Transforming Undergraduate Science Education

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Transforming Undergraduate Science Education

Undergraduate science education in India has witnessed acute problems in terms of academic and physical infrastructure and has not been accorded its due importance in the past several years. This has resulted in dearth of conceptual clarity and weak fundamentals in students graduating out of Indian universities. Key factors impacting the quality of undergraduate education are vacant faculty positions, lack of availability of competent faculty, and laboratory infrastructure. To circumvent this problem, the Department of Biotechnology (DBT) has initiated "Star College Scheme" to brand and nurture excellence in science departments of colleges and universities offering undergraduate education.

The Star College Scheme was conceived in 2007 by former secretary of the DBT, Dr MK Bhan and implemented in 2008 by the Department to address several important dimensions of undergraduate education, such as hands-on exposure to laboratory experiments, strengthen academic and physical infrastructure, better library facilities, exposure to guest faculty as well as research laboratories of national eminence and industries in the country, faculty improvement program, interdisciplinary, interdepartmental research projects of day-to-day relevance, and nurture excellence in science education for holistic development of colleges.

The scheme has national presence and is currently being implemented in 92 colleges in different geographical locations in India. The scheme is open to government, government-aided, urban, rural, and tribal colleges. Private colleges are not eligible for support. The scheme is gaining popularity which is evident from the number of proposals. It is based on proposed practicals and research projects to be undertaken on receiving DBT support. Since most of the colleges do not fulfill requirements under Star Status component due to stringent eligibility conditions, it has been decided to support colleges under strengthening component initially and consider awarding Star Status after review of progress on completion of three years.

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Financial Provision

There are two categories of financial support.

1. Strengthening of Support for UG in lifescience: Upon meeting the criteria, financial support of one-time non-recurring grant of Rs 5 lakh per department, recurring grant of `2 lakh per department and Rs 1 lakh per year for mentoring and monitoring is provided for a period of three years, subject to satisfactory progress which is reviewed annually by an Expert Committee.

2. Star College Status: On completion of one term of three years, the colleges are evaluated for upgradation to Star Status, which is highly competitive and selective. Only performing departments/colleges are awarded Star Status which then get a financial support of one-time non-recurring grant of Rs 10 lakh per department, recurring grant of `3 lakh per department and Rs 1 lakh per year for mentoring and monitoring committee meetings. No college is selected for Star Status when selected for the first term of three year funding. Performing departments of colleges are considered for Star Status based on review on completion of three years.

Study Design

The present study was carried out to study the impact of Star College scheme on undergraduate science education in participating colleges. Qualitative and quantitative information on the program from beneficiary colleges was sought in a questionnaire. The data collected measured across different parameters was compiled, collated and consolidated to arrive at meaningful analyses and inferences.

The scheme provides support to different science departments such as Physics, Chemistry, Mathematics, Botany, Zoology, Biochemistry, Microbiology, Biotechnology, Bioinformatics, Computer Science, Statistics, Biomedical Science, Food Science and Technology, LifeScience, Physical Science, Sericulture and
Aquaculture.

Our study clearly shows that the disciplines benefited mostly under the scheme are basic sciences departments such as Physics, Chemistry, Botany, Zoology, closely followed by Biochemistry, Microbiology, Biotechnology and Computer Science. Star College program has indeed helped the colleges to strengthen basic sciences, followed by life sciences, as per the mandate of the scheme. Low representation in disciplines such as Bioinformatics, Computer Science, Statistics, Biomedical Science, Food Science & Technology, LifeScience, Physical Science, Sericulture and Aquaculture is primarily due to less number of colleges offering these disciplines as optional subjects at the undergraduate level.

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Gender-wise Distribution of Students to Different Science Departments

Generally, there seems to be equal proportion of boys and girls seeking admission to undergraduate science courses. A trend in terms of subject preference is seen. Girls opt for subjects such as Biochemistry, Biotechnology, Bioinformatics, Microbiology, Biomedical Science, Food technology, while boys prefer disciplines, such as Physics and Chemistry.

