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TRENDS - BIOTECH EDUCATION

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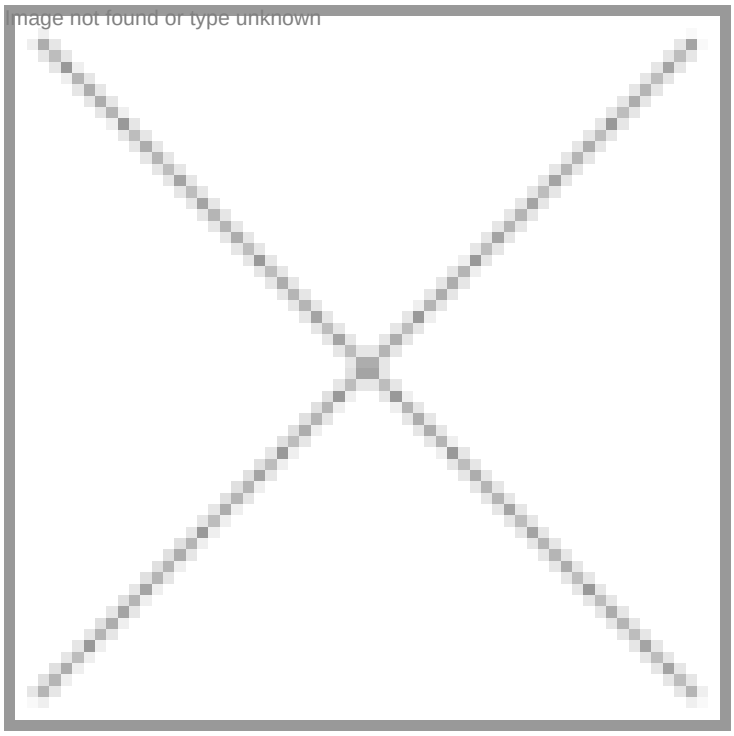


Fostering biotech education

Post graduates, doctorates and post doctorate research fellows are the key talent for research in any area requiring intensive scientific knowledge and development. A look into how this talent is being nurtured in the universities and institutes offering biotech
education in the country.

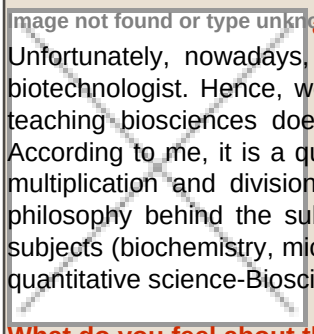
Biotechnology education in the country has received great impetus and support first from the National Biotechnology Development Board and then from the Department of Biotechnology (DBT). The National Biotechnology Development Board was established in 1982 and its very first mandate was human resources development as biotechnology is a very specialized domain and a very knowledge intensive field; development of infrastructure facilities; and to support R&D.

The DBT Thrust
Later, with the establishment of the DBT within the ministry of Science & Technology in 1986, this mandate was taken over by this Department. And to date there are about 70 courses being supported by DBT across the country. Initially biotechnology-teaching courses were introduced at the Masters level in universities like Madurai Kamaraj University, Jawaharlal Nehru University and the Pune University. Subsequently, the course was introduced in other universities. Today most of the universities, agricultural universities and even the Indian Institutes of Technology have introduced biotech courses across the country. They have not only gained acceptance at the master's level, but are also considered as one of

the best courses being run in the country. The annual budget of DBT for human resources development is Rs 10-15 crore. And to start a course in a university, it grants about Rs 1-1.5 crore for setting up the initial infrastructure and then the recurring support is about Rs 25 lakh. The total intake of students in the various DBT supported postgraduate courses is around 840 per year.

"Biotechnology is a quantitative subject and a biotechnologist is like a mathematician"

Dr Krishnamoorthy Kannan, professor, School of Biotechnology, Guru Govind Singh Indraprastha University, Delhi



about biotech as a subject?

