, Matunga (July 13, 2016); S. Datt was invited to the Innovation Hub at Nehru Centre (June 25, 2016); N. D. Deshmukh was invited to the Kendriya Vidyalaya Regional Level Science Exhibition (KV ONGC Panvel, December 20-21, 2016); S. Mukherjee was invited to the 'INSEF Science Fair' at SIES school, Sion (November 21, 2016); S. Mukherjee and B. Chemate were invited to 'EXPISCOR Science Fair' held at Vissanji Academy, Andheri (December 2, 2016); D. Gupta was invited to the 44th Jawaharlal Nehru National Science, Mathematics and Environment Exhibition JNNSMEE regional level science exhibition, KV (December 20, 2016); P. Nawale was invited for the science exhibition at M.H. High School, Thane (December 21-22, 2016); P. K. Joshi was invited to the 'Indian Science and Engineering Fair' at Rajkot (January 7-8, 2017); V. C. Sonawane was invited to Mother Teresa English Secondary School and Junior college, Charkop, Kandiwali West (August 26, 2016), Western Science Exhibition NSC 2016 (December 16, 2016), and Kendriya Vidyalay Sanghathan ONGC, Panvel (December 20, 2016).

Student interns and visitors to HBCSE

As part of our collaboration with academic institutes, HBCSE had numerous visitors and interns this academic year, during which they either carried out small projects in their area of interest or gave talks and/or offered short courses. Visitors included faculty members from the following national and international institutes: University of Kwa-Zulu-Natal (South Africa), Azim Premji University (Bengaluru), National Centre for Biological Sciences, IIT Bombay, Veterans Affairs St. Louis Health Care System, USA, etc. [S. Reddy, M. Vaz, S. Sane, J. Shah, A. Babu, N. Varadarajan, A. Bardapurkar, Kishorkumar Darak]. Visitors to the centre also included members from organizations like Teach for India. Students interns from the following institutes visited HBCSE for durations ranging from 1 to 3 months: Tata Institute of Social Sciences, Hyderabad, IIT Roorkee, D. Y. Patil School of Engineering, Pune, Mumbai Education Trust College, BITS Pilani [S. Kulkarni, S. Sen, E. Shokeen, H. Agrawal, N. Ponnuru]

MSTA- Dr. Homi Bhabha Young Scientists Camp

Since last six years, HBCSE has been organising enrichment camps in collaboration with Mumbai Science Teacher Association (MSTA) for Dr Homi Bhabha Young Scientist Awardees. The awardees are of two levels, students studying in class 6 and class 9 from schools that have English or Marathi as the language of teaching-learning. This year the camp for students of class 6 was organised from April 12-13, 2016 and the

camp for students of class 9 was held from April 15-16, 2016, at HBCSE. A total of over 180 students participated in both these camps. These camps are aimed at providing students with exposure to topics that may not necessarily be directly part of school syllabi, but which may spark curiosity and interest in science. Besides, students are also provided with opportunities to participate in hands-on laboratory activities and experiments. [A. Sule, B. Chemate, H. Raval, J. Ramadas, K. T. Hambir, N. D. Deshmukh, P. K. Joshi, P. Nawale (Programme Coordinator), P. Ranadive, S. Chakraborty, S. Chavan, T. Adangale, T. Khan, V. D. Lale, V. Pawar, V. C. Sonawane]

Chinmaya Vidyalaya, Tarapur

A two day science enrichment programme for students of class 9 from the Palghar district was organised by Chinmaya Vidyalaya, Tarapur. This programme focused on activity based and hands on science and took place from April 18-19, 2016 at Tarapur. [K. T. Hambir, N. D. Deshmukh, T. Adangale, V. C. Sonawane (Programme Coordinator)]

RGSTC- Science and Innovation Activity Centres (SIAC) Project

For the past three years, HBCSE is involved in setting up Science and Innovation Activity Centres (SIACs) in Maharashtra. This collaborative project involving HBCSE, the Nehru Science Centre, Mumbai, Bharatiya Vidya Bhavan's Muktangan Exploratory Science Centre, Pune and Vigyan Ashram, Pabal is funded by the Rajiv Gandhi Science and Technology Commission, Government of Maharashtra. The primary objectives of setting up SIACs is to inculcate a spirit of scientific enquiry, and address curiosity among students about scientific concepts. Achieving these objectives would require sustained mentoring that helps students to ask questions and make attempts to find answers to these questions, including undertaking experiments specifically designed for the purpose. The construction of two centres, Praveranagar and Warananagar is complete and they are now functional, while 2 other centres at Amravati and Satara are now under construction. As part of this collaboration, several workshops have been conducted and are planned in the coming year which will be aimed at training resource persons in designing and planning activities on various school science concepts. [H. Raval, J. Ramadas, K. T. Hambir, N. D. Deshmukh (Coordinator), S. Chunawala, V. C. Sonawane]

CUBE meetings, interactions and collaborations

The Collaborative Undergraduate Biology Education (CUBE) project expanded to several new nodes across the country. In this context, the CUBE team had several meetings and interactions with students, teachers and scientists at; the International Symposium- Dengue Prediction and Prevention through Community Engagement, Kochi (January 12 2017); St Xavier's Aluva and Cochin Colleges, Kochi (January 12, 2017); Keralavarma College, Thrissur, Kerala (January 13 2017); Colleges in Patna, Bihar (March 17, 2017). Meetings with M. Chandradattan, Scientific Advisor to CM Kerala at Secretariat, Thiruvananthapuram, Kerala (January 16, 2017) and with K. Pradeepkumar, Member Secretary, Kerala, State Council for Science, Technology & Environment Sasthra Bhavan, Thiruvananthapuram, Kerala (January 16, 2017) also took place. [M. C. Arunan]

Science Popularization

HBCSE, over the years, has developed a variety of popular science materials and has aimed at disseminating them to the masses of the country to improve scientific literacy and inculcate scientific temper among its people. During the period of this report, HBCSE staff members contributed articles, gave popular science talks, and featured in radio and TV programs as an integral part of its science popularization and outreach efforts. Expository articles were published in leading national science and technology periodicals of the country.

Visits to HBCSE

HBCSE receives a number of visitors to its laboratories and facilities throughout the year. Visitors include students and teachers from various schools and colleges. Pre-service teachers from B.Ed & D.Ed colleges and teacher-educators also visited HBCSE. Visitors also include children from some of the non-governmental organizations (NGOs) from within Mumbai and other regions. This year, HBCSE had more than two hundred visitors of the kind who spent an entire day at the centre. [V. C. Sonawane (Coordinator), N. D. Deshmukh, K. T. Hambir, V. Pawar, T. Adangale, T. Khan, H. Raval, S. Pathare, S. Narvekar, A. Gupta, N. Sonawane]

National Science Day 2017

HBCSE has had an open day on National Science Day (NSD) for over 15 years now. This year the open house witnessed over 2200 visitors, which included students, teachers, teacher educators and parents. Some of the main attractions of the NSD were rocket demonstration, glass blowing techniques, computer corner, botanical garden tour, design and technology activities, mathematical games, liquid nitrogen show, and Hindi cell show on water cycle and exhibition of educational posters. Simple Model System, by CUBE project, and presentation on solid waste management at HBCSE were also among the attractions.

Resource students from B.Ed colleges were trained and they helped in giving interesting demonstrations of science exhibits related to general science, biology, physics, and mathematics. Technical staff members of HBCSE displayed several gadgets and the working of household equipments. Maths laboratory had put an interesting activity called 'Let’s learn mathematics through activities'. Design and technology laboratory had arranged an array of activities on National Science Day 2017 which had the objective of sparking creative problem-solving and expression. There were several hands-on and minds-on games and activities that included toy inspired technology. There was also a Science, Technology and Society discussion board where students penned down their thoughts on mobile technology. This year ‘Star Burst Planetarium’ was another source of attraction where students enjoyed the 3D dome theater. The centre's publications as well as publications, resources, toys and posters of other organizations were displayed and kept for sale. [V. C. Sonawane, (Coordinator), and all HBCSE staff members]

Science Popularization at TIFR, Colaba Campus
HBCSE participated in the National Science Day program held at Colaba campus on February 26, 2017. One-day workshop on 'Let's learn mathematics through activities' was organized for all the participants of TIFR National Science Day at Colaba campus. [S. Naik, H. Raval, C. Navare, C. Ursekar, D. Mishra, H. Agarwal, Meenakshi, H. Sumegh]. Additionally, in connection with Founder's Day, a programme was held on November 13, 2016, where HBCSE members demonstrated working of a rocket, and had a book sale [K. T. Hambir]

Science Populariation at GMRT, Pune,
HBCSE participated in the National Science Day program held at Giant Metrewave Radio Telescope (GMRT) Centre, Pune. GMRT organized a two-day program on February 28 and March 1, 2017. HBCSE took active part in the program and put up many gadgets, working models, and exhibits. Members also demonstrated an interesting activity on measurement of total dissolved solids (TDS) in water, and the testing of water quality. [V. C. Sonawane (Coordinator), A. Gupta, P. K. Nawale, S. Mukherjee, K. T. Hambir, V. Pawar, A. Ajgaonkar, Pooja, B. Thube, A. Sadanandan, B. Chemate]

Outreach Programme
The Maths group of HBCSE conducted an invited session on 'Area and perimeter' under Chai and Why?, a TIFR event. It conducted workshops for students and teachers at various colleges. Some of the important collaborations include Rayat Education Society, Hemendra Kothari foundation, Vikas College, Ratnam College, etc. In these programs, the audience was engaged in hands-on activities and interactive sessions to address pedagogical issues in the learning of mathematics. [S. Naik, H. Raval, T. Khan]

HBCSE campus biodiversity documentation
In an attempt to create awareness about local biodiversity at HBCSE campus, common trees and plants were labelled with their scientific names as well as colloquial English and Marathi names. Posters documenting the various species of birds and butterflies that can be sighted on HBCSE campus have been prepared and displayed. [A. Muralidhar]

Lectures by visitors
A talk by a group of farmers of Prayog Parivar was organised at HBCSE on September 21, 2016. The presentation was in Marathi and Hindi, and a translation was prepared in English and distributed to the audience. [J. Vijapurkar, S. Patil, V. D. Lale, M. Gaitonde]

Kumar Vishwakosh
Kumar Vishwakosh, a project of the Government of Maharashtra, is aimed at preparing Junior Encyclopedia in Marathi. H. C. Pradhan was the Coordinating Editor of the volume on Biology and Environment and V. D. Lale, was the collaborator at HBCSE in this project. Two parts of the volume with a total of 580 entries were published and also put on the internet. [H. C. Pradhan, V. D. Lale]

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. Hindi Cell had developed and demonstrated a show on Water Cycle for students and teachers who visited HBCSE on National Science Day. It had put its books and materials on display in the Open House on February 29, 2016, National Science Day and had also put up an Exhibition of educational posters for visitors. Hindi Cell, in association with the Establishment Section, also took care of the '*Aaj ka Shabd*', where technical words related to administration were put up on the display board throughout the year. [K. K. Mishra, K. Sinha, D. Mishra, M. Bamne]

5. STAFF LIST

Members

J. Ramadas (Centre Director, up to 30/06/2016 & Member up to 17/01/2017), K. Subramaniam, (Centre Director), S. Chunawala (Dean, HBCSE Faculty), S. Ladage, R. R. Vartak, A. Mazumdar, G. Nagarjuna, K. K. Mishra, J. Vijapurkar, R. B. Khaparde, A. P. Sule, P. K. Joshi, P. De, S. Chandrasekharan, A. Gupta

