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GUEST EDITORIAL

Indian science and higher education: the way forward

During the last decade, India made a choice to move from a service-based economy to a knowledge-based society, which necessitated requirements of a large skill force. This led to a major expansion of Indian higher education system by the Government of India in establishing several new institutes such as IISERs, more IITs and Central Universities with large investments. To attract potential faculty, various five-year term fellowships equivalent to tenure tracks (Ramanujan, INSPIRE Faculty by DST, Ramalingaswami Fellowships by DBT and Faculty recharge scheme by UGC) were introduced. These have created huge academic opportunities for the best scientists to return to India and unprecedented chances for faculty mobility within the country. The DST initiative like INSPIRE and KVPY fellowship programmes is a driver to attract meritorious (top 1%) students to science stream. Recently, the fellowship for doctoral students was enhanced by almost 55%, making it attractive for students to join Ph D programme. The Science, Technology and Innovation Policy 2013 has clearly identified the missing links needed to propel science growth to recognizable outcomes to the society. Overall there have been significant positive steps from the policymakers to improve the societal perception of science. However, many of the top-down policies will not be fruitful, unless they are reciprocated in a complementary bottom-up way at various ministry, institutional and personal levels.

Setting-up new institutes with large investments has provoked justifiable criticism since many existing institutes suffer from poor infrastructure. However, funds alone cannot mitigate the problems of the many existing educational institutes, which carry past baggage in terms of managerial, procedural and attitudinal inadequacies. These institutes need major reformation of governance to enhance the quality of faculty, whose capabilities alone determine their success. The new establishments must avoid this pitfall, inculcating visionary leadership from the beginning to establish traditions and good practices towards nurturing a healthy academic ecosystem.

Today, young scientists aspiring to return to India after a successful postdoctoral stint abroad have many choices of institutes to look for their tenure tracks. Building new campuses from the scratch does not happen overnight and takes a minimum of 5–6 years from conceptualization and architectural design to the realization of academic, laboratory and residential amenities. Initiating careers of new faculties in transit campuses, involves compromises in establishing immediate analytical and advanced experimental research facilities, slowing down the settling of new faculty. It is crucial for new institutes to attract competent faculty by rapid creation of research laboratories and ambience.

Historically, in the Indian education system, faculty involved in UG teaching (mostly in colleges) do no research and those carrying out research (in national laboratories and universities) do not teach UG students. This is antithesis of the system in Western universities, where the best of research professors teach the first-year undergraduates. To set up a new paradigm in research-led undergraduate teaching of science, during 2006–2008, five IISERs were setup, one each at Pune, Kolkata, Mohali, Bhopal and Thiruvananthapuram. The sixth one is being commissioned this year at Tirupati. Recognizing the merit of such a model, the Indian Institute of Science, Bengaluru initiated an equivalent BS course in 2010–11 and the National Institute of Science Education and Research (NISER) was set up at Bhubaneswar by Department of Atomic Energy. In these institutes, science is taught in a holistic manner, seamlessly integrating UG teaching with research in an interdisciplinary manner. Science is learnt through inquiry-driven teaching, with emphasis on breadth (first two years), depth (third and fourth year) and research experience (fifth year). The UG students are exposed to research culture early in their career and receive science training in state-of-the-art research laboratories through excellent faculty who are active in research. This has resulted in many research publications from UG students and augurs well to propel them for futuristic research careers.

Most modern experimental research is highly equipment-intensive and unless institutes support new faculty with generous start-up funds, it is difficult to make rapid impact. The young faculty come with fresh ideas, ambition, and fire in the belly to be achievers. They need quality mentorship for establishing their research group and managing financial support. Successful and supportive senior faculty must steer them to realize their short- and long-term goals. Unfortunately, new institutes lack such mentorship due to lack of senior faculty, who are reluctant to move from their comfort zone in established institutes to the challenge of institution-building. What is desired is to incentivise mobility through dual appointments across institutes and professional perks, which is alien to the Indian academic system.

In order to make significant contributions from India, the initial choice of research areas is crucial, considering the

availability of financial and human resources and quality infrastructure. Faculty should be hired with a thrust on what they will do in future. Many new faculty tend to pursue on extending their postdoctoral work, competing with their past peers, but at a disadvantage. To choose areas that are highly competitive in the beginning of their careers is risky. Thus, a balance of research topics to make worthy impact even with disadvantages of initial conditions such as irregular flow of grants, non-availability of key reagents, computational resources, instrumental facilities, etc. is an unavoidable challenge.

