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ARTICLE

Interventions to promote, propagate & popularise science in schools

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ABSTRACT

Efforts have been made in the recent past to promote, propagate and popularise science amidst senior secondary school students at the National level. Innovations, debates, exhibitions, model presentations, developing prototypes are a few that can be listed. Interaction with science teachers and students reveals that scientific interventions in schools have played a major role in the popularisation of science and creating scientific temper in the society. Preliminary analyses have shown that Government programmes have yielded a mixed response to the desired results of developing scientific brains and mindset before leaving the schools. A lot more needs to be done to develop a behavioural change in the society regarding the scientific perspective and to achieve that school students as brand ambassadors can play a crucial role. Also, an ambience needs to be created to evoke scientific curiosity among the mass. Although huge investments have been made in institutions and programmes to promote science, there is still a lot of scope to popularise science at the school level.

KEYWORDS: Popularisation of science, Olympiads, Scholarships, INSPIRE, KVPY, NTSE

Introduction

In the recent past we have witnessed successful application of Science and Technology (S&T) in addressing societal problems in India like the Green Revolution, White Revolution and in the areas of Space, Computers, Artificial Intelligence, Robotics, Machine learning and Communication. This has helped to improve the quality of life of a major chunk of our population and strengthen economic independence. Like India, after the

Independence, the war-ravaged Japan resurrected its economy post World War II and systematically went on to become a developed country with the help of S&T.

The "science of science communication" is surveying studies of cultural cognition and related dynamics, it demonstrates how the form of disciplined observation, measurement, and inference distinctive of scientific inquiry can be used to test rival hypotheses on the nature of persistent public conflict over societal risks; indeed, it argues that satisfactory insight into this phenomenon can be achieved only by these means, as opposed to the ad hoc story-telling dominant in popular and even some forms of scholarly discourse.[1]

The role of science communication is no longer limited by the bandwidth of communication but the imagination bandwidth of scientists. Powerful science communication is an asset to the transformation of societies.[2]

In the last two decades, we have seen a tremendous increase in science communication and public engagement activities. There has been a drastic shift from 'public understanding of science' (PUS) models of communication to more dialogic approaches, based on two-way communication between science and its publics. Although one-way communication like science museums, science fairs and festivals, popular science media, science blogging, sci-art activities also create an ambience for developing scientific temper.

Scholarships have been instrumental in popularization of science. Theoretical and analytical attention, as well as experiments with practice, has, however, tended to focus on policy-oriented or governmentally-sponsored engagement, and especially on overt efforts to 'democratise' science.[3]

The Human Resource Development Group (HRDG) of Council of Scientific and Industrial Research (CSIR) promotes, guides and co-ordinates scientific & industrial research through funding of research projects at the national level. Some of its activities include: Award of Shanti Swarup Bhatnagar Prizes (SSB); Young Scientist Awards (YSA); Selection of Junior Research Fellows (JRF) through National Eligibility Test (NET); Selection of Senior Research Fellows (SRF), SRF Extended and

Research Associates (RA); Selection of Senior Research Associates (SRA); Funding of Extra Mural Research (EMR) schemes at universities/R&D organizations; Visiting Associateship Scheme; Travel/Conference/Symposium grants; Shyama Prasad Mukherjee Fellowship (SPMF) among others.

Several voluntary agencies like Kerala Shastra Sahitya Parishad (KSSP), Karnataka Rajya Vijnana Parishat (KRVP), and Eklavya are actively involved in taking science to the people by way of folk forms, street plays, theater, puppetry, folk songs, skits, etc.