Unfortunately, nowadays, biotechnology has become an extension of biology. So every biologist thinks that he is a biotechnologist. Hence, we are teaching it as a bioscience subject rather than as a technology subject. And the faculty teaching biosciences does not leave affiliation to their parent subject. Today, biotechnology needs a new definition. According to me, it is a quantitative subject and a biotechnologist is like a mathematician who does addition, subtraction, multiplication and division of bimolecular in a cell to make useful products for mankind. When one understands this philosophy behind the subject, then one is on a new plane to talk in integrated terms and "classicism" of the various subjects (biochemistry, microbiology, biochemical engineering) is done away with. Today there is a conflict of qualitative vs. quantitative science-Biosciences vs. biotechnology, resulting in a serious issue of identity crisis.

What do you feel about the biotech education being imparted in India?

The present 2-year masters program cannot teach technology in such a short span. It requires a 4-5 year course program, as it involves a whole gamut of subjects like IPR issues, marketing, biomanufacturing, biosafety, bioethics, strategic management, product formulation, clinical trials, etc.

Biotech education should be structured just like that of the IITs, which take students after 10+2 to teach them the engineering technology. Actually a biotechnologist is like an IAS officer whose main function should be to know the roadmap of metabolic synthesis and the systems biology. The social impact of the subject is equally important, as finally, it should be an equilibrium process. The risk benefit analysis should be a part of the technology course.

Should students be given training in the industry for better orientation?

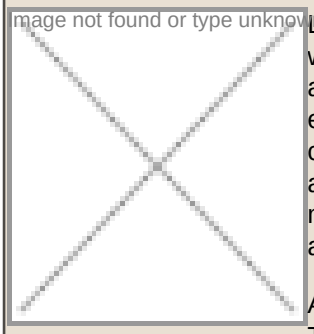
The industry is not the ideal training ground, as it follows a strict time-scheduled program. There every product has to be developed yesterday, everything is fixed and set and secrecy is important and children are not geared for that kind of training. We need to impart training in a way like the Bhabha Research Center (BRC), where every person needs to undergo training for about a year before induction in the institute. We need an incubation facility to train and orient students and need multi-dimensional people having both the industry and academic orientation to run it. Industrial training should be run as a separate course like the MBA program, which trains people for the industry.

But the gap remains...

With the thrust from DBT, the number of students wanting to pursue biotech education remains very large. Of the more than 17,000 applications received for the joint biotechnology entrance exam conducted by JNU in 2003-04, only 471 students were selected across 28 universities. In JNU, itself out of the over 9,000 applications received only 30 students were taken in during the last academic year. Similarly for the PhD program last year, out of the 1,500 direct applications received, only six were selected. In the Net/GATE qualified category, of the 74 applicants, 12 were offered a seat and in the experienced and service category (Direct Entry) of the 40 applicants, none was taken in.

A similar trend was seen in the other top universities in the country. Granted that of the many applications received a sizeable number will not have the aptitude for this specialized course but even then a large chunk of the students remain, who are desirous of studying biotechnology in the prestigious universities of the country.

HRD plan being mooted



Looking at the urgent need for a comprehensive HRD plan in the present situation or else, there would be a mismatch between the increasing number of students graduating from universities and the employment opportunities, the Department of Biotechnology (DBT) has constituted an expert panel, headed by Prof A S Kolaskar, vice-chancellor of Pune University to formulate a comprehensive plan for human resources development in the sector, keeping in view the demand and employment opportunities in the country. The panel is also expected to assess the manpower requirement in relation to the global trends of the biotechnology industry. It will also assess the current capacity available in the country for teaching and research.

Among the panel members are Prof A R Thakur, vice-chancellor, West Bengal University of Technology, Kolkata; Prof Akhilesh Tyagi and Dr Vijay Chaudhary of Delhi University; Dr G K Garg, GB Pant University, Pant Nagar; Dr G S Bhubaneswar, SCTIMST, Thirivananthapuram; Dr Saroj Mishra, Indian Institute of Technology, Delhi; Aseem Chauhan of Amity University, Delhi; Raju Barwale of Mahyco-Monsanto Biotech Company; Dr M Vidyasagar, Tata Consultancy Services; Dr Villoo Patel, Avesthagen Ltd, Bangalore; Dr Krisha Ella, Bharat Biotech; Dr S Balamanian, Reametrix Inc, USA; Dr Vijay Chandru, Strand Genomics. Other members are from the Union HRD ministry, University Grants Commission, All India Council of Technical Education and apex industry bodies like the Federation of Indian Chambers of Commerce & Industry (FICCI) and Confederation of Indian Industry (CII). The joint secretary in DBT is also a member of the panel. The DBT director, SL Govindwar, is the member-secretary of the panel.