N. D. Deshmukh, V. D. Lale, V. C. Sonawane, S. R. Pathare, S. M. Narvekar, A. Ronad, R. P. Nichat, M. B. Kharatmal, D. D. Pednekar, T. S. Rajashekar, P. K. Nawale, Manoj K. R., S. S. Naik, P. P. Pathak, A. Muralidhar, I. Das, A. Sankhwar, V. S. Ghanekar, P. Ranadive, H. Raval

Visiting Fellows

S. Bhide, R. Thengodkar, D. Gupta (up to 01/02/2017), S. Datt, R. Karandikar

Research Scholars

R. Shaikh (up to 31/07/2016), P. Pande (up to 31/07/2016), Ratna (up to 31/07/2016), K. Mishra (up to 12/10/2016), S. Ghag (up to 03/02/2017), M. Shah (up to 03/03/2017) R. Varkey, G. Singh, R. D'Souza, H. Srivastava, G. Date, D. Karnam, D. Dutta, C. Navare, S. Varadarajan, L. Shitap, C. Ursekar, Meenakshi, J. Subramanian

PhD students (external)

A. Raveendran, A. Sharma, A. Dhakulkar, R. Kumar, A. Kawalkar, A. Srivastava, S. Takker, S. Shome

M. Phil Student

K. Mishra

INSA Senior Scientist

S. M. Roy, D. P. Roy (up to 17/03/2017)

Raja Ramanna Fellow

H. C. Pradhan

Administration
M. D. Gaitonde, V. P. Raul, 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, J. J. Tambe, H. M. Mandlik, T. S. Shirodkar, R. Sawant, S. Shejwal, S. Wairkar

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

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

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

Obituaries (LAST PAGE OF ANNUAL REPORT)

D. P. Roy
INSA Senior Scientist
(29.07.1941 ─ 17.03.2017)
Joined TIFR on 02.08.1976

6. NATIONAL AND INTERNATIONAL INVOLVEMENT

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

A. Mazumdar was 1) National Coordinator, Science Olympiads; 2) Chair, Academic Committee, 10th International Olympiad on Astronomy and Astrophysics (IOAA) held at NISER, Bhubaneswar, December 2016.

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

A. Sule was 1) Regional Coordinator (Asia-Pacific) for the International Olympiad on Astronomy and Astrophysics (IOAA) from January 1, 2012 to December 31, 2016; 2) General Secretary for the International Olympiad on Astronomy and Astrophysics from January 1, 2017 to December 31, 2021; 3) Member of coordination committee for National Entrance Screening Test 2016, 2017; 4) Co-convener for 10th International Olympiad on Astronomy and Astrophysics (IOAA), Bhubaneswar, December 2016; 5) Chair, Local Organising Committee, 9th International Conference in Oriental Astronomy (ICOA), IISER-Pune, November 2016; 6) Member of Public Outreach and Education Committee of Astronomical Society of India.

G. Nagarjuna was 1) Associate Editor, *International Journal of Conceptual Structures and Smart Applications* (IJCSSA), an Official Publication of the Information Resources Management Association; 2) Reviewer, *Current Science*; 3) Reviewer, *Resonance*; 4) Reviewer, *Science & Education*, Springer; 5) Chairperson, Free Software Foundation of India; 6) Member, Board of Software Freedom Law Centre of India, New Delhi; 7) Member, Web Server Committee, National Board of Higher Mathematics 8) Member, Advisory Board, Centre for Education Innovation and Action Research, TISS, Mumbai.

H. C. Pradhan was 1) President, Indian Association of Physics Teachers (IAPT) for the term January 2016 to December 2018; 2) Chair, National Experts Advisory Committee of the National Council of Science and Technology Communication (NCSTC), DST, Govt of India; 3) Member, Maharashtra Rajya Vishwakosh Nirmiti Mandal; 4) Coordinating Editor of the volumes on Biology and Environment under their Kumar Vishwakosh (Junior Encyclopedia) Project; 5) Member, Maharashtra Rajya Bhasha Sallagar Samiti; 6) Chairperson, Monitoring/Steering Committee for Education and Content Development for Shikshan Pandhari, an ICT enabled rural school education project run by Maharastra Knowledge Foundation and sponsored by the Rajeev Gandhi Science and Technology Commission (RGSTC), Govt of Maharashtra; 7) President of Gram-Mangal, Pune; 8) Member, Academic Board, Department of Physics (Autonomous Status), University of Mumbai; 9) Acting President, Board of Trustees of Ekvira Education Society, Charkop, Kandivali, Mumbai, which runs a school complex.

J. Ramadas was 1) Member, IUPAP International Commission on Physics Education (ICPE or IUPAP Commission 14) for the period 2011-17; 2) Member (ex-officio), Governing Council of the Atomic Energy Education Society (AEES), July 2011- June 2016.

K. K. Mishra was 1) Member, National Academy of Sciences, India; 2) Member, Executive Council, Lok Vigyan Parishad, Delhi; 3) Member, Vigyan Parishad Prayag, Allahabad; 4) Joint Secretary, Peoples' Council of Education, Allahabad; 5) Member, Advisory Board, *Vigyan-Ganga*, a science magazine by Banaras Hindu University, Varanasi; 6) Member, Advisory Board, *Technical Today*, a national science and technology magazine by Mewar University, Chittor, Rajasthan; 7) Member, Editorial Board, and Referee for *Vigyan Prakash*, a quarterly Hindi journal of research in science, brought out by Lok Vigyan Parishad, Delhi and World Hindi Foundation, NY, USA; 8) Member, Central Level Committee of the Atomic Energy Education Society (AEES) Awards 2016.

K. Subramaniam was 1) Member, National Council for Teacher Education (NCTE); 2) Member (ex-officio), Governing Council, Atomic Energy Education Society 3) Country representative for India, International Commission for Mathematics Instruction; 4) Member, Journal Editorial board, *Contemporary Education Dialogue*; 5) Member, Journal Editorial board, *At Right Angles*; 6) Member, Advisory board, Information Age Publishing: International Sourcebooks in Mathematics and Science Education.

N. D. Deshmukh was 1) Executive Director for 26th Biennial Conference of the Asian Association for Biology Education; 2) Executive Member, Asian Association for Biology Education; 3) Executive Member, Indian Ocean Comparative Education Society and Executive Committee member for 2015-2017 IOCES conference; 4) Editorial Board Member, *Asian Journal of Biology Education* (AJBE); 5) School Council Member, YCMOU Nashik B.Sc. Course; 6) Advisory Member, *Shikshan Sankramann* Journal; 7) Honorary Member, *Vidnyan Warta* Journal; 8) Academic facilitator, National Institute of Open Schooling- Vashi Center.

P. K. Joshi was 1) President of the International Junior Science Olympiad for the period 2015 – 2018; 2) Chairman, Bombay Association for Science Education; 3) Chief Advisor, Science Society of India; 4) Life member of Indian Association of Physics Teachers (IAPT), Bombay Association for Science Education (BASE), Indian Physics Assocation (IPA).

P. Pathak was 1) Member, International Advisory Committee of International Physics Olympiad for the period 2013-17.

P. Ranadive was 1) Member of the Academic Committee, 10th International Olympiad on Astronomy and Astrophysics (IOAA) Bhubaneswar, December 2016.

R. B. Khaparde was 1) Member of the Editorial Board, *Physics Education*, Quarterly e-Journal devoted to Physics Pedagogy, Pune, India.

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

S. Chandrasekharan was 1) Adjunct Associate Professor, Interdisciplinary Program in Educational Technology, Indian Institute of Technology Bombay, Powai, Mumbai, India; 2) Committee member, Ph.D. Thesis Advisory Committee for Paul Clifton, Digital Media Program, Georgia Institute of Technology, Atlanta, USA; 3) Advisory Board Member, Studies in Applied Philosophy, Epistemology and Rational Ethics, Springer book series; 5) Program Committee Member for: *The 16th IEEE International Conference on Advanced Learning Technologies*, 2016, Austin, Texas, USA; Track 1- Technology for Learning of Thinking Skills and Track 2- CSCL and Learning Sciences Track, of the *24th International Conference on Computers in Education*, 2016, IIT Mumbai, India; IEEE Technology for Education, 2016, IIT Mumbai; 6) Reviewer for journals *Cognitive Science* and *Psychological Studies*.

S. Chunawala was 1) Reviewer for Indian Educational Review, NCERT; 2) Executive Council Member of the Peoples Council of Education for the year 2012-2015; 3) Member, Departmental Advisory Board (DAB), Department of Gender Studies, NCERT; 4) Member, Departmental Advisory Board (DAB), Department of Education in Science and Mathematics, NCERT; 5) Member, Board of University Teaching and Research, YCMOU; 6) Member, Board of Studies, SNDT University, Marine Lines, Mumbai; 7) Local Management Committee member, K. J. Somaiya Comprehensive

College of Education, Training and Research; 8) Executive Board Member, 2016-2018, Representative of South Asia, International Organization for Science Technology Education (IOSTE); 9) Organizing Committee Member and Reviewer for National level Researcher's Meet 2017.

S. Ladage was 1) National Coordinator, National Initiative on Undergraduate Science (NIUS) programme; 2) Member, Editorial Advisory Board, *Journal of Chemical Education* (JCE), American Chemical Society (January 2017-); 3) Member of International Steering Committee (ISC) for International Chemistry Olympiad (IChO)-2016-2017; 4) Member of Scientific Committee, 48th International Chemistry Olympiad 2016, Tbilisi, Georgia.

S. Narvekar was 1) Treasurer (West Zone), Association of Chemistry Teachers (ACT) (Jan 2017-19)

S. Pathare was 1) Member of the Executive Committee of the World Federation of Physics Competitions (WFPhC) 2016; 2) Reviewer for an article, *The Physics Teacher Journal*, published by American Association of Physics Teachers.

V. D. Lale was 1) Editorial Committee Member, Kumar Vishwakosh (Biology & Environment), Maharashtra Rajya Vishwakosh Nirmiti Mandal, Wai; 2) Academic Committee Member, Shikshan Pandhari Project, Maharashtra Knowledge Corporation Limited, Pune; 3) Executive Committee member, Grammangal, Pune; 4) Advisory Committee Member, Vishwakosh Dnyan Mandal (Physics), Maharashtra Rajya Vishwakosh Nirmiti Mandal, Wai.

7. VISITS

A. Mazumdar visited the Institut de Recherche en Astro-physique et Planetologie, CNRS-Universite Paul Sabatier and Observatoire de Midi-Pyrenees at Toulouse, France as a Visiting Researcher during May 2-26, 2016.

A. Srivastava participated in the *Annual Meeting of the Society for the Advancement of Biology Education Research (SABER)*, Minneapolis, USA, July 2016; *Spatial Cognition Conference*, Philadelphia, PA, USA, August 2016.

CUBE team visited National Centre for Biological Sciences, Bengaluru, October 7, 2016; Agharkar Research Institute (ARI, Pune) to establish Hydra as a model system for regenerative studies, October 10, 2016.

G. Date participated in a pre-conference workshop 'Engineering Community Engagement Workshop' organized by Louisiana State University and the EPICS program, at Purdue University, June 22-25, 2016; participated in the *123rd Annual Conference and Exposition of American Society for Engineering Education*, USA, June 26-29, 2016.

G. Nagarjuna visited the NROER Team, NCERT Delhi, August 5, 2016.

G. Nagarjuna, S. Bhide, M. Kharatmal, N. D. Deshmukh, M. C. Arunan, A. Ronad and R. Vartak participated in the *26th Asian Association for Biology Education (AABE)*, in Goa, September 20-23, 2016.

Gnowledge Lab members visited Vigyan Ashram. Pabal, Pune, December 27, 2016.