Science Policies

Science and Technology plays a key role in the development of a society and the nation as a whole. Post-Independence, four specific policies have been brought out to enhance the usage and popularization of Science and Technology in India:

- The 1958 Scientific Policy Resolution aimed at capacity building in advancement of science as the foundation for making a strong nation, which had just freed itself from the shackles of colonial domination.
- The 1983 Technology Policy statement focused on the attainment of technological self-reliance and building of national strength by reducing vulnerability in strategic areas.
- The 2003 Science and Technology Policy launched a massive programme for attracting the best talents to the arena of research in basic sciences, so that India could earn respect in a competitive knowledge society.
- The 2013 Science, Technology and Innovation Policy (STIP) emphasized that Science, Technology and Innovation (STI) systems are the driver for faster, sustainable and inclusive growth. The policy envisages creation of a new STI ecosystem which finds solution to societal problems and facilitates the entire innovation chain from knowledge to wealth creation, while at the same time attracting the best students to this area, ensuring a premier position for India in the scientific world.[4]

As far as S&T policy is concerned, the European Union has agreed on the common understanding that responsible

governance should include social and ethical considerations in strategy and policy formulation, encompassing both expert and public opinion and utilising wide consultation processes. In the national plan of science and technology in China, scientific development is still seen as the unquestioned driver of the country's economic performance but with a reference to responsible management and the right of society to take part in the discussions and decision making processes in S&T. Similarly in India, the 'Science, Technology and Innovation Policy 2013' document of the Department of Science and Technology (DST) suggested that S&T could be targeted at improving quality of life, stating that: "Science technology and innovation for the people is the new paradigm of the Indian science, technology and innovation policy".[5]

Most recently, the Government of India initiated a consultation process for formulation of a new national Science, Technology and Innovation Policy (STIP 2020). The priority areas are sectoral focus, the way research is done, and technologies are developed and deployed for larger socio-economic welfare. The formulation process for STIP 2020 is organised into four highly interlinked tracks. Track I involves an extensive public and expert consultation process through Science Policy Forum – a dedicated platform for soliciting inputs from larger public and expert pool during and after the policy drafting process. Track II comprises experts-driven thematic consultations to feed evidence-informed recommendations into the policy drafting process. Twenty-one focused thematic groups have been constituted for the purpose. Track III involves consultations with ministries and states, while Track IV is constituted of apex-level multi-stakeholder consultations.

Institutes Promoting Science Popularisation

Some of the Government-supported institutions promoting science education and science popularization are National Council for Science & Technology Communication (NCSTC), National Children's Science Congress (NCSC), Vigyan Prasar, Science Museums/Centres, National Institute of Science Communication & Information Resources (NISCAIR), and Homi Bhaba Centre for Science Education, among others.

Professional Associations like Indian Science Congress Association (ISCA), Indian Academy of Sciences (IAS), Indian National Science Academy (INSA) and the National Academy of Science India (NASI) are also making efforts to promote science. The National Science Day, National Technology Day, National Mathematics Year, World Space Week and the Year of Scientific Awareness are just a few science days celebrated with fanfare to promote science.

Public Science Movements (PSMs)

PSMs in India started with discourse activism and later on manifested into a form of social mobilization. Various PSMs that could be counted here. Among these *Bharat Gyan Vigyan Samiti*, Delhi Science Forum, *Jana Vignana Vedika*, *Paschim Banga Vigyan Manch*, *Odisha Bigyan Prachar Samiti*, and *Marathi Vidyan Parishad* are some that emerged with the aim to popularize science among various stakeholders.

Every movement had a specific agenda and a focus group of audience. The PSM trends could be classified into: (1) Humanitarian — a matter of personal conscience, without any social rationalisation; (2) Nationalist — an urge to contribute to the development of the national personality, coupled with the realisation that requires development of the economic conditions and the creativity of the broad masses of the people with whom S&T must link directly, and (3) Radical — an urge to contribute to the liberation of the masses from social oppression and exploitation and through this to the release of creative mass energy, a task of mobilisation which needs intellectual input and a scientisation of mass culture.[6-7]

Programmes to Popoularise Science

The Government of India after Independence gave utmost importance to the development of science and technology. Several institutes were set with the mandate to popularize science in the country. Some of the leading programmes to popularise science are:

Science Olympiads: The Olympiads do not lead directly to any career benefits; rather, they provide a stimulus to begin a career in science or mathematics, to undertake a lifelong journey

into the realms of exciting intellectual challenges. The Olympiads are not merely competitions, they are the meeting places of the brightest young minds of the world, and many friendships forged at the Olympiads form the seeds of scientific collaboration later in life. Much like the Olympics in sports, the Olympiads are a celebration of the very best in school level science and mathematics.