The Indian research system is seriously afflicted by lack of postdoctoral fellows, who contribute to quality enhancement in most institutions abroad. Most of our best-trained doctoral students go overseas to contribute to the intellectual wealth of other countries, while even senior most professors in India bereft of this, are overly dependent on fresh Ph D students. Postdoctoral training abroad in a different culture is necessary for personal and scientific growth. The recent proposal to support overseas postdoctoral fellowships from government funds, to gain domain experience and training in emerging/futuristic areas is a good initiative. The programme should be twinned with the candidates working initially for 50% of the time in an Indian institution different from where they secured their Ph D, followed by work in a collaborating institution abroad. These fellowships may also be open to foreign nationals who wish to pursue postdoctoral work in India. They should be dovetailed to new tenure-track systems such as Ramanujan, Ramalingaswami fellowships, etc. to assure career progression. We do not have the equivalence of the Centres for doctoral training as in most top universities to impart research and transferable skills, ethics, science communication, public engagement, industry linkages and entrepreneurship, etc. as part of doctoral programmes to augment life-long competency skills.

Institutions must focus on hiring the best faculty, develop leadership in science, create advanced research infrastructure, establish industry linkages and create special chairs for attracting eminent scientists. Importantly, they must undergo periodical peer reviewing of international standards. Sadly, most universities are not gainfully utilizing the various faculty schemes (Ramanujan, Ramalingaswami, INSPIRE faculty, UGC recharge) to refurbish their dwindling faculty pool. Institutes hosting such faculty should extend them all facilities that a regular faculty is entitled to and not treat them as secondary citizens. The concept of institutional alliances or university consortia as a strategy for harnessing the collective talent of each partner institute to secure governmental and private research funds is unknown in India.

Funding agencies should create Centres of Excellence in cutting edge and future areas of relevance with substantial and immediate flow of funds. The research grants should have built-in flexibility for investigators to use them without restrictions for different needs of the project. The advances in research at frontier areas critically depend on rapid dissemination of ideas through personal meetings and the government must generously support scientists in both organizing and attending international conferences. The creation of an independent funding agency (analogous to NSF) for managing governmental research funds, devoid of financial and bureaucratic entangles was the aim while establishing the SERB. However, this has not completely materialized in its present structure and function.

The current financial year has seen severe cuts in grants of all ministries, including science and technology. The quantum of funding allocated for scientific research in India (<0.9% GDP) is already lower than that of other developed countries. Also, it is disheartening to note that it has been further reduced in the current fiscal year. With industry contribution to science R&D being pathetic, the situation will 'undo' the progress achieved by Indian scientists under trying conditions in the past. In absolute magnitude, the amount of cut in science budget is insignificant on the economic scale for several programmes of the country, but in real terms, the consequences for science are serious irreversible damage. The government must forego the budget cuts for science and education even under adverse situations, because this is 'investment in future', which will never be a waste. Many important scientific agencies (e.g. CSIR, ICMR) and national laboratories are without heads for almost a year, which has stalled strategic decision-making, leading to dented morale in the community. In the absence of a Science Advisory Council to the government, there is no channel left for scientists to reach out to the Prime Minister and enlighten the government on the defining role that science could play in addressing the key issues related to energy, health, environment, water and education. The various Indian science academies must step in to establish this missing link and build the trust of the government in science and scientists.

The President of India, who is the Visitor of Institutions established by Acts of Parliament (IITs, IISERs, NITs and Central Universities), has been publicly and rightly so, expressing anguish over Indian institutions not being present in the top 200 world rankings. Excellence in science comes only with the recognition of necessary ingredients and sustained investment; there is a price to be amongst the best in the world. The high performing institutions must be bestowed immunity from the vagaries of budget cuts and inflexible rules to enable them graduate to world-class excellence. This is possible only when merit becomes an obsession at every level. Some of the achieving institutions must be endowed with special funds (25–30% over normal budget) every year for the next ten years, without any bureaucratic controls to invest in what it takes to be among the global best. The ecosystem and infrastructure should be worthy to attract nothing but the best faculty of international standards. Max-Planck Institutes of Germany would be ideal as the governing model. India has an unending supply of fantastic pool of talented young students and it is the bounden duty of the nation to nurture and harness their talent for a better world of tomorrow.

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