HIGHER EDUCATION IN SCIENCE AND RESEARCH & DEVELOPMENT: THE CHALLENGES AND THE ROAD AHEAD

by

Indian National Science Academy (INSA)
New Delhi
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(Recommendations to the Planning Commission for the XI Five Year Plan)

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MEETING CHALLENGES IN HIGHER EDUCATION AND RESEARCH & DEVELOPMENT

Recommendations of the Indian National Science Academy (New Delhi) and the Indian Academy of Sciences (Bangalore) to the Planning Commission for the XI Five Year Plan

India faces enormous social challenges as well as opportunities for rapid development in the new millennium. Our unprecedented recent economic growth, the values of knowledge and education shared by a billion diverse people, and the investments made over the last half century, all point to India's potential future as a knowledge economy with high level man (and woman) power in the science and technology driven global village. Other countries visualizing a similar future, are investing massively to improve both the quality and quantity of higher education and research, some to give their societies a competitive advantage, and others to preserve their advantage. India has suffered in the past because of severely sub-optimal investments in these areas. The present juncture is critical for Indian science: major positive steps would enable it to flower and play a key role in taking India to a leading position in the future, but inaction or sub-optimal action would accelerate the national decline.

Given this background, the Indian National Science Academy (Delhi) and the Indian Academy of Sciences (Bangalore), as representative bodies of leading Indian scientists (in the broadest sense of the term), are strongly of the opinion that concrete action needs to be taken urgently in science-based higher education and research and have jointly prepared a set of proposals and recommendations for the XI Plan. These proposals, if accepted and implemented, will improve higher education, give a fillip to R&D and will make India more competitive globally. These recommendations have been prepared after very wide consultations and reflect a broad consensus.

This report is focused on increasing and improving the 'supply side' of the scientific & technological community. However, a major change is needed to attract a large number of young Indians to science based careers, the Academies will bring out within a year, a document which describes authentically and in detail the various opportunities present and future in this large and central area. These opportunities could be in existing institutions, in research and development, in new institutions, in the industry as well as in new areas where we have advantages and potential for competitive growth, eg bioengineering and biotechnology, pharmaceuticals, nanotechnology, etc. This is a necessary complement to the public investment proposed here. It will help to sensitize the society at large to the possibilities, which such an investment will help realize.

For the preparation of these recommendations, besides the views of the Academy members, findings and recommendations of the following Committees and interactive symposia were also taken into consideration:

- India Science Report (Science Education, Human Resources and Public Attitude towards Science & Technology), Indian National Science Academy , 2005

- Report of the Committee constituted by SAC-C to examine and recommend a New Science Education Initiative from 10+2 onwards, 2004

- 'Attracting Young People to Careers in Science' a seminar organized by the Indian Physics Association, The Office of the PSA to GOI, IIT - Delhi and the Nuclear Science Centre, New Delhi, 2005

- The National Conference on 'India's Competitiveness and Preparedness in Science and Technology for the coming decades - Issues, Challenges and Strategies' organized by the National Institute of Advanced Studies and JN Centre for Advanced Scientific Research, 2005

- Report of the Task Force for Basic Scientific Research in Universities set up by the MHRD, GOI, 2005

- Recommendations of the Third Conference of Central Universities' Vice-Chancellors, January, 2006

The main thrust of the recommendations is to facilitate development of human resource that is capable of utilizing available knowledge to create wealth and of generating new knowledge and innovations. This is sought to be done by improving the higher education and research profiles of universities and institutes.

The Prime Minister, Dr. Manmohan Singh, spelt out succinctly the challenges and directions for our future as a knowledge economy while launching the Knowledge Commission last year. He said "At the bottom of the knowledge pyramid, the challenge is one of improving access to primary education. At the top of the pyramid, there is need to make our institutions of higher education and research world class. --- . The time has come for India to embark on a second wave of nation building. --- . Denied this investment, the youth will become a social and economic liability."

Worldwide, Universities continue to play a very vital and critical role in the development and evolution of societies. Universities educate young minds and create aware and dynamic citizens. But much more than this, universities generate new ideas and encourage innovation. A vibrant democracy like ours, wedded to the ideas of pluralism, secularism and inclusion must have universities, which not only cherish these values but also actively promote and nurture them.