Quality of education

The standard of the biotech education being imparted in the DBT-supported courses is very good. This can be judged from the fact that about 92 percent of the student toppers in the NET, UGC and GATE are from the biotechnology stream. Most of the top universities adhere to the standard course outline, which the institutes try to continuously evolve at their end. But many a times due to the bureaucratic processes involved, it is difficult to update the courses at regular intervals. This problem is much more widespread in the associated courses of biochemistry, microbiology, etc. "In India the problem is that though in the entire country there are at present 20-25 universities offering biochemistry courses, there is no uniformity in the syllabus taught. The syllabus is oriented by the faculty, resources and the infrastructure available," said Prof. Prahalad C Ghosh, dean and head, Department of Biochemistry, University of Delhi, South Campus. "This can be done away with by inter-university teaching and inter-department cooperation which will benefit the students," he added.

Another key issue affecting the quality of education is the infrastructure and practical oriented teaching. MSc biotechnology is very application oriented and the infrastructure has to be good for practical training, as research skills evolve in parallel with teaching. Almost all faculty members of the top universities have a few projects running and so there is a lot of practical exposure for the students. Research work and quality of dissertation is greatly emphasized upon.

It is the upcoming institutes, mediocre universities that face this problem most often. The practical aspects are lacking from the grassroot level and at the graduation level there is not much emphasis on practical education in most of such institutes. For project finding, the trend of solely depending on the government funding bodies like the DBT, DST, CSIR is passÃ©, the academia should come up with innovative ideas and tap the industry for funds.

Lastly, there is interdependency between faculty and students. Excellent faculty attracts bright students as again witnessed in top institutes. Most of their faculty members have 20-30 years of experience with good projects running under them. "While recruiting for faculty we have to be more diverse, broadminded and see which of the areas/fields are experiencing shortage. We should not support inbreeding which is rampant nowadays," said Prof Ghosh.

"Integrative teaching is a new model of Education"

Sameer Brahmachari, director, Institute of Genomics and Integrative Biology (IGIB)

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Will this model suit the current changing times?

Our present education system at the high school level or at the university level completely lacks innovative approach or inventive thinking. Prior to the Internet era, we needed information. So imparting education meant being informed. But now gathering information is no longer the objective of education. Now, we need to train people only to think and to innovate. And that is the role of a teacher and university system.

Our present education system, whether it is CBSE board, ICSE board, University board or University Grants Commission, is obsolete for tomorrow's education. We need new approaches for learning. All countries like Singapore, Europe, US, Germany have floated, what you call, integrative courses. In these courses trans disciplinary subjects are taught together for problem solving. Integrative teaching is a new model where dis-coordinated information is given and students have to synthesize information, to integrate the knowledge to create new knowledge, new information or new conclusion. This cuts across the subjects and orients the students for information processing in biology.

How can it be achieved?

It is not possible in the present structured system. We need an unstructured system. At IGIB, we have taken in students from the so-called microbiology, biochemistry, structured disciplines and put them through an integrated course that we have created. We have started this experiment with 20 students, whom we are exposing to this course. They all are PhD students and our objective is to reorient them. They have to unlearn something and relearn a few things. We are not new in introducing this concept. This October, in the US, several universities have started courses in integrative biology. Integrative courses have become a direction for Harvard, MIT because the drug and pharma industry has realized that we are not creating individuals who understand things holistically.

I believe that the national laboratory resource can play a very important role in this direction. They can be used to create research universities, where learning is through discovery. I do not find any reason as to why the masters degree should be only through a written exam. Why the masters degree cannot be part of a bigger assignment. Every national laboratory should award MSc degrees by research. And thereby one can empower a huge number of trained manpower very fast.

