level of the knowledge worker (teacher and student) but also at all levels of the organization, i.e. university or other administration bodies such as the UGC and the Government. Treating this as a scientific management project, a plan can be suggested as follows:

Define goals of each department, by defining the thrust areas with respect to specialization of faculty and ongoing research. Teaching courses have to be formulated accordingly.

Evaluate research quality and teaching quality of individual departments, taking into account the constraints which are hampering individual productivity or productivity of the department.

Possibilities of inter-departmental collaboration. This is important in terms of science departments. The heterogeneous funding has created a gap between faculties in each department. Through individual research projects, some departments are overtly funded whereas others are not. A feedback has to be generated on the faculty versus output and constraints (lack of funds, equipments) versus results by an individual researcher. Outcome should be to coordinate these data so that an equitable distribution of facilities is done.

To audit the number of instruments available in the entire university. How many of them are optimally utilized? How many persons are using them? Who else other than the Principal Investigator and his team can use them? How to access these?

To monitor and execute this plan, at every university a research coordination and monitoring cell has to be developed comprising faculty members from science, humanities and management departments.

These steps, it is hoped, would optimize the research facilities with output.

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INSA in the growth of Indian science

Under the Indian National Science Academy (INSA), various national committees are formed for a period of three years. Each committee consists of 5–6 members, most of them being members of such committees since a long time. These members are rotated from one committee to another. These committees meet infrequently, sometimes once in three years without much agenda. The formation of these committees is never looked into seriously and some members do not even have any experience of the objectives of the committees and are made members for namesake. Is it really justified? The Academy has never debated on the role of these committees. Once in four years or once in two years the General Assemblies of International Committees of different committees (e.g. International Union of Geodesy and Geophysics – IUGG, Committee on Space Research – COSPAR, International Union of Geological Sciences – IUGS, International Union of Pure and Applied Physics – IUPAP, International Union of Pure and Applied Chemistry – IUPAC, etc.) are held, only at that time these committees make an effort to report national activities. In some committees serious efforts are made. A few persons are identified who write only about their activities (e.g. one can see the report prepared by the National Committee of the International Union of Geological Sciences for the International Union of Geological Congress – IGC, Florence Assembly). Serious efforts are needed by these committees to collect information from various scientists and institutions if we really want to project our activities internationally.

The Indian National Science Academy is one of the pioneer academies in India. This academy has about 1000 Fellows. It is high time these Fellows must become active and think about what role they are playing apart from writing FNA (Fellow of National Academy) after their names.

From my experience with several assemblies, I have found that INSA deputes a delegation of a few scientists and the delegation has a leader but there is lack of proper coordination. As a result our bids for hosting General Assemblies are being defeated. The National Committees must discuss these matters and the leader of the National Delegation must try to coordinate and assign the responsibility of each delegate at the assembly. The membership of the National Committees may be enlarged – it should not be limited to four and five members and also representation of different disciplines/areas must be made. In the 2003 IUGG meeting, no representation was made to the International Association of Hydrological Sciences – IAHS, International Association of Meteorology and Atmospheric Sciences – IAMAS, and International Association for the Physical Sciences of the Ocean – IAPSO. Efforts should be made to depute scientists to represent each and every association of IUGG. The INSA is conservative about including scientists who are attending such assemblies as national delegates; due to such restrictions many international committees are not being represented by Indians and as a result even the work of Indian scientists is not projected in the International forum/committees. During the IUGG 2003 Assembly, three scientists were attending a meeting related to International Association of Hydrological Sciences (IAHS), when a question came by the IAHS about the national delegate from India. The scientists attending the meeting were not aware since they were not part of the national delegation sponsored by the INSA and as a result, Indian representation was not counted. A proper coordination prior to the General Assemblies of ICSU sub-committees and deputed delegates or participants is needed for the growth of science in the country and for better visibility in the international scene.

The National Committees must be broadened and feedback must be taken for the growth of science in the country through e-mails if the INSA has problem in taking care of the expenses for their attendance in the meeting. It is high time that the fellows of such a National Academy debate and review its role and restructure various committees and role for widening interest. The academy must ensure that the young Indian minds must be inducted and membership must be given to active scientists in the national committees. We must also try to see the way China is bringing changes for the growth of science and technology in their country. The Chinese Government is inviting their scientists who are living in US/Canada to spend few years in developing areas/fields in China by matching their salaries in US/Canada. In all scientific assemblies being held abroad, a handful of young and senior scientists are being deputed to represent their countries in a coordinated manner and there is no doubt that they are being more visible and they are playing an important role in projecting their countries. We must respect the sentiments of our seniors but at the same time we must convince and support them to make changes to bring more visibility and accountability to the money we spend and to our contribution.

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Computers and physics experiments

The debates and discussions concerning physics students' dwindling interest in doing experiments are not new. Yet, with newer inputs this debate occasionally takes some interesting turns. And 'doing' virtual experiments on a computer screen is a case in point.

Students with access to computers actually enjoy 'doing' experiments on the computer screen. A 'virtual' and simulated experiment is indeed nice on the computer screen, if you have the right software. Moreover, a section of the teachers feels that it would be more useful if these experiments can be shown to many students at one time. Then what about conventional approaches where students need to actually do the experiments by using their hands and mind? After all, these are the experiments we do assign to students in their plus-two or UG classes. Is it a sheer waste of time or does it really guide a student towards the right way of learning? Or should the students feel content with what they have seen on the monitor of a computer and not bother to enter the laboratory to have a hands-on experience with different equipment, materials and real life data?

On the other hand, in a computer-based experimentation, the computer offers a variety of opportunities: the density of a gas can be increased to a value that only liquids can have, one spring balance on the screen can measure weight range from one milligram to ten kilograms, the magnetic field can be raised to, say, 100 tesla to show the appreciable deflection of a charged particle that has entered the magnetic field, etc. However, it is difficult to design real-life experiments, either as a demonstration or as a laboratory experiment, where one physical phenomenon can be observed and the measurements are straightforward or the influence of one factor is not masked by another. The experiments in the UG curriculum of different universities are reasonably well chosen keeping these aspects in mind. These are, so to speak, real experiments involving statistical variation in data, and have their own limitations and are different from simulated experiments.

However, we cannot afford to forget that a large number of experiments designed for research work are actually computer-based. The data acquisition systems therein can be quite efficient with proper selection of software and some hardware aspects of the computer[1]. Computers have entered the world of experiments in a big way, but researchers are using them only as a tool. It is the researchers who design and run the experiments; the computer only collects and records the generated data through some sort of interfacing. The computer can be used to analyse the data and carry out necessary calculations, if instructed to do so and present the results in a graphical form. However, unlike in virtual experiments, the computer never 'does' the experiment.

All these aspects lead to the question as to how we should train our physics students, say the UG students, in experimental physics. It is understandable that the high school or the plus-two level experiments need to be direct and should be done 'by hand' as that is the entry level playing arena in the field of experiments. But for the UG level, can we plan to have at least one or two experiments that will involve a computer as an equipment for acquisition of data through suitable interfacing[1]? Can we give the students some flavour of the state-of-the-art facilities that are present in the research laboratories? This may help us to send a message to the students that the computer is not only meant for virtual experiments using the monitor, but real experiments can also be done using the computer as an 'assistant'. The computer actually obeys the instructions of an experimenter. A wide range of development in this front using suitable interfacing techniques is taking a new turn[2]. Simple PCs could be developed into powerful devices in the laboratory. These lead to laboratory automation but the extent and degree can be controlled by the designer of the experiment with adequate software support. Such uses of computers in the laboratory will encourage students to look at them in the right perspective.

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