H. C. Pradhan attended *Conference on Technology Vision 2035*, Technology, Information, Forecasting and assessment Council, DST, Government of India, Nehru Science Centre, Mumbai, April 18, 2016; Brainstorming Workshop for Preparation of the Project Guide for NCSC 2016, Tamilnadu Science and Technology Centre, Guindy, Chennai, July 8, 2016; National Convention of the Indian Association of Physics Teachers, Kadi Sarva Vishwavidyalay, Gandhinagar, Gujarat, October 20-22, 2016; Annual Convention 2016 – Marathi Vidnyan Parishad, Gadkari Rangayatan, Thane, December 17-18, 2016; National Children's Science Congress 2016, Vidya Pratishthan, Baramati, Maharashtra, December 26-31, 2016.

J. Ramadas attended the *UNISA International Mathematics, Science and Technology Education (ISTE) Conference* at Kruger National Park, Mopani Camp, Phalaborwa, Limpopo, South Africa, October 23-28, 2016; was on sabbatical leave at the Institute of Mathematical Sciences, Chennai, July 1- December 31, 2016.

J. Rahaman, S. Takker and **R. Dsouza** participated in the *13th International Congress on Mathematical Education*, at Hamburg, Germany, July 24-31, 2016.

K. Subramaniam participated in a collaborative research workshop on "Mathematical Discourse in Instruction" at the University of Witwatersrand, Johannesburg, South Africa, May 5-10, 2016; participated in the *13th International Congress on Mathematical Education*, at Hamburg, Germany, July 24-31, 2016.

M. C. Arunan visited Sunshine Worldwide School, Velha, Goa, along with Dr Sadanand as part of CUBE's Goa Extension Meeting, June 6, 2016; participated in the *Intenational Symposium- Dengue Prediction and Prevention through Community Engagement*, Kochi, Kerala, January 12, 2017.

M. Kharatmal participated in the *7th International Conference on Concept Mapping* in Tallinn, Estonia, September 5-9, 2016.

N. D. Deshmukh, V. C. Sonawane, K. T. Hambir, H. Raval and T. Adangle participated in the Science and mathematics teachers workshop jointly organized by Deepshikha Gurukul Sainik School, Chikhaldara, Amravati, Maharashtra, and Department of Education, Amravati Division, Amravati, October 3-4, 2016.

N. D. Deshmukh and H. Raval visited State Teachers Training Institute, GCERT, Gandhinagar, Gujarat, September 3, 2016.

P. K. Joshi visited Bali, Indonesia, as President of IJSO on two occasions, June 30- July 7, 2016; November 30- December 12, 2016, to inspect the preparations of 13th IJSO to be held in December 2016; attended the Teachers Try Science and STEM Training (IBM STEM Summit) organized by IBM, Agastaya International Foundation, EzVidya, Learning Links Foundation, SRF Foundation and Vikram Sarabhai Communiaty centre, in New Delhi, July 11-12, 2016; visited INO at Guwahati as Observer, January 25-30, 2017.

P. Pande and **R. Shaikh** participated in the *12th International Conference of the Learning Sciences (ICLS 2016)*, National Institute of Education (NIE), Singapore, June 20-24, 2016.

S. Chandrasekharan visited Kerala School of Mathematics (Visiting Fellowship), Kunnamangalam, Kerala, May 1-31, 2016.

S. Chunawala participated in the *International Organization of Science and Technology Education (IOSTE) Symposium* at Braga, Portugal, July 11-16, 2016.

S. Datt and M. Shah participated in the *International Conference on Creativity and Cognition in Art and Design (ICCCAD 2017)*, organized by the National Institute of Design (NID), India and National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, January 19-21, 2017.

S. Ladage visited Tbilisi, Georgia, as a member of the Scientific Committee of 48th International Chemistry Olympiad from July 20-August 1, 2016; participated in the *24th IUPAC International Conference on Chemistry Education* (ICCE), August 15-20, 2016.

S. Narvekar participated in the *24th IUPAC International Conference on Chemistry Education* (ICCE), August 15-20, 2016.

S. R. Pathare and V. Kurmude participated in the *7th Congress of the World Federation for Physics Competitions* (WFPhC) in Banten, Indonesia, September 26 to 30, 2016.

Several HBCSE members made a study visit to three Zilla Parishad (ZP) schools in Akole block (Ahemadnagar district) which was part of their course on 'Social Aspect of Education' (Instructor: Kishorkumar Darak), January 20-21, 2017.

8. AWARDS AND DISTINCTIONS

(already submitted)

A. J. Kumar, G. Shridhar, S. Ladage and L. Ravishankar
Best Poster Award, for the paper 'Sugar based low melting mixtures as green solvents in the Hantzsch synthesis of substituted 1,4-dihydropyridines', *International Science Festival* (IISF-2016), December 2016.

D. Semwal, I. D. Sen and R. V. Jayaram
2nd Prize in poster communication, for the paper 'Clouding and adsorption of Triton X-100: Effect of additives. *Environmental Sustainability and Wastewater Remediation: Current Status and Future Prospects', ESWR – 2017*, January 2017.

P. Pande received the International Society of the Learning Sciences (ISLS) Travel Scholarship Award 2016, NIE, Singapore.

S. R. Pathare and V. V. Kurmude
First prize in the *National Competition for Innovative Experiments in Physics*, for the experiment on low cost Michelson interferometer.

9. INVITED TALKS

H. C. Pradhan

1. Education in India in the next two decades, *Conference on Technology Vision 2035*, TIFAC, DST, Government of India and National Council of Science Communicators, Nehru Science Centre, April 18, 2016
2. Alternative frameworks in physics (Plenary Lecture), *National Conference on Science Education*, Regional Institute of Education, NCERT, Ajmer, Rajasthan, November 25, 2016

J. Ramadas

1. Visuospatial thinking in science education, *UNISA ISTE Conference*, Kruger National Park, Mopani Camp, Phalaborwa, Limpopo, South Africa, October 23-28, 2016

K. Subramaniam

1. Inaugural address, *Two Day National Level Researchers' Meet*, organized by Department of Education, University of Mumbai, in collaboration with HBCSE, Kalina Campus of University of Mumbai, January 5, 2017
2. Preparation of mathematics teachers - what are the significant gaps? Plenary talk at the *National Conference on Innovations in Mathematics Education*, Lady Shriram College, Delhi, March 3, 2017

P. K. Joshi

1. Olympiad experiments, the *13th International Junior Science Olympiad*, Bali, Indonesia, December 6, 2016

R. B. Khaparde

Thinking behind the doing, Sunday Science Activity Centre (Inaugural talk), Gokhale Education Society's H.P.T Arts and R.Y.K Science College, Nashik, December 11, 2016

S. Chunawala

New challenges and new pedagogies for 21st century education, (Keynote address), *the 24th Senior Scholar Seminar Series*, organized by IQAC of K J Somaiya Comprehensive College of Education, Training and Research In collaboration with Global Foundations, K. J. Somaiya College of Education, Training and Research, February 17, 2017

10. CONFERENCES / WORKSHOPS ORGANIZED BY THE CENTRE

IMOTC Award Distribution Function 2016
HBCSE, May 16, 2016

GNU KHATA Official Launch
HBCSE, June 15, 2016

Two short courses to enhance Science Education in Sri Lanka
HBCSE, July 17-31, 2016 and November 13-27, 2016

Fifteenth V. G. Kulkarni Memorial Lecture
HBCSE, September 7, 2016

The 26th Biennial Conference of Asian Association for Biology Education
(collaboratively organized by AABE, India Chapter, HBCSE, Vidya Prabodhini College of Commerce, Education, Computer & Management Goa, Rayat Education Society Satara, Shri Shivaji Education Society, Amravati, Association of Teachers in Biological Sciences, India, St. Ann's College for Women, Hyderabad, and The International Centre, Goa)
The International Centre, Goa, September 20-24, 2016

Annual Research Meet 2016
HBCSE, October 24-26, 2016

Infosys Award Function
HBCSE, December 22, 2016

National level Researcher's Meet 2017 (jointly organized by HBCSE and the Internal Quality Assurance Cell, Department of Education, University of Mumbai)
Kalina, January 5-6, 2017

National Science Day 2017
HBCSE, February 28, 2017

Play "Main aurat hoon" (directed by Manjul Bhardwaj, on International Women's Day, 2017)
HBCSE, March 8, 2017

Nutan Bal Mahotsav
HBCSE, March 22, 2017

WORKSHOPS LIST

Workshops for students

1. Pre-Departure Camp (PDC) for European Girls' Mathematical Olympiad for 2 students (HBCSE, April 6-10, 2016); PDC Chemistry for 4 students (HBCSE, June 6-21, 2016); PDC Physics for 5 students and several resource persons (HBCSE, June 27 - July 10, 2016); PDC Biology for 4 students (HBCSE, July 1-14, 2016); PDC Mathematics for 6 students (HBCSE, June 30- July 6, 2016); PDC Junior Science Olympiad for 6 students (HBCSE, November 23 - December 1, 2016);
2. Workshops on “Extrapolating mathematics of Nim game”, “Understanding area through multiple units” and “Algebraic patterns in day-to-day life”, Maharashtra Talent Search program for 60 students (HBCSE, April 12, 13, 16, 2016);
3. Mumbai Science Teachers Association and HBCSE's Dr Homi Bhabha Young Scientist Camps for 110 Grade 6 students (HBCSE, April 12-13, 2016);
4. Orientation cum Selection Camps (OCSC) 2016 for Chemistry, 19 students (HBCSE, April 13 - April 22, 2016); Junior Science, 29 students (HBCSE, May 5 - May 22, 2016); Physics, 34 students (HBCSE, May 24 - June 6, 2016); Biology, 24 students (HBCSE, June 1 - June 10, 2016);
5. Summer camp on “Learning integers through Integer Mall”, for 30 students from Nutan Vidyamandir, Mankhurd (HBCSE, April 14-30, 2016);
6. Mumbai Science Teachers' Association and HBCSE's Dr Homi Bhabha Young Scientist Camps for 74 Grade 9 students (HBCSE, April 15-16, 2016);
7. Summer camp on “Learning integers through Integer Mall”, for 17 students from Al-Kausar School, Govandi (Mumbai, April 16-30, 2016);
8. International Mathematical Olympiad Training Camp for 48 students (HBCSE, April 18 - May 16, 2016);
9. Workshops at two-day activity based science enrichment program, for 90 class IX students, Chinmaya Vidyalya (Tarapur, April 18-19, 2016);
10. Two workshops on waste, health, development and political literacy, for 20-30 early tenth grade students from Gayak Rafi Nagar Municipal Urdu Night High School (Mankhurd, April 20- 29, 2016; Govandi, Mumbai, July 15- August 20);
11. Teaching camp on “Learning algebra through patterns”, for 40 students, St. Xavier’s Institute of Education, Churchgate (Mumbai, April 25-28, 2016);
12. Summer camp for 12 deonar colony students on ICT skills, Municipal English