Currently, higher education is drawing tremendous attention in both developing and developed countries. In the developed countries the emphasis is on maintaining their edge in innovation and generation of knowledge. To maintain their competitive superiority, the developed countries are investing heavily in R&D both in the private as well as the public sector. It is worth noting that even a country like the USA, which remains the leader in Science & Technology, is investing substantially in science education at all levels to encourage its younger generation to take to science as a career so that it can maintain its leading position. These countries with their wealth of resources will also continue to attract the best talent from all over the world to their

universities and industry to maintain their competitive edge. This one-way flow of the best from the developing to the developed countries will only increase in the future due to the ageing demography of western societies.

Amongst the countries which have more recently moved from a developing to a developed status, strengthening of the education system, emphasis on R&D and training of professional managers have been the key ingredients of success. Countries like China have made substantial increases in their allocation of resources for higher education. In the first phase of their scheme for improving higher education, China has provided a grant of US $125 million to each of the 10 leading Universities and US $225 million to Beijing and Tsinghua Universities. In the second phase additional grants will be provided to 30 Universities with the overall aim of having 100 quality Universities in China in the 21st century and with 15% of its citizens in the age group 18-22 receiving tertiary education.

India cannot remain behind. In addition, with both the Services and Manufacturing sectors on the upswing, there will be a growing demand for qualified human resource.

At this point it is desirable to explicate the reasons why we believe that substantial public investments of the kind outlined below are urgently necessary. At our present stage of growth, where there is increasing international pressure for knowledge based, value-added development of major areas like pharmaceuticals, drugs, biotechnology, nanoscience/technology, healthcare, genetics, information/computer technology etc, it is clear that both in terms of numbers and quality, a vast expansion and intensification of higher level education embedded in research is essential. This situation is different from the felt need for expansion in professional education and training, which has indeed been met in many ways during the past decade or two. The first non-professional degree (viz., B.Sc.) by itself is, unlike professional degrees, of not much value or societal attractiveness unless it is of educationally good quality, obtained in a lively research environment, and is supplemented by a professional edge (e.g., additional skill building that adds to employability) or research experience. We make several suggestions about how to achieve these. Of the large number of such people with a first degree, a small fraction (typically a sixth) go on to higher degree or research; the remainder, if well trained, add to the knowledge economy in a wide variety of ways. Given the large numbers, their less defined employability and the long gestation period, it is universal practice to have massive public investments for ensuring their quality so that they effectively contribute to a knowledge economy. Our country has, however, invested much less by international standards. Following the first wave of nation building, the more recent investments have been largely concentrated on relatively small, specialized and primarily research oriented institutions. At this stage, we need a second wave of nation-building. If we embark on this fully, not only will there be a large number of skilled, well-trained, capable, flexible scientific knowledge workers needed both by our economy and by the world, but there will also be a remarkable flowering of research (and development). We must seize this opportunity since otherwise, in the intensely competitive, globalized environment of today, we will at best be spectators, perhaps victims, but not participants.

We recommend the following proposals for Universities and Institutes to improve the quality of higher education in India. Some of these recommendations, as may be expected, are similar in spirit to those made by a committee of SAC-PM under the chairmanship of Prof. M. M. Sharma for rejuvenation of basic research in universities and by other committees recently setup by the Planning Commission. The report of this committee has been accepted and it has been empowered to give effect to its recommendations, although action on the ground is still awaited.

We emphasize that the suggested enhanced quantum of support for teaching and research in Science & Technology during the next Plan can be meaningful only when matched by major administrative and financial reforms in the various government agencies as well as in the target academic institutions. It is, therefore, suggested that the availability of the enhanced funds be made conditional to the desired reforms being put in place at all levels.

A summary of the financial outlay to implement the suggestions is provided in **Annexure 1**.