A National Olympiad programme in basic sciences and mathematics which connects to the International Olympiads is in operation in India. The Homi Bhabha Centre for Science Education is the nodal centre of the country for this programme. The programme aims at promoting excellence in science and mathematics among pre-university students.

Among the sciences, the Olympiad programme in Astronomy (junior and senior level), Biology, Chemistry, Junior Science and Physics is a five stage process for each subject separately. The first stage for each subject is organized by the Indian Association of Physics Teachers (IAPT) in collaboration with teacher associations in other subjects. The Mathematical Olympiad programme is a five stage process conducted under the aegis of National Board for Higher Mathematics (NBHM).

Innovation in Science Pursuit for Inspired Research: The INSPIRE scheme is one of the flagship programmes of DST. The INSPIRE Awards-MANAK (Million Minds Augmenting National Aspirations and Knowledge), being executed with National Innovation Foundation–India (NIF), aims to motivate students in the age group of 10-15 years and studying in classes 6 to 10. The objective of the scheme is to target one million original ideas/innovations rooted in science and societal applications to foster a culture of creativity and innovative thinking among school children. Schools are to nominate five best original ideas/innovations of students through their website. Awareness and capacity building of District, State and School level functionaries across the country is carried out through regional workshops, audio-visual tools and literature. The top 60 ideas/innovations are considered by NIF for product/process development and their linkage with other schemes of NIF/DST and their display at the Annual Festival of Innovation & Entrepreneurship (FINE).

Kishore Vaigyanik Protsahan Yojna: The KVPY program of DST, started in 1999, is run by the Indian Institute of Science, Bangalore to encourage students who are studying Basic Sciences to take up research career in Science. The objective of the program is to identify students with talent and aptitude for research; help them realize their academic potential; encourage them to take up research careers in Science, and ensure the growth of the best scientific minds for research and development in the country. Selection of the students is made from those studying in XI standard to 1st year of any Undergraduate Program in Basic Sciences namely B.Sc./B.S./B.Stat./B.Math./ Int. M.Sc./M.S. in Mathematics, Physics, Chemistry and Biology having aptitude for scientific research. Generous fellowships are provided up to the pre-PhD level to the selected KVPY Fellows. A monthly fellowship of ₹ 5,000 and 7,000 along with an annual Contingency grant of ₹ 20,000 and 28,000 is awarded to the under graduates and Post graduates in the Science field respectively.

National Talent Search Exams: A scheme called National Science Talent Search Scheme (NSTSS) was introduced in the year 1963 by NCERT which provided for the identification of talented students and awarding them with scholarships. During the first year of the implementation of the scheme, it was confined to the Union Territory of Delhi wherein only 10 scholarships were awarded to the Class XI students. In the year 1964, the scheme was extended to all the states and Union territories in the country with 350 scholarships for the students of Class XI. In 2013, the Exam was shifted to class X and Language Test (English/Hindi) was included as an additional component along with Mental Ability Test and Scholastic Test. In the year 2014-15, the rates of scholarships were increased from ₹ 500 to the following rates for various stages of education: a) Scholarship of ₹ 1,250/- per months for class XI and XII. b) Scholarship of ₹ 2,000/- per month for UG and PG. c) Scholarship for students pursuing PhD in accordance with UGC norms. The NTSE scholarship is awarded to the candidates for pursuing courses in science and social science up to doctoral level and in professional courses like medicine and engineering up to second-degree level. As on date, over 2000 scholarships are awarded in the country every year.

Science Clubs: Vigyan Prasar NETwork (VIPNET) was added as a new project to Vigyan Prasar in 1998 with the objective of providing a fillip to the science clubs movement in India. This is a network to weave all science clubs, societies, organisations to strengthen the popular science movement in the country with far reaching implications for the development of society. A club gets the benefit of VP's monthly newsletter "Dream 2047", and access to vast information on S&T through VP Information System (VIPRIS) and all other communication materials of VP. It enables participation in programmes including trainings and campaigns launched by VP and/or NCSTC, DST, or their associated agencies. It plays an active role in the National Children's Science Congress (NCSC) as participant, motivator, or in any other capacity which would lead to wider participation and deeper penetration of this unique activity.