School (Mumbai, April 25-May 25, 2016);
13. One month summer camp for 15 students from Nutan Vidya Mandir (HBCSE, May 1- 31, 2016);
14. The third National Initiative on Undergraduate Science (NIUS) Physics camp for Batch 12, comprising of 18 students (HBCSE, May 1- June 30, 2016);
15. Summer Course in Experimental Physics (SCEP) 2016 for 41 students (HBCSE, May 9 - 20, 2016);
16. The first NIUS (Physics) Programme for Batch 13 (2016-17), comprising of 77 undergraduate students (HBCSE, June 8-17, 2016);
17. Hands-on-minds-on mathematics, for 14 students from BMC school (Mumbai, July 19, 2016);
18. Workshop series on 'Understanding algebra and understanding integers', for 14 students from BMC School (HBCSE, July 26, August 4 and 11, 2016);
19. Workshop on “glider making”, for eight grade 8-9 students from Adarsh vidyalaya (HBCSE, September 17, 2016);
20. Workshop on “Introduction to basic resources for design and children's' notion of problems”, for five grade 8-9 students from Adarsh vidyalaya (HBCSE, September 24, 2016);
21. Junior science olympiad (JSO) students' workshop for Atomic Energy Central Schools (AECS) for 60 participants (Mumbai, October 17-22, 2016);
22. Workshop on making microscope with webcam, for 6 middle school participants (HBCSE, October 31, 2016);
23. One day workshop on “Stop motion animation”, for 6 middle school students (HBCSE, November 2 and 4, 2016);
24. One day workshop on “Use of Maths Lab to teach school mathematics”, for 7 post-graduate students of education, Tata Institute of Social Sciences, Mumbai (HBCSE, November 3, 2016);
25. NIUS Biology camp for Batch XIII.1 for 30 students (HBCSE, November 7-11, 2016);
26. One day workshop on hands on minds on mathematics, for around 15 students from Imli Mahua School, Chhatisgarh (HBCSE, November 17, 2016);
27. One day “INSPIRE students workshops on science activities” for collectively over 160 students (S. P. College, Pune, December 1, 2016; Mahatma Phule A. S. C. College, Panvel, December 29, 2016; Y. C. College, Satara, December 30, 2016);
28. Workshop on science activities, Magic Bus Science and Maths Exhibition, for 100 participants, University of Mumbai (Mumbai, December 13-14, 2016);
29. NIUS Chemistry camp for 47 students (HBCSE, December 21-31, 2016);
30. Workshop on "learning through activities" for 15 college students and teachers from KLE College of Science and Commerce, Kalamoboli, Mumbai (HBCSE, December 30, 2016);
31. Science demonstrations workshop, for 100 students and 25 teachers at New English School, Murbad (Thane, February 21, 2017);
32. One day workshop on mathematics: What it is?, for 150 undergraduate students of Vikas college, Ghatkopar (Mumbai, February 23, 2017)

Collaborative Undergraduate Biology Education (CUBE) Workshops and Meets

33. CUBE summer workshop, for 50 students from various colleges across Mumbai, Pune and from Madras University, who worked on research questions addressed in *Drosophila*, Earthworm, *C. elegans* and Daphnia (HBCSE, May 5- June 5, 2016);
34. CUBE Summer Meet where 120 students presented their work on model organisms from Mumbai, Chennai, Delhi, Gujarat (HBCSE, August 7, 2016);
35. CUBE- India Bioscience workshop for 15 participants, on "Bridging the gap between what is taught in the college and what is done in research labs", Mount Carmel College (Bangalore, October 1, 2016);
36. CUBE- Connecting to classroom, for 20 participants, National Centre for Biological Sciences (Bangalore, October 2, 2016);
37. CUBE workshop (in collaboration with a Cubist from Jaipur), for 15 faculty and graduate students, National Institute of Mental Health and Neurosciences (Bangalore, October 4, 2016);
38. CUBE Diwali Meet, for 30 students (HBCSE, November 27, 2016);
39. Two-day workshop for 10students and 2 teachers on "Regeneration Studies on hydra and earthworm" in collaboration with Agharkar Research Institute, Pune. (HBCSE, November 19-20, 2016);
40. CUBE Diwali Workshop for 20 students from CHM, KBP, VES colleges (HBCSE, November 1-5, 2016);
41. Follow up workshop of CUBE- Asian Association for Biology Education Conference for 20 participants (Dhempe College and Carmell College, Goa and BITS Pilani Goa, December 5- 9, 2016);
42. Half day CUBE workshop on “model organisms” for 90 junior college science teachers, organized in collaboration with R. J. Jhunjhunwala college, (Mumbai, December 14, 2016);
43. CUBE Goof-ups in Science, for 75 participants from various colleges in Mumbai (HBCSE, December 26, 2016);
44. A week long CUBE Christmas Workshop on “model organism” for around 70 students (HBCSE, December 26, 2016 to January 1, 2017);
45. CUBE- Elphinstone College PRIMER Meet, attended by 30 Students and 2 teachers, Elphinstone College (Mumbai, January 20, 2017);
46. CUBE Winter Workshop Meet, 30 students from Mumbai, Baroda, Chennai presented their work on model systems (HBCSE, January 22, 2017);
47. CUBE- KBP College Research Meet, attended by 30 students, KBP College, Vashi (Navi Mumbai, January 23, 2017) ;
48. CUBE India Bioscience Workshop “Transforming classroom by collaborative research and active learning”, for 30 college teachers , Garware College (Pune, February 3, 2017);
49. CUBE Catalyst Workshop "Building Context to Content: Remodeling of Class-Lab Engagement Using Simple Model Systems", for 50 undergraduate students, 15 senior teachers from across India (HBCSE, March 24-26, 2017);

Workshops for Pre / In-Service Teachers

1. Connected Learning Initiative (CLIx) Orientation workshop for 15 participants (Chhattisgarh, April 7-8, 2016);
2. Course maker's workshop with the CLIx technical team for 15 participants (HBCSE, April 9-10, 2016);
3. International Junior Science Olympiad - Resource Generation Camp (HBCSE, for 16 teachers, April 9-10, 2016; for 15 teachers, April 23-24, 2016; for 21 teachers, August 20-21, 2016; for 15 teachers, October 1-2; for 22 teachers, November 5-6, 2016; for 16 teachers, February 11-12, 2017; for 20 teachers, March 25-26, 2017);
4. Workshop on "Mathematics knowledge for teaching" for 40 teachers of St. Stanislaus High School, Bandra (Mumbai, April 11, 2016);
5. Invitation to CLIx, Teacher Professional Development, CLIx Mizoram, for 180 participants (Mizoram, April 16 - May 5, 2016);
6. Three-day Workshop on "Teaching lab for algebraic thinking", for 8 pre-service teachers, Xavier's Institute of Education, Churchgate (Mumbai, April 25-28, 2016);
7. Workshop on 'An amazing educational tool: Microscope' at event organized by National Education Society, for 36 science teachers, at National English School Virar (Thane, April 30, 2016);
8. Astronomy Olympiad Exposure Camps for around 50 teachers from Jammu and Kashmir school and Jr. College teachers, collaboratively organized by HBCSE, Public Outreach Committee of Astronomical Society of India, Vigyan Prasar, Science Teachers Association of Kashmir, Directorate of School Education (Govt. of J&K), Kashmir University, Navanirmiti, Kothibaug High School (Srinagar, May 5-7, 2016);
9. NIUS physics- exposure cum preparatory workshop, for 9 college teachers (HBCSE, May 6-8, 2016);
10. One day mathematics laboratory workshop for 30 in-service TGT mathematics teachers from Kendriya Vidyalayas in collaboration with Zonal Institute of Educational Training, Kendriya Vidyalaya Sangathan (Mumbai, May 26, 2016);
11. Workshop on introduction to inquiry based learning and teaching, for 8 teachers from Natwar Nagar Municipal Public School (Jogeshwari, Mumbai, June 4 and 6, 2016);
12. Invitation to CLIx, Teacher Professional Development Workshop, Connected Learning Initiative - CLIx (for 45 participants, Jaipur, Rajasthan, June 8-11, 2016; for 40 participants, Sirohi, Rajasthan, June 16-19, 2016; for 40 participants, Sirohi, Rajasthan, August 2-5, 2016; for 45 participants, Warangal, Telangana, August 9-12, 2016);
13. Problem designing workshop for 12 college and university faculty for developing problems and pedagogical material for the chemistry olympiad programme (HBCSE, June 18-19, 2016; August 12-15, 2016);
14. Rayat Shikshan Sanstha's elementary teacher workshop for 39 elementary teachers (HBCSE, June 20-24, 2016);
15. Workshop on problem solving of open ended questions and its approaches, for

11 pre-service teachers of St. Xavier's Institute of Education (Mumbai, June 21-23, 2016);

16. Teacher training program organized jointly with BASE on 'forces in science' for 42 teachers (TIFR, Mumbai, June 25, 2016);
17. One day workshop on 'Use of learning resources', organized by St. Lord College of Education, Malad, Mumbai, for 48 pre-service teachers (Mumbai, June 29, 2016);
18. Two day biology teachers workshop on ‘Teaching biology- The missing link’, jointly organized by Department of Biology & EVS, Seth Anandram Jaypuriya School, Kanpur and HBCSE, for 34 science teachers (Kanpur, July 2-3, 2016);
19. Teacher training workshop by JSO cell for 32 teachers, South Gujarat University (Surat, July 8-10, 2016) and for 29 teachers, Pilukula Science Centre (Mangalore, July 19-21, 2016);
20. Teacher training program organized jointly with BASE on 'how to frame questions' for 47 teachers (NSC, Mumbai, July 23, 2016);
21. Teacher training program organized jointly with BASE on 'Syllabus based experimental workshop' for 30 teachers (HBCSE, August 12-13 & 26-27, 2016);
22. Invitation to Connected Learning Initiative- CLIx, TPD Workshop, for 40 teachers secondary school of Chhattisgarh (Chhattisagarh, August 29-September 1, 2016);
23. Resource Generation Camp for Biology, ethology and evolution, genetics, cell biology, animal sciences and plant sciences and ecology (HBCSE, for 2 teachers, August 29-30, 2016; for 2 teachers, October 20-21, 2016; for 2 teachers, November 21-22, 2016; for 3 teachers, December 2-3, 2016; for 2 teachers, December 6-7, 2016);
24. Akola district science teacher association workshop for 65 teachers, at New English School (Akola, September 6, 2016);
25. Resource Generation Camps (RGC) for Chemistry, for 11 participants (HBCSE, September 17-21, 2016);
26. Junior science teacher training workshop organized in collaboration with Janakalyan Samiti for 21 teachers (HBCSE, September 19-22, 2016);
27. Pre-conference workshop on “Simple model systems and sophisticated research questions”, for 30 teachers and college students, 26th AABE conference (Goa, September 20, 2016);
28. Follow-up workshop on “Simple model systems and sophisticated research questions”, for 30 teachers and college students, 26th AABE conference (Goa, September 22, 2016);
29. Problem coordination camp for Madhava Competition, for 15 teachers (HBCSE, September 24-25, 2016);
30. Resource Generation Camp (RGC) for Physics (HBCSE, for 13 teachers, September 26-28, 2016; for 4 teachers, December 27-29, 2016; for 10 teachers, February 3-10, 2017);
31. Science demonstration workshop, for around 40 teachers, M. H. High School, (Thane, September 27, 2016);
32. Two-days residential teacher professional development workshop on Module development for around 200 in-service science and mathematics teachers of

secondary and higher secondary schools, GCERT, Gujarat (HBCSE, September 29-30; October 17-18, 2016);

