

# Innovations in attracting the young to the pursuit of science

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*The last few decades have seen a drop in the percentage enrolment of the brightest young minds in the basic science streams. Besides the traditional professional fields like engineering and medicine, the emerging fields of business management and information technology captivated the imagination of career-oriented bright youngsters. Though there have been quite a few local initiatives in basic sciences, at the national level, 'catching them young' remained a catch phrase till the formulation of the INSPIRE programme of the DST and its beginnings in the 11th plan. This article is a report on the various components of the programme, their strengths and limitations as well as the opportunities that have opened up not only for the stakeholders in the programme, but also for Indian society at large.*

**Keywords:** Awards and fellowships, basic sciences, innovations and initiatives, young talent.

THE INSPIRE programme of the Department of Science and Technology (DST) started in the 11th Plan of the Government of India and had an outlay of nearly 2000 crore rupees with an intention of inspiring young people to pursue science. The plan aimed to target about 10 lakh young people between the ages of 10 and 32 years. By the end of the Plan, it was clear that lack of awareness amongst the stakeholders about the programme is one of the factors that stood in the way of achieving its full potential.

For example, DST's INSPIRE programme was a topic of five 'letters' published in *Current Science* during the past year<sup>1-5</sup>. And in the past two years, there were seven advertisements related to the INSPIRE programme, placed usually at the end of the journal<sup>6-12</sup>. Even if one reads the journal from end to end, one does not normally compare the contents of letters from readers and advertisers. So it is pertinent to note here that while the advertisements were about the INSPIRE faculty and fellowship schemes, the letters focused primarily on the internship camps and only one touched upon the award scheme.

Even if we put together the column inches from the advertisers and academicians, we would not be better off than the blind men trying to understand an elephant. Hence there is a need for a clarification that the INSPIRE programme covers age groups from 10 to 32 years through the following schemes:

(1) Cash award for innovative solutions to local problems for two lakh school students of 10 to 15 years of age.

(2) Exposure of 50,000 academically talented 17 year olds to the excitement of scientific discoveries and the rigour of its methods through one week in internship camps.

(3) Provision of scholarship and other support for 10,000 topmost achievers in the 12th standard from all school boards of India, if they take up a basic science stream.

(4) Fellowships for 1000 top achievers in Master's degree who opt for Ph D on a scientific topic.

(5) Faculty positions for 1000 Ph Ds who can come up with practicable research ideas with provision for financial support necessary for independent research.

Thus by the end of the 12th Plan period, the programme would have touched more than 2.5 million young people – equivalent to the population of Mongolia – with an expense of less than 4000 crore rupees. The sheer magnitude is unprecedented<sup>13</sup>.

It was also therefore, necessary that an independent assessment of the programme be done by an external agency to assess, evaluate and provide the necessary feedback to fine-tune the programme for execution in the 12th plan.

We took up the task of fulfilling the objectives of both improving the public understanding of the schemes under the INSPIRE programme as well as to generate feedback from the ground up. The schemes under the programme listed above were documented by us between July 2013 and July 2014. We covered east, west, north, south and central parts of India, documented the events and processes of the programme and held interviews with various stakeholders – on camera, to allow accurate reporting later – and generated video data of about 80 hours<sup>14</sup>.

No social system is immune to observers, as the Hawthorn effect kicks in. The effect would be amplified by the presence of TV cameras, tripods, lights and other

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digital paraphernalia. We therefore approached the project from a participatory action research perspective and tried to minimize the effect of the camera by reducing the crew and equipment for documentation to the bare necessities. While admitting these psycho-social influences of our materials and methods and the consequent colouring of our observations, as a partial fulfilment of the two-pronged objectives of the project, we present below a brief qualitative report on each of the schemes under the INSPIRE programme.

### **INSPIRE awards**

To understand the nuances of the award scheme, we interviewed several awardees, their parents, teachers, district-level and state-level officials, national- and district-level jury.