1.0 UPGRADATION OF UNIVERSITIES, COLLEGES AND NEW INITIATIVES IN SCIENCE AND TECHNOLOGY

1.1 Special Assistance should be provided to ten selected Universities to establish world-class Premier Universities in the country

At least ten Universities in the country need to be brought at par with the best Universities in the East Asian region if not with the best at the global level. The identified Universities must provide education at the undergraduate and postgraduate levels and conduct research of high standard. A financial assistance of Rs. 200 crore for each identified University will be required for upgrading infrastructure, laboratories, instrumentation and for repairs in their Science departments. These Universities should have uninterrupted water and electric supply, waste disposal systems and proper computational, internet and library facilities.

These Universities will require a substantial increase in their recurring expenditure so as to maintain the laboratories, instrumentation, computational facilities and databases. These Universities will also require some seed money for research. The recurring expenditure on bandwidth, journals and laboratories will have to be increased 3-4 times over current values. Each Science department within these Universities will require a grant of Rs. 10 lakhs per annum for proper laboratory training of students.

This proposal is in keeping with the philosophy that led to establishment of two new IISERs in the country and attempts to achieve the same goal by taking advantage of the already existing infrastructure in select universities and making investments only incremental to those already made by the country.

1.2 Every state of India should have a University at par with the best Central Universities with respect to funding and academic standards

Special assistance may be provided to at least one University in each State to upgrade infrastructural facilities, libraries and instrumentation to bring these Universities at par with the best Universities/Institutes in India. A grant of Rs. 50 crore may be provided to each such university with the stipulation that most of the expenditure should be on teaching, learning and research related activities rather than on construction of new buildings. These Universities must also strengthen their undergraduate education. These identified universities may be upgraded to Central Universities, if necessary.

1.3 Leading postgraduate teaching Universities and IITs should be encouraged to impart undergraduate science education

In India, the IITs and some leading Universities have excellent departments offering M.Sc. programs in science subjects and also have a good ambience for research. Most universities in the world have both PG and UG programs on the same Campus in an environment of research. Ten high quality post-graduate teaching institutions in the country may be identified and supported adequately to start undergraduate B.Sc. programs. Each may be provided with Rs. 20 crore for implementation. Block grants may be given to further upgrade the research facilities at these selected places. This measure will help us in attracting bright students to pure science courses.

1.4 At least 200 undergraduate Colleges in science, technology and social sciences be provided additional assistance to develop into Colleges of Excellence

Neglect of undergraduate (non-prodessional as well as professional) education will cost the country very dearly. It is suggested that undergraduate education in all streams – science, social sciences, languages, commerce and technology be provided major support during the XI Plan.

A scheme was earlier started by the UGC to recognize Colleges of Excellence and to provide them additional grants of Rs. 30-50 lakh. This amount is too meager to bring about any significant change in quality. A one-time grant of Rs. 2 crore and a three to four-fold increase in recurring grants (other than expenditure on salaries and administration) will be required to improve the infrastructure, inter- and intra-net facilities and libraries in undergraduate Colleges. Around twenty Technology Colleges should be upgraded. Upgradation of Technology Colleges will require higher levels of resource input, around Rs. 5 crore per college.

1.5 Encourage interdisciplinary movement between Science & Technology streams and industrial R&D by establishing 20 Engineering Schools that admit students with a Bachelor's degree in Sciences for a two-year B.Tech. degree in selected areas requiring strong science-technology interface

This is a new proposal and has received very wide support. Urgent steps need to be undertaken to enhance the perceived status of conventional B.Sc. degrees in Universities as a career option. Currently, the low morale of B.Sc.

students in the country is a very worrying feature of the higher education scenario in the country. A large number of college students pursuing B.Sc. degrees, several of them talented and motivated, feel 'left out' and 'discarded' by the system. Most of them pursue their degrees without any enthusiasm or motivation and are constantly looking for opportunities to defect to the 'professional' streams.

An important measure to address the problem of low morale in B.Sc. degrees is to initiate post-B.Sc. 2-year B.Tech. programs, followed by 2-year M.Tech. programs. This will provide greater choices in career development to the meritorious amongst the 16 lakh students with undergraduate degrees in Science.

These schools would offer B. Tech. degrees in frontier areas of industrial R&D like robotics, design, microelectronics, materials and nanomaterials, chemistry and chemical engineering, software engineering, nuclear sciences and nuclear technology, biomedical sciences and biotechnology. An expenditure of Rs. 50-150 crore would be required for the development of infrastructure for each such college. Recurring expenditure will also have to be provided at par with those in good colleges of engineering.