33. Science and mathematics teachers workshop, jointly organized by Deepshikha Gurukul Sainik School, Chikhaldara, Amravati, Maharashtra, and Department of Education, Amravati Division, for 100 teachers (Chikhaldara, October 3-4, 2016);
34. One day TPD workshop for 50 Raje Chhatrapati Sambhaji High School Teachers, Deonar Mumbai (HBCSE, October 5, 2016);
35. Fifteen YCMOU workshops for around 100 Post Graduation Research Programme students who are professionals and teachers (HBCSE, October 23, 2016; November 27, 2016; December 18, 2016; January 15, 2017; January 29, 2017; February 12, 2017; March 5, 2017, March 19, 2017);
36. Five-day residential teacher professional development workshop on Enhancing Pedagogical Skills to Impact Classroom Transactions for 26 in-service mathematics teachers of primary and secondary schools, Zonal Institute of Education and Training (ZIET), Kendriya Vidyalaya (KV), Mumbai (HBCSE, November 7-11, 2016);
37. Somaiya teachers workshop, for 40 science and maths teachers (HBCSE, November 8-10, 2016);
38. Workshop on understanding three approaches to hands-on science activities, for around 24 teachers of Natwar Nagar Public School and Lakshmi Nagar Municipal School (Jogeswari, November 9, 2016);
39. Biology Olympiad Exposure Camp for 30 teachers (HBCSE, November 16-18, 2016);
40. Chemistry Exposure Camp for 30 teachers (HBCSE, November 21-24, 2016);
41. Collaborative workshop on “Enhancing pedagogical skills to impact classroom transactions” for 30 KV science teachers (HBCSE, November 21-25, 2016);
42. Workshop on Process Oriented Guided Inquiry Learning for 45 teachers, Baburao Gholap College (Pune, November 26, 2016);
43. One day workshop on “Development of mathematics lab in schools- Hands on mathematics” for 60 primary and secondary school teachers of Rayat Education Society, Raigad (HBCSE, November 28, 2016);
44. Three-day workshop on “Teaching undergraduate biology through history of science”, for 3 teachers from Vivekanand Education Society's College of Arts, Science, and Commerce (HBCSE, December 1-3, 2016);
45. Workshop for BMC (M-Ward) 152 elementary school teachers on science and mathematics Education (HBCSE, December 8-9, 2016);
46. One day experimental workshop, as part of UGC-HRD University of Mumbai Refresher Course for 31 junior college teachers (HBCSE, December 19, 2016);
47. Two days workshop on Project Based Learning for 30 in-service TGT and PGT KV maths teachers along with principals, in collaboration with KV-ZIET (Mumbai, December 19-20, 2016);
48. Three day science and mathematics education workshops at the fourth Shri Shivaji Vidnyan Parishad, for 65 science teachers, Shivaji Science College (Nagpur, December 20-22, 2016);
49. Junior Science Olympiad follow-up workshop for 14 teachers (HBCSE, January

9-12, 2017);
50. Workshop on understanding science education, for 34 D.Ed students of Rayat Shikshan Sanstha's (HBCSE, January 16, 2017);
51. Three-day residential teacher professional development workshop on "Learning to design a lesson: What it entails?." for 30 in-service primary and secondary mathematics teachers, in collaboration with ZIET, Kendriya Vidyalaya (HBCSE, February 1-3, 2017);
52. Three-day residential teacher professional development workshop on "Enhancing pedagogical skills to impact classroom transactions", for 30 in-service primary and secondary science teachers, in collaboration with ZIET, Kendriya Vidyalaya (HBCSE, February 7-9, 2017);
53. Swami Vivekanada Youth Movement's Karnataka D.Ed students workshop, for 57 pre-service teachers from Karnataka (HBCSE, February 10, 2017);
54. Physics exposure cum preparatory workshop for 31 teachers, from different parts of India (HBCSE, February 20-24, 2017);
55. Four-day workshop on 'Central forces' for 32 undergraduate physics teachers (HBCSE, February 28-March 3, 2017);
56. Astronomy Olympiad Exposure Camps for about 50 teachers from Rajasthan (Jaipur, March 2-4, 2017)

Workshops for teacher educators/ resource persons

1. User Interface/ User Experience (UI/UX) Workshop with FOLO design team for course player and course maker of gstudio platform for 15 participants (HBCSE, May 10-11, 2016);
2. Invitation to CLIx, Teacher Educator's workshop for 15 participants, Connected Learning Initiative - CLIx (Rajasthan, June 5-6, 2016);
3. Short course to enhance Science Education in Sri Lanka, a two-week workshop for 20 science teachers and education officers from Sri Lanka (HBCSE, July 17-31, 2016);
4. Workshop on National Repository of Open Educational Resources (NROER) for 13 participants, NCERT (Delhi, August 5, 2016);
5. Collaborative Open Online Learning (COOL), knowledge transfer and capability building workshop for 30 field support persons, field technologists and field action research fellows of CLIx (HBCSE, September 12-17, 2016);
6. Short course to enhance Science Education in Sri Lanka, a two-week workshop for 30 science teachers and education officers from Sri Lanka (HBCSE, November 13-26, 2016);
7. Hackathon between MIT team, Gnowledge Lab, CLIx Technology team for DLKit integration of Gstudio, TISS, for 15 participants (Mumbai, December 5-9, 2016);
8. Five day workshop on design training programme for 29 lecturers of District Institute of Education Training, Navsari, Gujarat Council of Educational Research and Training (HBCSE, February 13-17, 2017)

11. NON-DAE PROJECTS

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

12. PUBLICATIONS

In Journals

Carneiro, G., Parulekar, T., Shridhar, G., & Ladage, S. (2016). Experimenting with the teaching of organic chemistry: The process-oriented guided inquiry learning way. *Current Science*, *111*(7), 1152-1155.

Clifton, P. G., Chang, J. S. K., Yeboah, G., Doucette, A., Chandrasekharan, S., Nitsche, M., Welsh, T., & Mazalek, A. (2016). Design of embodied interfaces for engaging spatial cognition. *Cognitive Research: Principles and Implications, 1,* 24. doi: 10.1186/s41235-016-0032-5

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

D'Souza, R. (2016). Ableism and the ideology of merit. *For the Learning of Mathematics*, *36*(3), 21-23.

De, P. (2016). The arithmetic mean - geometric mean - harmonic mean: Inequalities and a spectrum of applications. *Resonance, 21*(12), 1119–1133.

Joshi, P. K., Singh, B., Singh, S., & Jain, A. K. (2016). Nuclear data sheets for A=139. *Nuclear Data Sheets*, *138*, 1-292.

Kumar, A. J., Shridhar, G., Ladage, S., & Ravishankar, L. (2016). Synthesis of 1, 4-dihydropyridine esters using low melting sugar mixtures as green solvents. *Synthetic Communications*, *46*(24), 1989-1998. doi: 10.1080/ 00397911.2016.1242750

Pande, P., & Chandrasekharan, S. (2016). Representational competence: Towards a distributed and embodied cognition account. *Studies in Science Education*, *53*(1), 1-43. doi: 10.1080/03057267.2017.1248627

Pathak, P., & Singh, V. (2016). Yet another encounter with the golden ratio: Balancing laminar bodies on the edge. *European Journal of Physics, 37*(5), 55001-55009.

Pathare, S. R., & Kurmude V. V. (2016). Low cost Michelson-Morley interferometer. *Physics Education, 51*(6), 1-6.

Pradhan, H., & Singh, V. (2016). Students' conceptions in heat and elementary thermodynamics. *Physics News, 46*(3-4), 53-62.

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Conference Abstracts

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Shimpi, N. P., Mavalankar, A. T., & Pradhan, H. C. (2016). *Ganit sandnyakosh-Bhag 2: Bhoomitee (In Marathi) (revised and published).* Pune: Jyotsna Prakashan.

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Khedkar, D., Deshmukh, N. D., Gogte, S., Jyothi Ch., Mahajan, B. S. (Eds.). (2016). *Trends in biology education and research: Practices and challenges (Abstract Booklet) of the 26th Biennial Conference of Asian Association for Biology Education (AABE).* Goa: AABE.

Mishra, K. K. (Ed.). (2016). *Saaraansh pustika (Abstract Booklet) of the 5th National Workshop on Development of Educational E-materials in Hindi, November 2016.* Allahabad: Vijnana Parishad Prayag.

Nair, M., Amin, S., Pathare, S., & Mazumdar, A. (Eds.). (2016). *Proceedings of the forty sixth International Physics Olympiad, 5-12 July 2015*. Mumbai, India: HBCSE.

Ramasubramaniam, K., Sule, A., & Vahia, M. (Eds.). (2016). *History of Indian astronomy: A handbook.* Mumbai: TIFR.

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Ranadive, P. (2016, May 8). Vigyanacha kalbram. [Review of the book *Science in saffron* by M. Nanda]. Loksatta, 8.

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13. LECTURES / LECTURE COURSES GIVEN ELSEWHERE

A. Bose and K. Subramaniam
Implications of out-of-school knowledge of measurement for school learning, *13th International Congress on Mathematical Education*, Hamburg, Germany, July 26, 2016

A. Bose, K. Subramaniam and M. Phakeng
Identity fostered language communication in a mathematics classroom: An analysis, *13th International Congress on Mathematical Education*, Hamburg, Germany, July 27, 2016

A. J. Kumar, G. Shridhar, S. Ladage and L. Ravishankar

1. Sugar based low melting mixtures as green solvents in the Hantzsch synthesis of substituted 1,4-dihydropyridines, Indo German Convention of Lindau Alumni (IGCLA) 2016, Kasturba Medical College, Manipal September 15-18, 2016.
2. Sugar based low melting mixtures as green solvents in the Hantzsch synthesis of

substituted 1,4-dihydropyridines, *National Conference on Recent Advances in Chemical Sciences 2016*, Maharishi Markandeshwar University, Mullana, November 11-12, 2016

3. Sugar based low melting mixtures as green solvents in the Hantzsch synthesis of substituted 1,4-dihydropyridines, *India International Science Festival 2016*, CSIR-National Physics Laboratory, Delhi, December 7-11, 2016

A. Mazumdar

1. Oscillations in oscillations of stars -what do they tell us?, Observatoire de Midi-Pyrenees, Toulouse, France, May 13, 2016
2. One semester course on "Optics", UM-DAE Centre for Excellence in Basic Sciences, Mumbai, January to April, 2017

A. Muralidhar

1. Environment friendly lifestyles: Some thoughts, Dr. Bhanuben Mahendra Nanavati College of Home Science, September 27, 2016
2. Diversity in Indian classrooms, K J Somaiya Comprehensive College of Education Training and Research, Mumbai, March 10, 2017

A. Sule

1. Astronomical coordinate systems, Lecture in *Pre-Conference Workshop of 9th International Conference on Oriental Astronomy*, IISER Pune, November 12, 2016
2. History of Indian astronomy, University of Mumbai 160th Anniversary, Invited Orations Series, at Gogte Joglekar College, Ratnagiri, January 2, 2017; R.D. National Collge, Mumbai, February 10, 2017

D. Dutta and S. Chandrasekharan

1. Practice-based approaches to nurturing environmental values: A case study of an urban farming group in Mumbai, Second Graduate Seminar School of Public Policy & Governance, TISS, Hyderabad, India, April 29, 2016
2. Time for action: Towards an integrative practice-based environment education. Paper presented at *Philosophy of Education Conference*, Bangalore, India, January 9-11, 2017

D. Pednekar and S. Rajashekar

Creating institutional repository using DSpace at HBCSE library: Need and challenges. Paper presented at the National Conference on Library Innovations for Excellence (LIFE 2017), IISER, Pune, February 16, 2017

D. Semwal, I. D. Sen and R. V Jayaram

1. Clouding and aggregation of Triton X-100 micelles: Effect of additives, Indo German Convention of Lindau Alumni (IGCLA) 2016, Kasturba Medical College, Manipal September 15-18, 2016
2. Clouding and adsorption of Triton X-100: Effect of additives, *National Conference on Environmental Sustainability and Wastewater Remediation:*

Current Status and Future Prospects 2017, Venketeshwara College (University of Delhi), Delhi January 19-20, 2017

G. Date and S. Chandrasekharan
Teaching for socially-engaged engineering and innovation: A case study of grassroots design, Second Graduate Seminar School of Public Policy & Governance, TISS, Hyderabad, India, April 29, 2016