Science through A/V Media: Various audio visual channels like Doordarshan and All India Radio are promoting science programmes. A variety of them are now available on AIR, like Radioscope, Science Today, Science Magazine, Science News, etc.; the interest was triggered by two joint NCSTC-AIR radio serials `Method of Science' and `Human Evolution'. On TV, 'Turning Point' a science based programme was able to catch the attention of viewers. Besides, the University Grants Commission (UGC), National Council of Educational Research and Training (NCERT), Indira Gandhi National Open University (IGNOU), and National Council for Science and Technology Communication (NCSTC) also prepare science programmes from time to time. Science based radio serials on various topics are produced and broadcast by 119 stations of All India Radio (AIR) and through community radio. Some of the popular serials are: "Jeevan Ek-Roop Anek", Rahiye Matwaley, "Ankon ke Khiladi", Radio Mathematics (on community radio). Video programmes were made and telecast on DD. They are Challenge Chatani, Utthan, Ignited Minds I-II, Hum Honge Kamyab, Fossil Memoirs, etc. Video CD's on achievements of S&T in India were also developed and telecast. DD Science is a one-hour slot on Doordarshan National channel. India Science is an online channel, which is available on internet-enabled devices and offers live, scheduled play and video-on-demand services round the clock.

CSIR Program on Youth for Leadership in Science: The CPYLS scheme is a unique 'hand holding' program started for school children at secondary level. The scheme was started to attract the meritorious young school children towards science. About 150 students are invited from each state to participate in two days program at CSIR Labs. Thousands of students get an opportunity to participate in the programmes organized by CSIR Laboratories.

Atal Tinkering Labs: Atal Tinkering Laboratories (ATLs) are being established in schools across India with a vision to 'Cultivate one Million children in India as Neoteric Innovators'. It promotes curiosity, creativity and imagination in young minds; and inculcates skills such as design mindset, computational thinking, adaptive learning, physical computing, etc. It provides a work space where young minds can give shape to their ideas through hands-on do-it-yourself mode and learn innovation skills. Young children get a chance to work with tools and equipment to understand the concepts of STEM (Science, Technology, Engineering and Math). ATLs contain educational and learning 'do it yourself' kits and equipment on science, electronics, robotics, open source microcontroller boards, sensors and 3D printers and computers. Periodically, they conduct regional and national level competitions, exhibitions, workshops on problem solving, designing and fabrication of products, lecture series, etc. A grant-in-aid that includes a one-time establishment cost of ₹ 10 lakh and operational expenses of ₹ 10 lakh for a maximum period of 5 years to each ATL is also granted.

Knowledge and Awareness Mapping Platform: KAMP is an Initiative of CSIR-National Institute of Science Technology and Development Studies (NISTADS) which intends to develop creativity, meaningful learning, critical reading and thinking skills that brings out the inherent abilities of the students. It is an International intellect E-based assessment platform to evaluate cognizance of 21st century skills, awareness and knowledge of Science, Technology & Humanities among school students. The Mapping enables students/parents to identify scientific attitude & enables them to understand their inherent potential for different career choices like that of becoming a scientist or technologist. It

creates awareness among students about the latest developments in emerging technologies. The identified students are linked to junior scientist clubs.