When implemented, this proposal will permit:

- Freedom of movement for meritorious students between Science and Technology.

- Students to choose between technology, basic sciences and teaching streams at the age of 20, when they can make more informed decisions.

- Development of human resource that is comfortable with both science and technology and, therefore, is more tuned to converting knowledge into innovation for wealth generation.

- Creation of human resource for industrial R&D in many key areas.

- Young students to be freed from the excessive pressure of studies in class XII and also offer them relief from choosing subjects under parental pressure.

- Increased choice after a bachelor's degree so that bright students will choose to study sciences and basic sciences in larger numbers thereby adding to the prospects of quality research in the basic sciences.

1.6 The three Inter-University Centres for Science Education and Research need to be developed further

The establishment of the three Inter-University facilities (IUCAA at Pune, NAC at New Delhi and the UGC-DAE Consortium for Scientific Research at Indore) is one of the successful UGC initiatives in the past decade or two to upgrade science education and research in Universities by making available major facilities centrally. These Centres are noted for their good work and academic

ambience and have offered excellent opportunities to several thousands of University/College teachers and research students for carrying out internationally competitive research. A substantial block grant to each of these Centres will strengthen their programs further, resulting in direct benefit to many active and motivated teachers and research students. Other such centres, especially in the area of Life Sciences, should be established in consultation with the scientific community.

1.7 The Competitive Grant System for Research and Development should be further strengthened

All over the developed world, Science and Technology research in Universities has been supported through a competitive grant system. Fortunately, India also has an extensive competitive grant system. However, this grant system needs to be substantially strengthened through significantly increased financial outlay and major administrative reforms.

- Projects in University-Institution-Industry mode should be provided major support. The NMITLI scheme of CSIR, and Technology incubators of DST are some existing examples. Funding for such initiatives should be increased threefold.

- All proposals under the competitive grant system should be on a Proposal Tracking System where the progress of the proposal can be monitored in an open manner. Decision on the proposal and release of funding should not take more than six months.

- Each project given to an investigator in a University should have provision for overheads amounting to 30% of the total grant.

- The FIST (DST), SAP (UGC) and COE (DBT) grants, which are given to departments to improve their research competitiveness need further strengthening. For example the FIST grants do not effectively take care of recurring expenditure on the facilities that are created. All these programs should include recurring grants to maintain and run the equipment and other facilities that are created. Funding for all these grants needs to be enhanced several-fold in the XI Plan.

Although the suggestions in our proposal are for science and technology education, it is important to note that an integrated development of the country is possible only when education and research in other areas is also strengthened. Therefore, it is essential that social sciences, arts and other areas be also provided adequate research funds through competitive grant systems. Research in most of these areas is generally lagging far behind international standards.

1.8 Development of e-learning materials should be given very high priority

Worldwide e-learning resources are being developed for upgrading skills of those who are employed and also for sustaining life-long learning. In India e-

learning can achieve much more. E-learning can improve access to education and establish some basic minimum level of standards in pedagogy across the country. Further, an open platform will allow constant improvement of the course material. E-learning could be made challenging for the bright and helpful for the mediocre students. E-learning platforms could also help college teachers across the country catch up with the latest developments in their fields.

Development of e-learning materials in the core and vocational subjects and in language learning should be a major priority of the XI Plan. As the tradition of writing quality course materials and text books is not very strong in India, a major national effort will have to be mobilized to prepare world class e-learning materials. Inputs from the software industry will also be required. The Science Academies can take the major initiative in these tasks in view of the strengths of their Fellowships.

The INFLIBNET initiative by the UGC, which is expected to enable universities, colleges and other academic institutions to keep abreast of the current knowledge, needs to be actively strengthened, by additional financial resources to the programme itself, its professional management, and by improving vastly the electronic connectivity of the university and college networks. We do not put down any suggested outlays for this since we believe that world-class electronic connectivity of educational/research institutions will be an area of major investment in the XI Plan under other provisions.