G. Nagarjuna

1. Digital restrictions and digital rights in the context of a digital library, national institute of fashion technology, Kharghar, Mumbai, August 20, 2016
2. Tree mapping project, and open online ongoing learning project, Seminar organized by Department of Zoology, University of Goa, September 23, 2016
3. Scratching scratch, *National Workshop On "Pedagogical training using ICT tools"* organized by the Department of Mathematics, Institute of Chemical Technology (ICT), Mumbai, October 9, 2016
4. National Repository of Open Educational Resources (NROER) online and offline, talk at the *International Forum on ICT*, (organized by MHRD, Government of India, National Council of Educational Research and Training (NCERT) in collaboration with UNESCO - International Bureau of Education, Geneva and UNESCO - International Institute of Technology for Education, Moscow) *NCERT*, New Delhi, November 2, 2016
5. Network (graph) based computing, VIVA Institute of Technology, Vasai, Mumbai, January 19, 2017
6. Ethics in digital space, University of Mumbai, Kalina, Mumbai, January 25, 2017

G. Nagarjuna, A. Das Gupta and R. Radhakrishnan
The recipe of a renaissance (podcast) by Syntalk (https://syntalk.wordpress.com/episodes/turn-three/troar/), July 16, 2016

G. Shridhar, S. Vaidya, L. Ravishankar and S. Ladage
A facile synthesis of isoxazole derivatives catalyzed by $CeCl_3.7H_2O$ using 70% ethyl lactate as a solvent: A green chemistry strategy, *International Conference on Green and Sustainable Chemistry 2016*, Berlin, Germany, April 4-6, 2016

G. Singh
Asking questions in science classrooms: An empirical investigation, K J Somaiya Comprehensive College of Education, Training and Research, September 27, 2016

H. C. Pradhan

1. Theory of assessment, Workshop for Resource Persons for National Students' Examinations, IAPT, Indian Institute of Science Campus, Kudapura, Karnataka, May 20, 2016
2. Importance of procedural understanding in physics curricula, IAPT Refresher Course for Junior College Physics Teachers, R. Jhunjhunwala College,

Ghatkopar, Mumbai, August 19, 2016

3. Course on 'History and philosophy of science', students of the Integrated M.Sc. Programme, UM-DAE Centre for Excellence in Basic Sciences, August -November 2016
4. The evolution of the scientific method through history of science, Teaching and learning workshop organized under TEQIP II, Institute of Chemical Technology, September 24, 2016
5. Science education – New methods of instruction, University of Mumbai, Junior College Teachers' Seminar, R. Jhunjhunwala College, Ghatkopar, Mumbai, December 14, 2016
6. New directions in S&T education- at primary, secondary and tertiary levels, Panel Discussion, *Annual Convention 2016 – Marathi Vidnyan Parishad*, Gadkari Rangayatan, Thane, December 18, 2016
7. Course on 'Ethics in science and intellectual property rights', for students of the Integrated M.Sc. Programme, UM-DAE Centre for Excellence in Basic Sciences, January-April 2017
8. Significance of statistics in behavioural science research, *National Level Researchers' Meet*, Department of Education, University of Mumbai, Mumbai, January 6, 2017
9. Counseling and mentoring for an effective S&T career, Workshop on Counseling – Protocol Preparation, Bombay Psychological Association, Nehru Centre, Mumbai, January 19, 2017
10. Introducing thermodynamics in an axiomatic way, Meet a Scientist Programme, M.B.B. College, Agartala, Tripura, January 27, 2017
11. Approaching quantum mechanics with minimal anxiety, Meet a Scientist Programme, M.B.B. College, Agartala, Tripura, January 27, 2017
12. How did scientific rationality evolve historically? Refresher Course for Teachers of Biotechnology, Institute of Career Advancement, University of Mumbai, Mumbai, March 1, 2017
13. Brain science and development of scientific attitude in early childhood, S*eminar on Brain Science based Early Childhood Education*, Indian Women Scientists Association, Vashi, Navi Mumbai, March 2, 2017

H. Raval

Teachers' difficulty in teaching, for secondary and higher secondary teachers of Gujarat Council for Education Research and Training (GCERT), State Teachers Training Institute, Gandhinagar, Gujarat, September 3, 2016

H. Raval and R. Shaikh

Understanding students' error and hands on mathematics, for 30 school teachers from Kendriya Vidyalaya (KV) of Zonal Institute of Education and Training (ZIET), Mumbai, December 26, 2016

J. Ramadas

1. 'Small Science' in the classroom: Some observations on curriculum change, Connected Learning Initiative (CLIx) Seminar, Centre for Education Innovation

and Action Research, Tata Institute of Social Sciences, November 2, 2016; Institute Colloquium, Institute of Mathematical Sciences, December 29, 2016
2. Design and use of the Homi Bhabha Curriculum for Primary Science, *New Creation Symposium on Innovative Practices in Education*, Matridarshan, Champak Hills, Jangaon, Warangal District, December 10-11, 2016
3. Small Science - An innovative approach in changing the learning levels of children, Panel discussion on 'Evidence based education innovations: Bridging the academia and industry gap', *Maidan Summit*, Mumbai, December 13, 2016

J. Rehman and K. Subramaniam
Constructing the concept of area measurement in a classroom. *13th International Congress on Mathematical Education*, Hamburg, Germany, July 29, 2016

K. Subramaniam
1. What is science – Philosophical and historical views. Teaching and learning workshop organized under TEQIP II, Institute of Chemical Technology, September 23, 2016
2. Research on algebra education, as part of 'Pedagogy of Mathematics Education Course, for students of MA Education, Tata Institute of Social Sciences, Mumbai, October 2, 2016
3. Connecting university mathematics and school mathematics, *National Level Symposium on "Mathematics and Women in Mathematics"*, N.E.S. Ratnam College, Mumbai, January 28, 2017
4. School mathematics education – multiple challenges. Workshop on Studies on Science and Technology Education, Zakir Hussain Centre for Educational Studies, JNU, Delhi, March 2, 2017

K. Subramaniam and S. Naik
Thinking mathematically, for middle and secondary school teachers, Bai RFB Pandey School, September 24, 2016

M. C. Arunan, G. Nagarjuna and CUBE team
1. Introduction to various research models like Drosophila, *C. elegans*, earthworm and their maintenance, St Xavier's College, Mumbai, June 8, 2016
2. CUBE seminar on various research models and their maintenance, tree mapping project, and open online ongoing learning project, University of Goa, September 23, 2016
3. Introducing research (CUBE) using model systems at the undergraduate level, for teachers and students of zoology and microbiology, Maharani College, Bangalore, October 3, 2016
4. Activities of CUBE, National Institute of Mental Health And Neurosciences, Bengaluru, October 5, 2016
5. Introducing research (CUBE) using model systems at the undergraduate level, at CUBE Meet Bihar organized at Siksha Bachao Samelan, Begusarai, Bihar, March 21, 2017

M. C. Arunan and J. Advani
Epigenetics of Daphnia, *XL All India Cell Biology Conference and International Symposium on Functional Genomics and Epigenetics*, Jiwaji University, Gwalior, November 17-19, 2016

M. Kharatmal and G. Nagarjuna
Refined concept mapping, the *7th International Conference on Concept Mapping*, Tallinn, Estonia, September 5-9, 2016.

N. D. Deshmukh
Use of learning resources, The Lord's Universal College of Education, Malad, June 29, 2016

P. Bhat, G. Shridhar, S. Ladage and L. Ravishankar
A green methodology for the synthesis of pyrazoline derivatives, Indo German Convention of Lindau Alumni (IGCLA) 2016, Kasturba Medical College, Manipal September 15-18, 2016.

P. K. Joshi
1. Introduction to Junior Science Olympiad, Teachers' Workshop at M. H. High school, Thane, September 27, 2016
2. Misconceptions in science, science olympiad and activities in nuclear world, Innovation in Science Pursuit for Inspired Research (INSPIRE) Science Camp, Latur, November 2 to 4, 2016.
3. Teaching science through experiments, Rajya Vigyan Shiskshan Sangstha, Nagpur, December 15, 2016
4. Role of experiments in science, State Institute for Science Education workshop for science teachers, Sangli, January 18, 2017
5. Teaching science through experiments, RMSA Teachers' workshop, Nana Saheb College of Engineering, Sangli, January 19, 2017
6. Nuclear data evaluation, *Nuclear Data Physics Centre of India Conference*, Shillong, March 6-10, 2017

P. K. Nawale
1. Talk on science activities, Science Exhibition at M. H. High School, December 21-22, 2016

P. Pande and D. Karnam
Manipulable computer interfaces for teaching-learning school science and mathematics, *Teachers' Conference Science Utsav*, collaboratively organised by Navi Mumbai Science Foundation and HBCSE, Vashi, February 25, 2017

P. Ranadive
Basic astronomy, lecture at Marathi Vidnyan Prasarak Mandal, September 20, 2016

R. Biswas, L. Ravishankar, G. Shridhar and S. Ladage

Effect of deep eutectic solvents on the synthesis of 1,2 dihydropyrimidinones, *International Conference on Green and Sustainable Chemistry 2016,* Berlin, Germany, April 4-6, 2016

R. D'Souza
Challenging ableism by teaching processes rather than concepts. *13th International Congress on Mathematical Education*, Hamburg, Germany, July 29, 2016

R. Shaikh
1. Session on OLPC and Sugar Learning Platform, TISS, Mumbai, November 9, 2016
2. Session on math lab activities, Kedriya Vidyalaya school 1, Navy Nagar, Mumbai, December 26, 2016

R. Vartak
About olympiads, Workshop organized by the Yashwantrao Chavan Pratishtan, Badlapur November 26, 2016.

S. Bhide and S. Chunawala
1. Making a case for outdoor engagement in environmental studies at Indian schools. Paper presented at the *XVII IOSTE Symposium*, organized by CIEC - Institute of Education, University of Minho, Braga, Portugal, July 15, 2016

S. Chandrasekharan
The impossible optimization problem, Teaching and learning workshop organized under TEQIP II, Institute of Chemical Technology, September 23, 2016

S. Chunawala
1. Gender, science and technology, Teaching and learning workshop organized under TEQIP II, Institute of Chemical Technology, September 24, 2016
2. International social justice day, K. J. Somaiya College of Science and Commerce, February 20, 2017
3. Gender, science and technology, Gender Sensitization Programme, School of Biotechnology and Bioinformatics, D. Y, Patil College, Nerul, March 24, 2017

S. Godse and N. D. Deshmukh
Perception about use of ICT in classroom teaching-learning, T*he 26th Asian Association for Biology Education (AABE) Conference*, Goa, September 23, 2016

S. Ladage
1. Introduction to POGIL, Workshop at Baburao Gholap College, Pune, November 26, 2016
2. Role of chemistry laboratories in chemistry education: Some reflections from the domain of chemistry education research, *National Conference on Innovations in Laboratory Teaching*, Zakhir Husain Delhi College, Delhi, February 8, 2017

S. Naik

1. Mathematics needed in teaching for teachers of St. Stalisnaus school, Bandra, April 11, 2016
2. Encounters with horizon content knowledge for M.Ed and PhD students of K.J. Somaiya college, K.J. Somaiya college, Mumbai, July 23, 2016
3. Development of mathematical thinking among teachers and students, Narotam Seksaria Foundation, October 20, 2016
4. Proportional reasoning research in mathematics education, as part of 'Pedagogy of Mathematics Education Course, for students of MA Education, Tata Institute of Social Sciences, Mumbai, October 4, 2016
5. Access and equity issues in using ICT, *Teachers' Conference Science Utsav*, collaboratively organised by Navi Mumbai Science Foundation and HBCSE, Vashi, February 25, 2017

S. R. Pathare

1. Experiments in physics, UGC HRD University of Mumbai Refresher course for Junior college teachers, R. Jhunjhunwala College, December 23, 2016
2. Error analysis, K. J. Somaiya College of Science and Commerce, March 29, 2017

S. R. Pathare and V. V. Kurmude

1. Demonstrations in physics, Acharya Marathe College, Mumbai, August 5, 2016
2. Talk and workshop on Low Cost Michelson Interferometer, the *World Federation of Physics Competitions* (WFPhC) meeting, Banten, Indonesia, September 26-30, 2016

S. Takker and K. Subramaniam

Changing teacher knowledge-in-practice: the case of decimal fractions. *13th International Congress on Mathematical Education*, Hamburg, Germany, July 29, 2016.