At the district-level exhibition of the awards, according to both the district educational officers and the jury, there are a large number of entries that may be judged as ‘not worth it’, ‘models bought from market’, ‘projects done by others’, ‘waste of money’, etc. Yet these are weeded out as the competition goes through the state to the national level. And then, the entire pitch changes. Both the state-level officials and jury members at the national level seemed to be excited and energized by the innovations from children aged 10 to 15 years<sup>15</sup>.

From the cream of less than 1000 children (from the initial 2 lakh) who reach Delhi, about a 100 patentable ideas are identified each year. From the first batch of the national-level competition, 10 patents have already been filed. Are about 100 patentable ideas worth the investment of 5000 rupees each on 2 lakh children?

If we stop at justifying the expense on the basis of the input–output or return-on-investment models, we would miss the social impact of the programme. ‘You will see this product soon in the market’, announced a child. He was approached by two entrepreneurs during the district-level exhibition. The obstacle of intellectual property rights in socio-economic development is sidestepped even before the competition reaches the national level.

‘I am a consultant in my village’ said a young girl. Her parents did not believe her when she presented her idea on irrigation to them. But she executed it at home, with success, and the neighbours and other villagers soon started coming to her for advice. The young people, who go through the process, seemed to be highly empowered.

Most of the innovations that we see in the national-level exhibition are directly related to the immediate concerns of the students. So, a girl proudly showed her ‘fire alarm’ which was the product of her own experience when her house was gutted in a fire due to short circuit. The girl who won the first prize in the 2013 national exhibition was motivated to make a rain sensor so that her clothes left for drying in the line in the hostel do not get wet in flash rain. Ultimately, is not identifying some

few thousand future innovators of the nation a worthwhile project by itself?

It is clear that many of the projects had the inputs of others – friends, siblings, parents, relatives, teachers and even education officers as well as the jury of district and state-level exhibitions. We do not see this as a flaw, since all innovations take place in a social milieu. Hence it could perhaps be claimed that the awards scheme is facilitating the creation of an enabling environment for innovation. When a child reaches state or national level, the whole village gets involved. If the innovative spirit of the nation – irrespective of whether it is a parent or a teacher behind – can be harvested through this scheme, is it really a negative aspect of the programme?

The Prime Minister’s Advisory Council had created a vision document that dreams of 20,000 patents filed per year by 2020 (ref. 16). The INSPIRE awards scheme has the potential to meet a part of the target if we leverage on the strengths of the programme.

The weakness that we found in this particular scheme of the INSPIRE programme is the lack of awareness of what constitutes an innovative science project. School-level and district-level science exhibitions of the earlier years have set the tone and tenor of science projects by school children. Quite often, a model that explains a scientific principle is good enough for school science projects. But the focus here is on innovation, using science and technology, not an explanation of a scientific principle or technology per se. Ultimately, only children who go through the competitions at district and state levels understand what is required: a problem and an innovative solution. However, this limitation of the scheme can be overcome if the case studies of the projects that reach the national-level competition can create a benchmark for the projects at district level in the coming years. Effective communication can help the awards scheme to make 2010–2020 truly the ‘Decade of Innovation’ as envisaged and declared by the Government of India<sup>17</sup>.

It is important to highlight here that the award scheme is not dependent on the marks of the students. Extensive documentation done earlier on innovators in different parts of the country<sup>18</sup> has provided enough evidence that the innovative spirit is not dependent on educational degrees. The schools are given the power to choose the most innovative children without consideration of their academic performance. The scheme assumes that the tendency for nepotism in the choice will be resisted by local society, especially since winning the competition at district, state and national levels brings name and fame to the school.

### **INSPIRE internship camps**

We documented the processes of eight internship camps in different parts of the country and interviewed the

students, mentors, organizers, coordinators, parents and teachers. The issue of marks as a determining parameter for the selection of the participants in these camps came up consistently from everywhere. But if not marks, what should be the criterion for selection? The question complicates and derails the discourse. Marks have indeed been an accepted norm for selection in educational systems, whereas application of other criteria creates more problems than it solves.