What is the role that national laboratories can play?

By empowering the national labs, we can increase by four times our present research capacity. We can immediately create 300 percent more trained manpower without spending more money. Wherever the university has taken advantage of the national laboratory, they have been able to attract very good students. But unfortunately very few university departments consider national labs as partners. They have an inferiority complex of national labs. Most of the universities propagate mediocrity. And mediocrity has a fear of interacting with excellence. We promote and propagate mediocrity. And mediocrity protects them. That is why some of our universities are so bad.

There are so many university professors, who get in their credit, papers and PhD students, whose face they have not seen because they have just lend their name to be a registered PhD, whereas the student works in some national laboratory. And this is the highest academic corruption prevalent in the country.

We must remove the so-called divide between the national laboratories and the universities. While on one hand we are allowing very mundane small institutes to become deemed universities, we need the national labs to play a very major role in human resource development shoulder to shoulder, with the UGC. To create 500 percent growth in high tech manpower, if India has to face the challenge post WTO.

Centers of Excellence

The culture of the DBT supported courses gave a huge impetus to the human resource generation, which fueled research in the country. According to estimates approximately about 20 percent of the initial human resources generated were going into research, which is huge! And earlier a big percentage of this group was going abroad to National Institute of Health (NIHs). Agrees Dr Arun Balakrishnan, director, Center for Biotechnology, Anna University. Several of his institute's students are abroad. But now this trend is seeing a change. Now many researchers are looking towards and are being absorbed by the National Centers of Excellence (CoEs) like the National Brain Research Centre (NBRC), National Institute of Immunology (NII), National Centre for Plant Genome Research, Institute of Genomics and Integrative Biology (IGIB), National Centre for Cell Science (NCCS), etc. These CoEs were established not only to promote research in specific areas (Brain, Cell Culture, Plant Genomics) but also keeping the socio economic problems and the question of job opportunities in purview. This is akin to something like what China has done. They have created institutes across the country, which have been able to absorb

their trained researchers from within the country and those coming from abroad. A very remarkable effort but unfortunately this takes care of a very small fraction of the Indian research community.

Post doctorate culture

Most of the students, about 90 percent, of good universities like the JNU and Delhi University go for higher research. And a sizeable number of them go abroad for higher studies. But then what are the options for the large number of doctorate degree holders left in India? The Government institutes are not big hirers - they only provide temporary jobs. And the biotech industry is still in a nascent stage. The county does not have a very strong post doctorate culture. For example, the present research associateship is for two years and the scale is just Rs 13,000. So this has become just a time gap arrangement between jobs and PhDs. Said Prof. RK Saxena, head, Department of Microbiology, University of Delhi, South Campus, "Indian Science is totally dependent on PhD students. And that is the reason why we produce so many PhDs. The Indian science managers should develop a good culture in terms of the post Doc's status (emolument-wise on a contract basis) and account for their seniority level as well. To a large extent, these problems are responsible for the dwindling number and quality of scientists in the last 25 years.

Compared to 32 percent students pursuing science in the 1950s, today only 15 percent of students are pursuing sciences now.

"Molecular biology is in a typical 'Catch 22' situation"

Dr GK Garg, Dean of the Basic Sciences College and Head of the Molecular Biology Department, The Govind BallabhPant University of Agriculture and Technology, Pantnagar,

There are apprehensions amongst the prospective biotech professionals about their finding suitable avenues in the industry. Your comments.

Adequate trained manpower is absolutely essential for the development of the industry. But today since the field is still nascent, so it does not have a very large absorption capacity. Later when the industry matures, there will be an acute lack of qualified professionals. So at present the field of molecular biology is in a typical "Catch 22" situation.

First of all awareness about biotechnology and its potentials is essential, then adequate trained quality manpower is needed and then we need to set the targets. Even today, in this area, we are dependent on technology from outside. In the industry the R&D skills have not been traditionally strong. And they found the fastest way was to import the technology. And now with the Product-patent regime coming up, if we need to develop a process or a product, it brings us to square one. We need to develop both techniques at the lab level, which can translate into technology for the industry. And for this associate manpower is necessary.