S. Yasmin and M. C. Arunan

Learning biology through inquiry: Undergraduate research activities at Patna women's college, *The 26th Asian Association for Biology Education (AABE) Conference*, Goa, September 21, 2016

V. D. Lale

Kumar Vishwakosh, Workshop organized for authors to write articles in Physics by Vishwakosh Mandal, HBCSE, August 12, 2016

V. Ghanekar

Plant Anatomy, Course on Field Botany organized by Fern Foundation, Bhagavati Vidyalaya, Thane, April 23, 2016

V. C. Sonawane

1. Experiential science and scientific revolution from 16th Century in electricity and

magnetism, Innovation in Science Pursuit for Inspired Research (INSPIRE) internship science Camp, S. M. Joshi College, Hadapsar, Pune, December 1, 2016

2. Vidnyan sahityache Marathi sahityatil Yogdan, J.P. Naik College of Science & Arts, Nashik, December 29, 2016

LECTURES, COLLOQUIA, SEMINARS

14. LECTURES BY VISITORS

Sandesh Kulkarni (*Max Planck Institute for Extraterrestrial Physics*), Outside-in quenching of star-formation: Evidence in group environment from the H-alpha Galaxy Groups Imaging Survey, April 7, 2016

John Mathew (*IISER, Pune*), European interventions in the making of taxonomic zoology for colonial India, May 5, 2016.

Khushboo Soni (*Centre of Product Design and Manufacturing, IISc, Bangalore*), Designs to capture spatial intelligence/skills using non-rigid transformations, June 2, 2016

Palash Baran Pal (*Saha Institute of Nuclear Physics, Calcutta*), Three horizons for terminological vocabulary in Indian languages, June 16, 2016

R. Gopichandran (*Vigyan Prasar, New Delhi*), Emerging trends in science communication: Some challenges and opportunities to strengthen its niche, July 7, 2016.

Joseph Samuel (*Pest Control Department, MCGM*), Awareness of malaria and dengue, July 8, 2016

Sweta Anantharaman (*University of Auckland, NZ*), Social cognition in early childhood, September 8, 2016.

Vasudevrao Kathe and team (*Prayogparivar Movement*), Prayog Pariwar: A new methodology for science education, September 22, 2016.

Shakila Reddy (*University of Kwa-Zulu-Natal, South Africa*), Researching gender violence at a South African university, drawing on post structural feminist approaches, November 3, 2016

Anil Sadgopal (*Educationist*), Analysis of Hoshangabad Science Teaching Program (HSTP) and history of science, November 11, 2016

Melita Vaz (*Independent Consultant*), Workshop on the use of MAXQDA software for

qualitative analysis, November 21, 2016

Garima Bansal (*Department of Education, Lady Irwin College, University of Delhi*), Classroom talk in science classrooms, December 29, 2016

Havovi Wadia (*Director, Impact, the Magic Bus*), How do we create optimal conditions for learning: Using a sport for development approach, January 19, 2017

Rama Shyam (*Programme Head, Education & Citizenship, Apnalaya*), Life on the margin: Charting realities, on occasion of International Social Justice Day, February 20, 2017

Amrita Hazra (*IISER, Pune*), The Millet Project, February 23, 2017

Corinne Manogue (*Oregon State University, USA*), Public lecture on women in sciences, HBCSE, March 16, 2017

Gagan Deep Kaur (*IIT Bombay & National Institute of Advanced Studies, Bengaluru*), Linguistic mediation in multi – weaver Kashmiri carpet weaving, March 16, 2017

V. G. Kulkarni Memorial Lecture

N. Mukunda (*INSA C. V. Raman Research Professor*), The nature of scientific knowledge - Some reflections, Fifteenth V. G. Kulkarni Memorial Lecture, HBCSE, September 7, 2016

Lectures at Olympiads Valedictory Functions and Infosys Functions

Arvind Natu (*IISER Pune*), Interdisciplinary approach in sciences, Chemistry OCSC Valedictory Function, April 22, 2016

Sudhir R. Ghorpade (*IIT Bombay*), Elementary transcendental functions, IMOTC Valedictory Function, May 16, 2016

Tali Pinsky (*TIFR*), Surfaces and tilings, IMOTC Valedictory Function, May 16, 2016

Anil Kakodkar (*Chairperson, Rajiv Gandhi Science & Technology Commission*), Advancement of science in India, Junior Science OCSC Valedictory Function, May 22, 2016

Tarun Souradeep (*Inter-University Centre for Astronomy and Astrophysics, Pune*), LIGO-India: Beyond discovery of gravitational waves, Physics OCSC Valedictory Function, June 6, 2016

Vijay Kumar Sharma (*Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore*), Connecting genes to behaviour : Clocks that time us, Biology OCSC

Valedictory Function, June 10, 2016

Sanjay Sane (*National Centre for Biological Sciences, Bengaluru*), Insects as architects: How insects engineer our ecosystems, Infosys Award Function, December 22, 2016

Mahan Mj (*TIFR*), What is hyperbolic geometry?, Infosys Award Function, December 22, 2016

NIUS Seminars

Bala Iyer (*ICTS-TIFR, Bengaluru*), An introduction to general relativity and gravitational waves, March 1, 2017

Tevian Dray (*Oregon State University, USA*), Bridging the gap: Vector calculus in mathematics and physics, March 15, 2017

Tevian Dray and Corinne Manogue (*Oregon State University, USA*), 'Using geometric reasoning to teach vector calculus', 'Active engagement: Lessons from education research' and 'Activities for introductory quantum mechanics', March 15 and 17, 2017

LECTURES, COLLOQUIA, SEMINARS

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

Seminars at Annual Research Meet, October 24-26, 2016

A. Sawant and S. Patil, A first look at second year college students' understanding of some topics in biology
C. Navare, Mickey mouse and the big evil corporation: Visual narratives of environment
D. Karnam, Interactive vectors for model-based reasoning
G. Date, Probing 'design thinking' through simulation tasks: a novel tool to elicit thinking strategies and principles in grassroots engineering design
G. Date and D. Dutta, Doing technology as if ecology mattered: Moving beyond engineering efficiency towards education aimed at "solving for pattern"
G. Shah (University of Mumbai), Relationship between secondary school students' educational aspirations, educational resilience, social connectedness and well-being: a mixed methods research
G. Singh, Student questioning: a way to engage students in argumentative discourse
H. Srivastava, Science education and the possibility of social transformation: analyzing educational experiences of the adolescents from the M (East) ward, Mumbai
K. Chavan (Education Dept. of University of Mumbai), Development and impact of self-directed learning package on learning readiness, knowledge management and learner empowerment of student teachers: A mixed method study
M. Kharatmal, The role of re-representing linking words in concept mapping for developing rigor and expertise

P. Pande and A. Kothiyal (IIT Bombay), Interactivity is necessary, but not sufficient, for imagination-based integration of multiple external representations
P. Pathak, Assessing the test: insights from the physics olympiad exam
P. Sivaramakrishnan (St. Xavier's Institute of Education), Perception of global citizenship among secondary school students in relation to critical thinking, social justice and service learning
R. Varkey, Futures orientation in the discourse around agriculture in Kerala school science textbooks
R. D'Souza, Ableism and the dialectical nature of mathematical knowledge
S. Datt, Problem categorisation in learning by doing
S. Ghumre, Understanding and facilitating knowledge generating practices in a laboratory environment
S. Naik, Mathematics teachers' understanding of teaching algebraic identities
S. Negi (University of Mumbai), Effectiveness of a cyber bullying sensitization program (CBSP) for enhancing sensitivity towards cyber bullying among secondary school students
S. R. Pathare, Building a low-cost Michelson interferometer
S. Varadarajan, Understanding various instructional styles in chemistry laboratory

Other in-house talks

A. Gupta
The processes in composting: The natural and the anthropogenic, Seminar Series, HBCSE, October 13, 2016

A. Raveendran
Conceptualizing critical science education using socioscientific issues, Ph.D. Synopsis Seminar, HBCSE, July 5, 2016

A. Srivastava
The cognitive role of external representations in students' understanding of DNA structure, Ph.D. Synopsis Seminar, HBCSE, November 25, 2016

D. Dutta
Community-practice based approaches to nurture environmental values: Linking motivation, action and a sustainable future, Ph.D. Proposal Seminar, HBCSE, December 1, 2016

D. Gupta
Designing pedagogy based on secondary data analysis for undergraduate biology students, Seminar Series, HBCSE, January 12, 2017

D. Karnam
Change in students' conceptual understanding of vectors using an interactive media tool for model-based reasoning, Ph.D. Proposal Seminar, HBCSE, December 1, 2016

G. Nagarjuna
Designing connected learning space for quality education at scale, Seminar Series, HBCSE, August 4, 2016

J. Ramadas
Visuospatial thinking in science education, Seminar Series, HBCSE, June 9, 2016

J. Vijapurkar
Teaching and learning science through inquiry at the middle school level, ASET Colloquium, TIFR, April 1, 2016

K. Mishra
Role of language in science learning: A review of the literature and implications, HBCSE, August 3, 2016

K. Subramaniam
Capturing the quality of mathematics instruction, Seminar Series, HBCSE, July 14, 2016

P. Pathak
The golden ratio, the centre of mass and aesthetics, Seminar Series, HBCSE, September 29, 2016

P. Ranadive
The transit of Mercury, Seminar Series, HBCSE, May 12, 2016

R. Thengodkar
Extending the CUBE model to schools, Seminar Series, HBCSE, October 6, 2016

S. Bhide
Biomimetics: A bio-inspired design approach to enrich biology learning experiences, Seminar Series, HBCSE, October 20, 2016

S. Chandrasekharan
When cognition is enaction, what is education?, Seminar Series, HBCSE, June 30, 2016

S. Datt
Creativity in education, Seminar Series, HBCSE, March 23, 2017

15. GRADUATE COURSES

Spring 2016 (January to April)- Core Courses

1. Cognition, Cognitive Development and Learning (*Jayashree Ramadas and Ankush Gupta*)
2. Philosophy of Education (*G. Nagarjuna and Abhijeet Bardapurkar*)
3. Methods of Science and Mathematics Education Research (*Aniket Sule and*

Shweta Naik)

Elective Courses

1. Environmental Science Education (*Ankush Gupta*)
2. Advanced Topics in Cognition [based in IIT, Powai] (*Sanjay Chandrasekharan*)

Summer Elective Courses (May-July 2016)

1. Visuospatial thinking in science education (*Jayashree Ramadas*)
2. Creativity in education (*Sachin Datt*)

Fall 2016 (August to December)- Core Courses

1. Cognition, Cognitive Development, Learning Theories (*Sanjay Chandrasekharan*)
2. History of Science (*Ankush Gupta and Rutwik Thengodkar*)
3. Introduction to Science, Technology and Mathematics Education Research (*Shubhangi Bhide and Aniket Sule*)
4. Research Methodologies in Education (*Sugra Chunawala*)