Many that we interviewed – teachers, facilitators, and even some mentors – were of the opinion that the aim of the scheme is to make the interns into scientists. But consider that there are 50,000 internees every year. Even after the slight increase in the public investment on scientific research in the recent years, India is not able to absorb more than 6000 or 7000 thousand scientists every year. Evidently, DST does not want to create an oversupply of scientists in India? According to the Secretary, DST, the objective of the internship camps is to create a cohort of scientifically aware citizenry. It does not matter whether the students participating in these camps become businessmen or bureaucrats. Without a critical number of educated public becoming highly aware of scientific activity, we cannot create an intellectual ecosystem for high-class research.

One week of immersion in various fields of science does seem to ignite the young minds. After the camps, most of the participants we interviewed declared their determination to become scientists. Teachers and parents that we interviewed also reported this change in the direction of a large number of participants from such camps. It is quite possible that this resolve will slowly degrade into an aspiration, hope or wish later, due to other life influences amongst these 17 year olds. Yet, it is an indication that the reduction in the best students enrolling in basic sciences courses observed during the last two decades may now change due to the inspiration derived from the internship camps.

Beyond attracting the best brains to science, the camps serve another purpose: they provide a platform for the academically gifted children to come together. The mentors we interviewed were unequivocal in their assessment of the intellectual capabilities of the internees. This is an age where friendships matter. And for most, this is the first time away from home. The anxiety is overcome by the excitement of finding new friends and forming new bonds in a totally new atmosphere. Such residential camps for children from different schools could help in reducing the gender, class, caste and rural–urban divides and create networks of the kind that the internet is capable of sustaining nowadays. From amongst the top 1% of 10th standard board exams, quite a few will become opinion makers of tomorrow. If this network of a citizenry supports scientific research, the promised investment in science in terms of 2% GDP<sup>19</sup> will not take long to come.

Another criticism that came up was on the number of children in each camp. Indeed, it is not good to herd large number of teenagers into enclosed spaces, especially since they are at the stage of human development when individuality and identity are causes for emotional turmoil. Though DST has put limits on the maximum numbers, quite often, larger numbers are accommodated in these camps. We found two reasons for this: (1) larger numbers provide economic incentive for organizing the camps and (2) the number of organizers is less and therefore it becomes difficult to provide proper facilities to all those who qualify to participate in such camps. The first reason motivates the private sector institutions and the second reason pressurizes the Government sector institutions to admit larger numbers of children in the camps. This problem can be overcome if and only if more institutions of higher education come forward and take active part in organizing such camps, if possible, in all districts of the country.

Also, visits to remote locations in India may challenge the scientists focused on their laboratories, publications and students to confront the social developmental issues in different districts of India. While the scheme provides a platform for scientists to address the most impressionable age group, it also provides the degree colleges near the camp venues access to scientists to deliver guest lectures for the benefit of their students. We did find case studies of this happening. However, this opportunity is rarely used by the degree colleges – again due to lack of awareness about the camps.

We note that initially, the mentors list<sup>20</sup> was mostly composed of the fellows of science academies who had volunteered for the task. With the limitations in terms of availability of mentors from the list, accessibility of the venues and other exigencies, organizers have taken the freedom to involve local talent. A fair mixture of award-winning scientists, managers of science, professors and lecturers from a variety of disciplines has evolved over time. Formal feedback mechanisms apart, the camp organizers learn through experience the variations in the reception of different mentors by the internees and are forced to adjust to the demands.

We interviewed some internees a year after their attending the camp and found that they remember some mentors more than others. Though it would take a statistical investigation to confirm this, our qualitative study would suggest that two factors have long-term impact – the passion of the mentor in the topic of his/her choice, and the age of the mentor. A bimodal distribution is to be expected in the age preference – either very young or very old. Considering that we are looking at the preference of 17 year olds, this is not surprising. Perhaps the rebellion against parents and authority figures that we primates exhibit immediately after puberty, may determine this bimodality. Many internees also expressed their satisfaction of seeing and interacting with real scientists.

