

# CURRENT SCIENCE

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GUEST EDITORIAL

## IISERs: emerging science universities of India

'I know from the social media that IISERs are the chosen destination for students wanting to pursue science in the country', remarked the Honorable Minister for Human Resource Development while chairing the first meeting of the Directors of five Indian Institutes of Science Education and Research (IISERs) in June 2014.

By the beginning of the 21st century, the Indian Institutes of Technology (IITs) had established themselves as a brand name. The alumni from the IITs had emerged as leaders in academia, industry and administration due to which countless children in the country aspired to become IITians. As a result, enrolment in science dropped. While students who could 'crack' JEE, the joint entrance examination conducted by the IITs, joined them, those who could not, joined private engineering colleges that mushroomed across the country. Students of science and mathematics were sacrificed at the altar of these engineering colleges. If brilliant young students fail to enroll for science programmes, there would be a decline in the quality of researchers and teachers in science. As a result, the quality of science education and research in the country would deteriorate. Given the moribund environment in its science departments, the university system was not in a position to improve the situation. The only way forward was to set up institutes of science. There was only one Indian Institute of Science (IISc, Bengaluru) and it was getting ready to celebrate its centenary year at that time. But one institute of science was simply not enough for a country of India's size.

In 2006, following the advice of the Scientific Advisory Council to the Prime Minister of India, the Government of India took the path-breaking decision to establish two IISERs, in Pune and in Kolkata. Subsequently, three more IISERs were set up, in Mohali (2007), Bhopal (2008) and Thiruvananthapuram (2008), and, more recently, one in Tirupati (2015).

The idea behind setting up these IISERs was clear: improve the quality of education and research in basic sciences, with special emphasis on interdisciplinary areas. Science cannot be compartmentalized. For historical reasons, physics, chemistry, botany and zoology emerged as sub-disciplines of science. It is time to view Nature in its entirety, understand its simplicity and complexity, and reap benefits for humanity using technology. Science and technology go hand in hand. A close look at history reveals that various developments in science led to innu-

merable inventive technologies, which in turn pushed the frontiers of science even further, be it in sub-nanoscale or astronomical scale. Man has learned to deal with attosecond (millionth of a millionth of a millionth of a second) in one extreme and billions of years at the other extreme (recall the recent discovery of gravitational waves arising from a cosmological event that took place a billion years ago). Such developments necessitate reflection in the curricula of colleges and universities, and research laboratories. If this is not done, India would be left behind as a poor cousin in the emerging knowledge economy.

Thus, instituting IISERs was a step in the right direction for the country. The task in hand was to ensure that they were established in record time with state-of-the-art infrastructure together with the selection of outstanding faculty members and aspiring young students.

The academic model of IISERs had to be unique and yet it had to imbibe the strength of the IITs and the university system. It had to have a vibrant undergraduate (UG) programme and a doctoral programme to ensure that teaching and research went hand in hand. The time has come to make research an integral part of the UG curriculum. Students should not be made to choose either mathematics or biology; they should learn both. The bane of the Indian system of education constrained students to choose between science and engineering, seldom providing any opportunity to alter their minds later. Choice and flexibility are key elements in improving the system. The research infrastructure has to be of international standard, so that both the Indian scientists working overseas and the non-Indian scientists are attracted to IISERs. In turn, the prospective students need not look for greener pastures. Science is a global enterprise and the benchmarks are global. If Indian institutes have to be ranked among top institutions in the world, there is no choice but to ensure quality intake and quality infrastructure. Quality input is essential for quality output.

Set up with a five year BS-MS dual degree model, the IISERs ensure that the students learn mathematics, physics, chemistry and biology in the first two years. Subsequently, they spend another two years mastering a major subject of their choice. Eventually, they spend their final year carrying out research that culminates in the submission of a Master's thesis. They undergo research internship in all the summers that come in between. They are also exposed to a fair knowledge of computer skills,

communication skills, history and philosophy of science. A good dose of humanities and social sciences is included too! Earth and environmental sciences is an integral part of the curriculum.

Opportunities are provided to the UGs from numerous colleges and universities across the country to pursue science in the form of an integrated PhD programme in the IISERs. For students graduating from IISERs and elsewhere, there is a programme to pursue research at the doctoral level. A two-year postdoctoral programme for PhDs from other institutions is built into the system.