Elective Courses (August to December)

1. Essential Readings in Mathematics Education Research (*K. Subramaniam and Shweta Naik*)
2. Readings in Chemistry Education Research (*Savita Ladage and Arvind Kumar*)
3. Introduction to Physics Education Research (PER) (*Rajesh B. Khaparde*)
4. Introduction to Science Technology Society Environment Education (*Aswathy Raveendran and Sugra Chunawala*)

Short Course

1. History of Education (*N. Varadarajan, Azim Premji University*), September 12-23, 2016
2. Social Aspects of Education (*Kishorkumar Darak, Independent Researcher*), October 5-7, and October 17, 2016

Spring 2017 (January-April)- Core Courses

1. Philosophy of Science (*G. Nagarjuna*)
2. Methods of Science and Mathematics Education Research (*Shweta Naik, Sugra Chunawala and H. C. Pradhan*)
3. Teaching practice and school internship / design of learning resource (*Shweta Naik and Shubhangi Bhide*)

Foundational Elective Course

1. Philosophy of Education (*Abhijeet Bardapurkar, Azim Premji University*)

Elective Course

1. Advanced Topics in Cognition (*Sanjay Chandrasekharan*)

Projects under the National Initiative in Undergraduate Science, HBCSE [Page 328]

Chemistry

Ashish Parihar (Hindu College, Delhi); Synthesis of heterocycles and bisbenzalacetone using lewis acids and green solvents; (Mentors: G. Shridhar, V. K. Menon College Mumbai, L. Ravishankar, KET Vaze College, Mumbai and S. Ladage, HBCSE,

Mumbai)

J Ashwin Kumar (IISER Mohali); Synthesis of 1,4-dihydropyridine esters using low melting sugar; (Mentors: L. Ravishankar, KET Vaze College, Mumbai, G. Shridhar, V. K. Menon College, Mumbai and S. Ladage, HBCSE, Mumbai)

Prabhat Bhat (ISERC, Shantiniketan); A facile synthesis of 1,3,5-triaryl-2-pyrazolines and 3,5-diaryl isoxazoles using cerium chloride in ethyl lactate mixtures as a green solvent; (Mentors: L. Ravishankar, KET Vaze College, Mumbai, G. Shridhar, V. K. Menon College, Mumbai and S. Ladage, HBCSE, Mumbai)

Shreyas Vaidya (V. G. Vaze College, Mumbai); A facile synthesis of isoxazole derivatives catalysed by CeCl3.7H2O using ethyl lactate as a solvent: a green chemistry strategy; (Mentors: G. Shridhar, V. K. Menon College Mumbai, S. Ladage, HBCSE, Mumbai and L. Ravishankar, KET Vaze College, Mumbai)

Swapnil Parjane (S P College, Pune); Using the jobs method to determine the equilibrium constant of complex; (Mentors: S. Ladage, HBCSE, Mumbai and I. Das Sen, HBCSE, Mumbai)

Physics

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

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

Smriti Suman (IISc Bangalore); The quantum-classical correspondence for a particle in a constant field; (Mentors: V. Singh, formerly HBCSE, Mumbai and S. Singh, Patna University, Patna)

Smruti Manjunath (Women's Christian College, Chennai); Atmosphere accelerator and reactor-neutrino oscillation; (Mentor: D. P. Roy, HBCSE, Mumbai)

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

Unnati Akhouri (Miranda House, Delhi); Atmosphere accelerator and reactor-neutrino oscillation; (Mentor: D. P. Roy, HBCSE, Mumbai)

16. PH.D Thesis

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17. POPULAR SCIENCE LECTURES [Page 332-334]

A. Mazumdar

Night Sky observation session and lecture, Navy Children School, February 10, 2017

A. Sule

1. Careers in science, Khagol Mandal, Nashik, May 1, 2016
2. Telescopes of the future, Mumbai University Summer School for undergraduate students, May 12, 2016; K. J. Somaiya College of Engineering and Technology, Mumbai, February 3, 2017
3. Indian GPS, Panel discussion, organised by Maharashtra Times at Lokmanya Seva Sangh, Mumbai, May 21, 2016
4. India's Olympiad programme, MKCL school student workshop, Garware College, Pune, May 28, 2016
5. Career Guidance Session (Marathi), S. K. Patil College, Malvan, January 6, 2017; Paat High School, Parule, January 7, 2017
6. Indian Olympiad programme (Marathi), Akash Mitra Mandal, Kalyan, January 22, 2017
7. Careers in Physics, K. J. Somaiya College of Science and Commerce, Mumbai, March 30, 2017

A. Sule, P. Ranadive, K. Raodeo and V. Kurmude

1. Lecture on "Astronomy, astrology and scientific temper" and sky observation, INSPIRE camp organised at G. N. Khalsa College, November 25, 2016
2. Lecture on "Careers in astronomy" and sky observation, Science Movement, Bhubaneswar, December 20, 2016

H. C. Pradhan

1. Planning a meaningful career in education, Annual Career Development Workshop for Students, Wilson College, Mumbai, April 11, 2016
2. The challenge of a career in physics, Career Guidance Programme, organized by the daily-Maharashtra Times, Maharashtra Sewa Sangh, Mulund, Mumbai, June 28, 2016
3. What is science and why do we learn it? Conclave of Science Teachers of Schools of General Education Institute, M.H.High School, Thane, September 27, 2016
4. Face to face with scientists, Children's Question and Answer Session, National Children's Science Congress, Vidya Pratishthan, Baramati, Maharashtra, December 28, 2016
5. Physics research – an exciting career and concepts and misconcepts in physics, Two talks to school students of Std XI and XII, Town Hall, Agartala, Tripura, January 28, 2017
6. Communicating science, Talk to students of the Engineering Faculty, ICFAI University, Agartala, Tripura, January 30, 2017
7. Teaching science, Talk to students of the Education Faculty, ICFAI University, Agartala, Tripura, January 30, 2017

P. K. Joshi

1. Junior Science Olympiad: A movement, M. H. High school, Thane, September 27, 2016; Rajya Vigyan Shiskshan Sangstha, Nagpur, January 2-5, 2016; KV Guwahati University, January 25, 2017; Ramanujam Junior College Nagaon Assam, January 27, 2017
2. Junior Science Olympiad and its experiments, St. Anthony's College, Shillong, March 9, 2017

P. K. Nawale

Reading cards, at municipal teachers' workshop organized by Nutan Vidya Mandir, December 8, 2016

P. Ranadive

1. Sky observation program, Rotary club of Badlapur, Industrial area, April 9, 2016
2. Overnight sky observation program, Khagol Mandal, Mumbai, April 9, 2016; May 7, 2016; February 25, 2017; March 25, 2017
3. Sky observation program, Maharashtra Science Teachers Association (MSTA), April 12 and 15, 2016
4. Observation program - Transit of Mars, Dadar, May 9, 2016

S. Naik

Area, perimeter and some fun connections, Chai and Why? Talk, Alexandra Girl's High school, Mumbai, January 29, 2017

S. R. Pathare

1. Lecture on Olympiads, Abasaheb Garware College, Pune, August 31, 2016
2. Fun with physics, Bhate school, Mangaon, December 3, 2016

17. POPULAR SCIENCE ARTICLES [Page 332-334]

A. Srivastava

Dissect three-dimensional models. *Teacher Plus*, *14*(4), 42-44, April 2016

B. Dutta, S. Moorthy & S. Chunawala

Staying healthy - in school and in life. *Teacher Plus*, *14*(9), 46-47, October 2016

D. Dutta

1. Teaching for a resilient tomorrow. *Teacher Plus*, *14*(4), 24-26, April 2016
2. Mending a broken relationship: Education and ecology. *The New Learn, 2*(14), 23-26, November 2016

D. Gupta, A. Muralidhar & S. Chunawala

What robotics can bring to the teaching table. *Teacher Plus*, *15*(1), 38-40, January 2017

D. Karnam & S. Motiani

Assessment in the education system: A sanity check. *Robinage, 8*(49), Editorial page, March 2016

G. Singh & K. Haydock
The case of a variegated plant. *i Wonder- Rediscovering School Science, (2)*, 71-76, June 2016

J. Vijapurkar
To "Bio sir" with love. *Teacher Plus, 15*(1), 58, January 2017

J. Vijapurkar, A. Sawant & S. Patil
Different strokes with starch. *Teacher Plus, 15*(1), 45-46, January 2017

K. K. Mishra

1. Transfat: Swasthya sambandhi khatare. *Awishkaar, 46*(5), 16-18 & 44-46, 2016
2. Bhumandaliya taapan- Ek gambhir samasya. *Vigyan*, *102*(3), 9-11, 2016
3. Soochna proudyogiki aur shiksha: Badalata paridrishya. *Anaupacharika*, *41*(7), 11-13, 2016
4. Takaniki awishkaar ki prakriti prerit abhiprerana- Biomimicry. *Technical Today*, *1*(2), 45-48, 2016
5. Ab nahi milenge bread me khatarnak rasayan. *Awishkaar*, *46*(8), 36-39, 2016
6. Khane me ghulati banavati mithas. *Technical Today*, *1*(4), 45-47, 2016

K. Subramaniam

1. Jill Adler - A South African mathematics education researcher. *At Right Angles, 5*(2), 5-10, July 2016
2. Institutions of higher education and research in India: Do they need to take interest in school science education? (Guest Editorial) *Current Science, 111*(10), 1575-76, November 2016
3. Giving meaning to numbers and operations in arithmetic. *Voices of Teachers and Teacher Educators, 5*(1), 18-25, December 2016

P. De
An eye on eyeball. *At Right Angles*, *5*(2), 34-37, July 2016

P. K. Nawale
Kalpakatela jod krutishilatechi. *Jeevan Shikshan*, *61*(12), 16-17, 2017

S. Ladage & T. Joshi
The periodic table: A window to the history of chemistry! *i Wonder- Rediscovering School Science*, *3*, 37-43, February 2017

S. Motiani & D. Karnam

1. Teaching kids to be politically informed in a polarised world. Retrieved from http://www.huffingtonpost.in/sangeeta-motiani/teaching-kids-to-be-politically-informed-in-a-polarised-world_a_21605283/, November 2016.

2. Four smart learning strategies to boost your exam performance. Retrieved from http://www.huffingtonpost.in/sangeeta-motiani/sangeeta-motiani/sangeeta-motiani/4-smart-learning-strategies-to-boost-your-exam-performance/, October 2016
3. Reconsidering assessments in school education. Retrieved from http://www.huffingtonpost.in/sangeeta-motiani/reconsidering-assessments-in-school-education/, October 2016
4. Seven ways in which digital technology is shaping us. Retrieved from http://www.huffingtonpost.in/sangeeta-motiani/7-ways-in-which-digital-technology-is-shaping-us/, July 2016
5. 50 Online learning tools that will keep the kids sharp all summer. Retrieved from http://www.huffingtonpost.in/sangeeta-motiani/50-online-learning-tools-that-will-keep-the-kids-sharp-all-summe/, June 2016
6. Learn online. *Robinage*, *9*(34), Editorial page, December 2016.

S. Naik
Real-life context in school mathematics: Not really! *Teacher Plus*, *15*(1), 41-43, January 2017

S. Patil, A. Sawant & J. Vijapurkar
Pishtmay padarth chachani: Sadarikaranachi ek utkanthavardhak padhdhat. *Shaikshanik Sandarbha*, *(104)*, 4-8, 2017

18. RADIO & TV PROGRAMMES

A. Sule
National Science Day (Interview), DD Sahyadri, February 28, 2017