In a nation of young people where sports and movie stars hold sway in popular imagination, the INSPIRE camps are slowly creating a genre of science celebrities.

Amongst methodologies used for different sessions, the internees showed greater response to demonstrations and interactive sessions than lectures and presentations. Small group interactive sessions called 'walk the talk' were especially memorable to those who had experienced it. Visits to laboratories also seemed to have left indelible marks in the young minds, especially if there was some amount of hands-on activity.

We note that some camps had elaborate inauguration ceremonies with religious overtones and detected hidden political, religious and commercial agendas in some sessions. But these constitute an insignificant minority that will hopefully reduce over time.

There is a clearly articulated feeling among the academia that such camps should be organized for social sciences and humanities also. This is a good indicator that the internship camps are generally viewed positively by the academic community.

### INSPIRE scholarships

Topping the 12th standard board exams and then taking up a science stream for study is the only way to get the INSPIRE scholarship. We note that the arguments against mark as the criterion for selection to internship camps, do not prevail for the scholarship scheme.

As against 50,000 students every year in camps, the scholarship is only for 10,000 every year – again, much lesser than the number of scientists that we can absorb. But considering that the scholarship is for five years – from Bachelors' to Masters' degree – there would be about 50,000 young people getting this scholarship at any point in time, once the scheme reaches its maturity. Thus the total investment in the scholarship scheme is much higher than for the camps. Yet, we do not see any criticism about the scheme. Is it only because there are many other scholarships as well?

Given that this scholarship scheme provides 5000 rupees per month, much higher than most other scholarships, it should have got some attention. Yet, we find that the scheme is not yet well known. In fact, many top-ranking students who are eligible, did not even apply for the scholarship in the early years of the scheme. A part of the reason could be the bureaucracy that invents acronyms – SHE – for scholarship for higher education, obfuscating the intention. But since the scholarship scheme is becoming more popular every year, hopefully, this limitation is bound to disappear in time.

The provision of an extra 20,000 rupees every year for doing a project is also not utilized by some of the scholars, again because of the lack of awareness about details of the scheme. Moreover, scientists also do not seem to have

recognized that during the vacation period, there is a young talent pool that can be tapped – extra hands, free of charge, to execute their research protocols!

In spite of these limitations at present, we were often touched by the finding that many young people, who would otherwise have dropped out of tertiary education because of economic difficulties, are able to pursue their education. Some of them are even able to help their families in times of financial crisis<sup>21</sup>.

### INSPIRE fellowships

First, we notice with some satisfaction that the topics chosen by the INSPIRE fellows for their Ph D is overwhelmingly in the area of agricultural sciences. India is still predominantly an agricultural country and surprisingly, the young people seem to have chosen topics relevant to our population rather than fashionable and trendy topics for research.

Fellowships to pursue Ph D, like scholarships, are also accepted by the academic community without any criticism. In fact, this is only an addition to the variety of fellowships available in India. CSIR, UGC and other bodies also provide fellowships. The difference in the amount for the INSPIRE fellowship is much higher when compared to the UGC fellowships for the meritorious students, but when compared to the CSIR fellowships the difference narrows down. From interviews, we could not notice any appreciable difference in the quality of the fellows either.

Yet, the scheme fits well into the programme in two ways. About 1000 more fellowships means that a larger number can opt for Ph D in basic sciences. Thus the programme contributes towards the goal of 10,000 Ph Ds in science and technology per year as envisioned by the Prime Minister's Advisory Council. Most importantly, the fellowship scheme provides a larger number of candidates for final selection to the next and last stage of the INSPIRE programme.

### INSPIRE faculty scheme

The faculty scheme, like the awards scheme, oversteps the traditional marks-oriented selection. If innovative spirit is the factor, an innovative research idea is the main criterion for selection of the faculty. Demonstrated ability to do research and publish papers is the second criterion. The third criterion includes interviews to judge the ability to do independent research.