Popular Science Magazines: A number of newspapers, magazines, journals and bulletins are being published with a focus on science themes. Some of the leading magazines catering to the senior secondary school students include *Science Reporter, Vigyan Pragati, Resonance, Current Science* and *Chakmak, Sandarbh* and *Srote* of Eklava among others. *Science Reporter* published by CSIR-NISCAIR makes science exciting and has articles about latest scientific innovations and events, biographical sketches of scientists, quizzes and puzzles, and fiction. *Resonance* is a monthly magazine published by the Indian Academy of Sciences, Bangalore that publishes articles in almost all streams of science: physics, chemistry, mathematics, computer science, biology, etc. The best thing about this magazine is that they publish articles on specific topics which the students consider difficult to understand, including new classroom experiments, emerging techniques and ideas, and innovative procedures for teaching specific concepts. *Current Science* was started in 1932 by the heavyweights of Indian science CV Raman, Birbal Sahni, Meghnad Saha, Martin Foster and S.S. Bhatnagar. The journal forms a medium for communication and discussion of important issues that concern science and scientific activities. Eklavya, an NGO committed towards education and developing scientific temper publishes *Chakmak*, a monthly science magazine for children, of the age group 11-14, that gives space to literature and art as well; *Sandarbh*, a bimonthly magazine, which is a resource bank for teachers, and serves as a repository of innovative pedagogical methods, teachers' classroom experiences in addition to articles that explain a range of curricular and related topics; and *Srote* is a monthly compilation of news and features in science and technology.

Discussion

Despite several schemes and programmes in place, the scientific approach of most of the school students and teachers has been limited to their clearing of exams alone. More often a student studies science to clear the exam and not to understand its

knowabout or the practical utility. In the domain of research it is considered to be a futile exercise. The students in specific and the society in general are unaware of the usage of scientific research in their lives. It is observed that most of the scientific interventions were in an activity mode with an upper hand of the administration. The motivational level of science teachers is itself questionable. Many parents are also totally unaware of scientific developments. According to *India Science Report 2005* of NCAER by Rajesh Shukla, science teachers are not taking much interest in inculcating scientific attitude among students. Also students are giving up science for want of any interest and complications.

A recurring challenge for science communication is that it is a mix of various fields [Priest, 2010]. This is part of the strength of science communication, but it's also one of its weaknesses as these various fields sometimes pull in different directions. And working out the ethics of science communication exemplifies the latter. The best-established norms of science are the Mertonian norms commonly combined under the acronym CUDOS. These are: Communalism (scientific knowledge is owned in common by the whole scientific community); Universalism (the validity of scientific claims should be based on universal criteria and not on sociopolitical traits); Disinterestedness (scientific work should be pursued for the benefit of the common scientific enterprise, not for personal gain); and Organized Scepticism (scientific claims should be not be accepted until they have been critically examined and tested). While these norms aim to guide how science itself should be carried out, they also (in some cases) strike a chord with the aims of science communication.[8]

On reviewing the key players, like the news organizations, reporters, science information professionals, scientists and audiences, it was revealed that a lack of science communication is responsible for the widespread science illiteracy.[9]

Nobel Laureate Joshua Lederberg, in the year 1991, delivered a speech titled "Communication as the Root of Scientific Progress" and reiterated the significance of scholarly literature, scholarly publishing, and scholarly communication for the progress of science.

Though work on science popularisation is being carried out world-wide, it is still found to be less than the total recorded research found in scholarly journals. Scientific discoveries outnumber popularization efforts of these discoveries. More emphasis must be given to bring in trained science communicators in all scientific institutions and laboratories where work on scientific discoveries is taking place. The gap between scientific discovery and popularising that discovery should be reduced. Doing this will encourage a revolutionary change not only in the mind sets of people but also benefit the economic policies, government policies, literacy, political environment, inflation and much more besides creating a paradigm shift in corrosive factors like pollution, fuel, energy, etc.[10]

The study enables us to ponder upon the ongoing Government schemes to popularise science and their impact in developing the required scientific temper in the society. It also gives an insight into identifying the missing links/gap areas to achieve the goals of scientific interventions in schools. It helps us to analyse the Government schemes and recommend suggestive changes in the existing programmes for the enhancement of Science Popularisation.

It sheds light on the challenges of translating science policies into action. The STI (Science, Technology and Innovation) system does not operate in vacuum. Scientific strategy and effective mechanism are keys for proper implementation and success of efforts to popularize and promote science. Learning by doing and hands-on science models is the way out for promoting science. There has to be an enabling environment and an accepting public so that the programmes can function effectively, efficiently and enrich the society at large to develop the desired scientific temper.

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