1.9 Fee increase and resource mobilization should not lead to cuts in grant-in-aid

A more fair and robust system of education will require significant increase in tuition and other fees. In order to facilitate higher education for the meritorious students from financially weaker backgrounds, adequate provisions for fellowships/soft loans will also need to be made.

Currently income from any increase in fees by Universities is deducted from their grants-in-aid. This is totally undesirable. Any resources generated by a University should be invested in the institution itself instead of being deducted from its grants-in-aid. In fact, to encourage resource generation by Universities, the MHRD and UGC should provide matching grants so that the Universities move on to achieve financial robustness.

2.0 HUMAN RESOURCE DEVELOPMENT

Excellence in education will require improvement in infrastructure, well-crafted courses, e-learning materials, access to laboratories, computational facilities and above all well-trained and highly motivated teachers. We believe that active research is integral to faculty members' work and enhances what the student learns. We propose the following measures for improvement in human resources.

2.1 The scheme of summer schools for meritorious undergraduate and postgraduate students should be expanded to cover more students

The Indian Academy of Sciences, Bangalore is implementing, for more than a decade, a very forward-looking program to provide scholarships to undergraduate and post-graduate students for summer training in some of the leading laboratories in the country. This scheme should be increased several fold. The summer training should be imparted in two ways: the first approach is the current method of providing exposure to bright students in good laboratories while the second approach would be to provide funding to the best Institutions and University departments in the country to organize 2-4 week intensive courses in laboratory work, backed by appropriate sets of lectures for students. This will provide opportunities to bright students to learn new laboratory techniques and also expose them to scientists active in R&D. Besides the selected university departments, the national laboratories (CSIR, DAE, DRDO, ICMR, DBT etc.) should be encouraged to participate in such workshops for students. The Science Academies may be entrusted the responsibilities of organizing these activities.

2.2 National Merit Scholarships for B.Sc. and M.Sc. students

1000 under-graduate and 500 post-graduate science students should be selected nationally every year for award of National Merit Scholarship of Rs.1,000/month and Rs. 2000/month respectively. This will help attract good students to study basic science with self-esteem and confidence. It may be noted that most of those who are selected for the various Science-talent search scholarships pursue professional rather than basic science courses. Therefore, scholarships exclusively for basic science students are necessary.

2.3 Research fellowships for Ph.D. students need to be enhanced

In order to attract more students to join Ph.D. programs at various universities and colleges, the numbers and quantum of JRF and SRF needs major revision, especially in view of the fact that other professions provide much more lucrative salaries and perks. It is suggested that JRF should be increased to Rs.12,000.00/month and SRF to Rs. 15,000.00/month The NET (CSIR/UGC) and equivalent tests need to be re-vamped to ensure quality of those selected for JRF/SRF and thus for Ph.D.

2.4 Meritorious doctoral students should be recognized through teaching assistantships with stipends over and above the research fellowships

Identifying talented, meritorious students and encouraging them through recognition is very important to attract students into research and teaching. It will be very useful to provide teaching assistantships to the deserving students joining Ph.D. programs in the Universities. These assistantships will carry a stipend over and above the CSIR/UGC or other research Fellowships. These students will assist faculty members in laboratory work and/or in tutorials for a certain specified number of hours. This will improve laboratory practicals and keep meritorious students in touch with teaching during their Ph.D. research programs.

2.5 Young school students should be given stipends to spend time in active laboratories and institutions

A new programme involving about 1000 secondary school children (classes 6-8) every year from not-so-elite schools from villages, small towns and cities across the country needs to be started which would enable them to spend two weeks in various institutions of DAE, DST, DBT, CSIR, ICAR, ICMR, Space, Defense, Public and Private sector R&D companies and selected Universities. These children may be selected on the basis of recommendations of their teachers or from among the responses received following national advertisements through the media. Each child may be given a fellowship of say Rs. 3,000 for travel and stay, and during the 2 weeks, he/she will observe and even carry out hands-on work at these places. To catch them young in Science, Technology, Agriculture, Medicine (STAM) is vital for attracting talent for a career in Science. This affirmative action model is somewhat like the Kishore Vaigyanik scheme, but at a level lower, and can be organized along similar lines.