At present, the target of IISERs is to admit yearly 200 students at the BS–MS level and a similar number at the doctoral level in each institute. An annual steady output of 1000 Master's degree-holders and 1000 PhDs from the IISER system would increase the pool of scientists, slowly but steadily. It is also expected that there would be 200 faculty members and 200 postdoctoral fellows on the rolls of each IISER.

With an initial outlay of Rs 500 crores for each IISER to build a fully residential campus with pioneering research facilities and teaching laboratories providing a hands-on experience, the mood was upbeat. Initially established as registered societies, the IISERs were declared institutes of national importance by an amendment to the NIT Act, subsequently called the NITSER Act.

The admission to the BS–MS programme of IISERs was assured to Kishore Vaigyanik Protsahan Yojana (KVPY) scholars and those who had cleared the JEE. In subsequent years, the major input for the programme was from the top 1% of students coming out of state and central school boards. This was facilitated by the announcement of INSPIRE scholarship by the Department of Science and Technology for all students of IISERs.

About 50% of the BS–MS graduates of IISERs pursue PhD either in India or abroad. Many of them choose to stay back in the IISER system for their PhD, thus contributing to the quality of research students. Incidentally, within a short span of 4–5 years, IISERs have been recognized globally and the IISER graduates have no difficulty in securing admission to the top graduate schools in the United States and Europe.

The quality of the faculty input is unmistakably excellent. PhD holders from India and abroad flocked to the IISERs for faculty positions. With a success rate of selection of 2–3%, quality of the intake is assured. A reversal of brain drain is now taking place quietly.

The time-tested way of establishing a high-quality academic institute is to hire excellent faculty, provide them with essential infrastructure and absolute academic freedom to pursue excellence in their fields of choice. Such a conducive atmosphere brings forth outstanding output in terms of quality manpower, quality research publications, patents and other deliverables.

Recently, the IISERs have undertaken a peer review of their departments. The score card looks excellent. Despite the fact that the IISERs are only 7.5–9.5 years old, the number of publications from them (1133 [IISERK], 914

[IISERP], 545 [IISERM], 464 [IISERB] and 290 [IISERT] for the period 2007–2015) puts them on par with the established IITs in terms of per capita output of the faculty. As a matter of fact, the recently published Nature Index ranks IISERs in fourth position with regard to overall performance in publications from India, after all the IITs put together (rank 1), CSIR labs put together (rank 2) and IISc (rank 3). The quality of research output from the IISERs is reflected in publications in high-profile journals like *Nature*, *Nature Materials*, *Nature Physics*, *Physical Review Letters*, *Developmental Cell*, etc. It is also worth mentioning that many of the research papers are co-authored by UGs from IISERs. Many publications have co-authors coming from different disciplines, institutions and nations.

The idea of protecting intellectual property rights and filing of patents has become an integral part of life in the IISERs. Some of the UGs have been able to innovate and file patents.

With the Prime Minister of India announcing 'Make in India' and 'Startup India' programmes, and the Government approving the establishment of Technology Business Incubators (TBI) in some of the IISERs, the students of science are keen to become entrepreneurs. Knowhow transfer from IISERs to industry is already underway. With the announcement of the IMPRINT programme of the Government, the IISERs are ready to join hands with the IITs and IISc, and collaborate with industry.

The quality output of IISER faculty is already being recognized. Some of the young faculty members have received Young Scientist Medals from the Indian National Science Academy and some have become Young Associates of the Indian Academy of Sciences. Some have received the NASI Scopus Young Scientist award too. A number of IISER faculty have hogged the DBT–Wellcome grants to work on problems that are at the forefront of science and relevant to mankind. A number of faculty members are recipients of Ramanujan and Ramalingaswami fellowships that were designed to attract Indian scientists abroad to come back to India. Some of the senior faculty members of IISERs represent the who's who of Indian science. The IISERs project has given some additional dividends too. At the last count, 40% of students at IISERs are girls and 20% of the faculty are women. Such empowerment of women is important for our society. In addition to achieving excellence and equity, inclusiveness has been achieved in IISER admissions. IISERs have changed the landscape of Indian science.

In summary, IISERs have shown what India can do, when it wants to!

N. Sathyamurthy

Indian Institute of Science Education and Research

Mohali,  
Sector 81, SAS Nagar,  
Manauli 140 306, India  
e-mail: nsath@iisermohali.ac.in