Even if we have to import technology we have to be very focused. It is just like the automobile industry in India, where at one time we did not have any indigenous cars, then we were able to make develop a indigenous industry through foreign collaborations and tie ups. Same should be the case in biotechnology. We need to develop a long-term vision. Like in the area of medicinal plants there is a lot of scope for isolation of medicinal components, neutraceuticals, development of ethnic food and food related technologies.

What is the significant gap in the efforts made for the development of the biotech field?

The field is coming up. Though attempts have been made but there is a need for planned effort. A consortium of academia, industry and the government is needed to spearhead the effort. We do keep making vision papers but they are not very precise. They just state what we wish to do. We need to come up with precise action plans with liaison at the state and the national level in the interest of the country. See, for example, in the pharma industry, biotech applications are doing so well - Shantha Biotech is making recombinant vaccines; Biocon is into recombinant enzymes. Similar will be the case in agricultural biotechnology in a few years from now.

How do you view the trend of Indian researchers working abroad?

Today in modern biology the trend in exporting your training is following the same trend as in the sector of information technology. There was a lot of Indian talent going abroad in IT and then the trend got reversed. Similar reversal will happen in the case of modern biology. This is just a transient stage.

I feel that even if our students are going abroad, it is not a big issue. We are still getting tremendous returns, as we are able to get their help with increasing globalization. Also, many people of our generation, who received extensive training abroad, came back to India, then should the US also cry about brain drain?

Today in the field of medicine and IT, India's skills are recognized. We have excellent trained doctors and people from abroad are coming to India for treatment. I predict a similar future in biotechnology a few years from now.

Why is the industry-academia interaction not really taking off?

The problem lies with both the industry and academia. Although a lot of it is talked about in various forums, most of it remains on paper. The academia perceives the industry with a huge bag of money, which will give them lots of grants. And the industry wants to take in the R&D, which is already done. So there has never been a good match.

A good model can be Japan where real partnerships take place between the industry and the universities. First a research is done on what will be the requirements ten years hence in the field, it is visualized and then the industry picks on people with specific skills to provide solutions in that field. This is a good model of industry academia interaction.

Actually, the industry need not set up a very elaborate R&D center; they can in turn liaison with those having the infrastructure. For example, in Pantnagar, we are actively looking at partnering with the Tatas in the field of agricultural research. An advanced scientific center is proposed to be set up in the university campus with Tata Chemicals. This advisory body of the center consisting of scientific experts and trustees of Tata Chemicals, will examine and screen proposals/projects having innovative ideas and a potential for commercialization. The project will be funded by the Tatas. The important point here is that the industry is using the university as a vehicle for higher research rather than setting up its own R&D infrastructure or funding a few projects on an ad hoc basis. This is a new concept.

Revamping higher education

Restructuring and revamping the higher education system was frequently suggested in our interaction by top academicians. According to Prof Deepak Pental, Director, Delhi University, South Campus, "The education system has to be completely revamped. We should have B Tech degrees in agricultural biotechnology, which should be offered in 5 universities to start with. IARI should take the lead. We should teach plant biochemistry, mapping techniques, etc and should have a strong field working environment."

Across the world, in universities, the academic courses have been restructured. Like in Oxford, courses like Organic chemistry, Inorganic chemistry and Physical chemistry have been done away with long back and now courses like Chemical biology, Bioorganic chemistry have been introduced. The idea being that courses need to retain the scientific vigor but should become interdisciplinary in approach and applied in nature. "We need to work with academics and national labs on projects not on a contract basis but as stakeholders. We have a foundational weakness. We have to think above disciplines and do qualitative thinking," said Dr T Balganesh, Vice President, Head of Research, Astra Zeneca Pharma India Ltd. Even our ministers have made a note of things. In a recently held CII meet on "Building Innovative Pharma in India", Kapil Sibal, the minister for science and technology, said Higher education be dealt in a manner different from the past. Higher education is the raw material that will be serving the industry tomorrow. Industry should take the lead and interact with the academicians and politicians and tell them about their requirements."