2.6 Post-doctoral research culture must be promoted for improvements in R&D

Unlike the advanced countries, where a large pool of post-doctoral research fellows carries out the bulk of high-quality research, there is a near total absence of a post-doctoral culture in India. One way of encouraging the growth of such an environment in India would be to give positive recognition to good post-doctoral research work in India at the time of appointing faculty/scientists. Further, the stipends must be improved from the current less than Rs. 15,000 per month to Rs. 25,000 per month. There should be provision of hostels/housing for post-doctoral fellows.

2.7 Refresher courses need to be strengthened for improvement in quality of existing faculty

Besides expanding and revamping the UGC's Academic Staff Colleges, more pro-active "hands-on" training in laboratory methods in different emerging areas needs to be provided to the faculty across the country. Every year, there must be at least 200 training courses, of 2-3 weeks' duration, at established centres (research institutes and university departments). Each course should have an intake of at least 15 teachers. Special attention may be given to teachers from colleges from less developed areas of the country, so that the training can have a ripple effect in the neglected parts of the country. Besides the UGC, DST and DBT, the Science Academies should play a major role in these training programs on the basis of the strengths of their Fellowship (the Indian Academy of Sciences, Banagalore, is already organizing such workshops). It would strengthen the participation of teachers in such quality training workshops if they are also recognized as being equivalent to the Refresher Courses conducted by the UGC Academic Staff Colleges.

2.8 Meritorious scientists should be recognized by creating positions of National Professors

A new cadre of National Professors should be created to recognize eminent scholars/researchers. The National Professors should be selected at the national level by a panel of the best Indian scientists. The two Academies can play a major role in the selection process. During the XI plan period at least 200 scientists/researchers should be recognized as National Professors. They should be provided a fixed salary of Rs. 25,000.00 + allowances per month (salary equivalent to that of a Vice-Chancellor of a University) and appropriate research grant.

2.9 Working conditions for women in Science and Technology need to be improved

Although the number of women at post-graduate and doctoral levels in various universities is high, very few of them make sufficient advance in their careers for a variety of social reasons. In order to attract and retain meritorious women in active teaching and research in science and technology, the following measures are suggested:

- All major institutions of higher learning and research should have on campus crèches.

- Funds need to be allocated to pay for the salary for replacement of woman faculty that needs to take a break (1 or 2 years, at the most) for child bearing and rearing.

2.10 Incentives should be provided to teachers and researchers to make these professions more attractive for the younger generation

The following measures are suggested:

- It is obvious that the quality of the young degree-holders generated by the various colleges and universities depends heavily upon the quality of teachers**.** In the current market-driven globalized economy, the pay-packets and working conditions have to be competitive to attract talented persons to teaching and/or a research career. The basic salaries need to be at least doubled at all levels. To make the university jobs truly attractive, it is crucial that other conditions, like housing and better facilities/environment at the place of work leading to better quality of life, are also provided.

- Provision for advance increments to bright young appointees must be effectively implemented to attract and retain deserving candidates. Young bright Ph.D.s should be given faculty positions with adequate “start-up” grants soon after their obtaining the Ph.D. degree to enable them to start productive teaching/research career at an early and more creative age.

- All new faculty members should be provided a ‘start up’ grant of at least Rs. 10 lakh for faculty in experimental sciences and Rs. 2 lakh in theoretical sciences.

- All initial appointments should be on a five-years contract with adequate start-up facilities; renewal and permanent placement has to be done only after a rigorous and objective evaluation of the performance during the five-year period.

- During the first two years, the teaching hours of first-time appointees at the Lecturer level should not be more than 75% of the stipulated load to enable them to get used to the teaching system and to also have sufficient time to set-up their research activities.

- Wherever necessary, University campus housing should be significantly enhanced. To begin with, each of the major Universities may be provided Rs. 5 crore on this account.

- Currently, college and university teachers have only two promotions. A third promotion for the meritorious through selection will make teaching more attractive as a career.

- A voluntary retirement scheme (VRS) may be introduced to make room for much needed “fresh and young blood”.

- To encourage university/college teachers to undertake externally funded research projects, particularly those sponsored by industry, a certain amount (a part of the recurring grant, not exceeding 50% of the gross salary of the PI) may be added to their pay for the duration of the project approved to them.