The outlay in terms of the benefits to those who are selected is quite impressive: salary equivalent to an assistant professor in the IITs and a research grant of Rs 7 lakhs per year for 5 years. It is quite attractive to those who are confident in delivering results in five years.

The scheme envisages 1000 faculty every year. But the scheme has not received the attention that it deserves and

hence the posts were not filled in the initial years because of lack of applications from those who are eligible and capable of meeting the requirements.

There are two routes for applications – the prospective Ph D holder with a bright research idea could apply directly or the application can be routed through an institution. The applicants who had become faculty through the direct mode seemed to face difficulties in finding an institution that will absorb them for the specific research project for which they received the faculty position. Quite often, they have to go through another selection process, since research institutions have their own rules for inducting employees. The other route where the application has gone through a research institution seems to pose lesser problems and the proposed research project takes off without too many delays. However, the faculty that came through the direct mode seemed to be brighter than some of those came through the institutional recommendations. Since this observation is based on a few case studies, there is a need to re-examine this point with a more detailed study.

The INSPIRE faculty that we interviewed expressed satisfaction about the tenure duration and salary. We did find some INSPIRE faculty who took up jobs that paid less salary, tempted by the security, stability and continuation beyond the five years. Such faculty can continue receiving the research grant. This also seemed to be attractive for the institutions that provide such employment.

All those interviewed suggested flexibility in the heads of expenditure under the research grant, to meet the specific requirements of the research area. Mathematics or theoretical sciences requires less capital investment but benefit from participation in conferences abroad. Some experimental research requires more funding than others. Since different research areas require different levels of funding, many interviewees suggested a more appropriate distribution of the total funds available for the disbursement of research grant. However, this might increase the administrative load and give rise to accusations of favoritism in disbursement of funds.

Some of the INSPIRE faculty interviewed also suggested a platform for the faculty to interact with each other. Such interactions have been organized in the case of Ramanujam fellows and it would not be difficult if tackled with focus on specific research areas. We also note that there have been attempts for virtual interactions on the internet. If this is formalized, perhaps the cost of actual face-to-face meetings could be reduced.

Whatever the minor limitations of the scheme, it has the potential to reduce brain drain. In fact, it has even been effective in bringing back quite a few scientifically talented young people to India from their postdoctoral research abroad.

When the scheme is fully mature, at any point in time, there would be 5000 INSPIRE faculty – young scientists

who are allowed to do the research that they want to do and are given reasonable support. This is a necessary condition for the unexpected to happen: the quality of research from India would make a quantum jump even if only one-tenth of it rises up to the expectations.

## Conclusion

The full impact of the INSPIRE programme will need about two decades to emerge – when the present 10-year-old awardees start competing for the INSPIRE faculty positions. Though presently there are lateral entries into each scheme, soon consistent performers will emerge from within the stream. Allowing the INSPIRE faculty and scholars to interact with the internees in the camps will provide an impetus to make this happen.

The first and the last schemes of the INSPIRE programme are the strongest in terms of their vision and also the potential impact over the years on Indian science. Science Technology and Innovation Policy 2013 of the Government of India accepts data from the Global Science Report and admits that India needs to increase the R&D personnel by 68% in the next 5 years. Evidently, this is not an easy task even if the public investment in science goes up to the goal of 2% of GDP. Private investment in R&D as envisioned becomes feasible only if there is a large enough talent pool. The scholarship and fellowship schemes help create such a talent pool.

The reduction in investment in science and technology in some developed countries in the recent past also creates an environment where offshoring of research work becomes attractive. Thus the spillover of manpower that has been motivated by the INSPIRE programme will perhaps meet the challenges of the future, including making India a research hub for the world at large.

In this article, we have provided a qualitative assessment of the INSPIRE programme, with the hope that it will help formulate a more rigorous and comprehensive quantitative study, to evaluate the socio-cultural and economic impact of the programme on Indian science and the people of India.

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