- Every Faculty member should be provided financial support to participate in one international conference at least once in two years. Adequate provisions for study/sabbatical leave must also be ensured.

3.0 ACCOUNTABILITY AND ADMINISTRATIVE REFORMS

The provision of additional funds to Universities and Colleges in all cases should be linked to enhanced accountability and administrative reforms. The following reforms are critical:

3.1 Vice-Chancellors should have a term of 5-years so that positive changes can be initiated and pursued. Only those with strong academic and administrative values should be appointed as Vice-Chancellors, without any political interference.

3.2 To ensure uniformity and quality, Universities provided with enhanced funding should be made Central Universities and should have the President of India as Visitor. These Universities should admit students from all over the country.

3.3 All research institutions and university departments must have an audit of their productivity in terms of new and original research findings published as research papers in quality journals and/or patents/industrial processes developed in relation to the total expenses incurred.

3.4 All promotions must be clearly linked to performance; the philosophy and practice of merely “time-bound” promotions should be scrapped.

3.5 All Universities/research institutions should avoid in-breeding by generally not hiring their own students immediately after Ph.D.

3.6 Close monitoring of Universities in terms of affirmative action and fulfilling of social obligations should be done regularly.

Publicly funded academic institutions in India are governed by a wide variety of rules and regulations and consequently follow very different practices. There is need for urgent action to bring in uniformity of rules and regulations, by incorporating the best of these varying practices. The rules should be appropriate for the purpose of the academic institutions and should provide autonomy, public accountability and transparency at all levels. Support should be contingent on the necessary changes being implemented.

Annexure 1

Estimated outlay required to implement the proposals

S. No.	Recommendation	Rs. in Crores	Total (in Crores)
1.1	Special Assistance to ten Premier Universities a) One-time grant b) Recurring grant (average 10 Science departments per university) for five years i) Research (@Rs.10 lakhs p.a.) ii) Teaching (@Rs.10 lakhs p.a.)	 2,000.00 50.00 50.00	 2,100.00
1.2	Up-grading of State Universities a) One-time grant b) Recurring grant (average 10 Science departments per university) @ Rs. 5 lakhs p.a. per department	 1,450.00 75.00	 1,525.00
1.3	Undergraduate science education in leading Universities and IITs	200.00	200.00
1.4	Enhanced assistance for 200 undergraduate colleges a) One-time grant for 160 pure science and 40 engineering colleges b) Recurring grant for laboratories (@ Rs.20 lakhs p.a. per college) for five years	 420.00 400.00	 820.00
1.5	Establishment of 20 Engineering schools for two year B.Tech. degrees a) One-time grant b) Recurring grant (only on labs, maintenance etc.)	 1,500.00 200.00	 1,700.00
1.6	Assistance for Inter-University Centres	150.00	150.00
1.7	Assistance for Competitive Grant Systems	To be worked out by individual Science and Technology Departments	
1.8	Development of e-learning materials	50.00	50.00
2.1	Summer schools for undergraduate and postgraduate students	30.00	30.00
2.2	National Merit Scholarships for B.Sc. and M.Sc. students	12.00	12.00
2.3	Enhanced research fellowships for Ph.D. students	150.00	150.00
2.4	Teaching Assistantship for doctoral students	150.00	150.00
2.5	Stipends for school students	2.00	2.00

2.6	Enhanced post-doctoral fellowships (500 PDF per year @ Rs.25,000 pm)	75.00	75.00
2.7	Refresher courses for faculty improvement	50.00	50.00
2.8	National Professors	20.00	20.00
2.9	Improvement in working conditions for women a. Crèche facilities (at 100 universities @Rs.20 lakhs per crèche) b. Salary for replacement appointment	 20.00 30.00	 50.00
2.10	Incentives for teachers and researchers	250.00	250.00
	Total		**7,334.00**

Note: The above does not include the outlay on several of the items suggested. These include the enhanced salaries of teachers/scientists, assistance provided by UGC/DST/DBT in the form of SAP/FIST/COE programs, the research grants provided by different agencies etc. The outlay on these should be projected by the concerned departments/agencies.