A gradual increase has been observed in the cut-off percentage of marks for admission to different science courses in most of the colleges supported under the scheme. The cut-off percentage for disciplines like Physics and Chemistry has significantly improved in a few colleges. Increase in cut-off percentage could also be due to continuous increase in percentages awarded by CBSE and other state boards in 10 + 2 examinations. The impact of the scheme on the admission procedure was not visible in a few colleges such as St. Agnes, Mangalore, Srikrishnan Sarada College, Assam, Doaba College, Jalandhar, Khalsa College, Amritsar as in some states admission is purely on first-come first serve basis and not on merit. Most of the colleges have also reported an increase in the number of applicants vis-Ã -vis seats available at the time of admission indicating a positive trend of renewed interest in undergraduate science education.

Drop-out Rate

The data from colleges, which have availed support for a minimum of three years or more under the scheme shows that across the board, all colleges have registered decreased drop-out rate. For disciplines such as Physics and Chemistry, the decreased drop-out rate is conspicuous for most of the colleges. This is a positive fall out of the scheme as practical training is helping attract and retain students.

Pass Percentage

The pass percentage across all disciplines has shown an increase post Star College support in most of the colleges supported under the scheme. A few colleges have reported 15-25 percent increase in pass percentage in most of the

departments supported.

Enhanced Enrollment in PG Science Courses
Benefits in terms of enrollment to PG courses in science subjects has been observed in most of the colleges. PSG, Coimbatore showed increase in PG admission in Chemistry. Increased enrolment for Food Technology and Biomedical Science was observed in Bhaskaracharya College. Consistent increase in enrollment in Chemistry was observed in Ramnarain Ruia College; enhanced enrollment was seen in Biochemistry at Sri Venkateswara College, and Gargi College exhibited increased enrollment in all disciplines over the years.

Qualitative Enhancement
Due to access to multiple copies of routine laboratory equipment and expensive chemicals provided by Star College scheme, students were provided hands-on training in basic experiments such as estimation of pH, estimation of proteins using colorimeter, study of polyploidy in onion root tip by colchicine treatment, preparation of different culture media for selective isolation and identification of bacteria, and preparation of a temporary mount of a neuron. They introduced advanced techniques such as isolation and quantification of genomic DNA and restriction digestion, identification of sugars in different fruit juices by Thin Layer Chromatography, determination of viscosity of a macromolecule, DoT ELISA assay, immunoelectrophoresis and Ouchterlony Double Diffusion, PCR techniques through minor research projects. Relevant research work experience was given in contemporary areas including the area of biofuels. This has helped students to be ready for the competitive job market and national level entrance examinations.
Enrichment of library and access to recent and advanced level text books has enabled students to improve their knowledge.

Enhanced culture of inter-departmental cooperation and collaborations promoting inter-disciplinary activities dissolving departmental boundaries is leading to better inte action.

The program has helped in bridging the industry academia gap through seminars, workshops and industry visits providing exposure to students to leaders.
Capacity building of faculty by specialized training programs and workshops in Biochemistry and Molecular Biology, Nanotechnology, Synthetic Biology, Photonics etc. has helped them to keep abreast with latest developments in the field.
Opportunity to interact with eminent national and international experts has encouraged students. Increase in the cut-off percentage of marks for admission, decrease in the drop-out rates, increase in the pass percentage of students has increased capability of students to seek admissions to post graduate courses and /or employment and crack competitive exams.

A number of outreach programs for students and teachers from neighboring schools and colleges have been held under the ambit of the program.
Creation of e-resources, laboratory manuals, and SOPs are tangible outcome of the program and efforts are bein made to share the same with all participating colleges.

Holistic Science Education
To sum up, the Star College scheme has facilitated holistic science education to a larger student base at the undergraduate level. It is evident that the undergraduate education landscape has changed considerably in terms of laboratory and academic infrastructure, hands-on exposure to students, inter-disciplinary inter-departmental project assignments. Enhanced cut-off percentage at the time of admission, decreased drop-out rates, better results in the UG exams, increased admissions to post graduate science courses have been reported by participating colleges in India cutting across geographical locations.

Government colleges, government aided colleges, rural and tribal colleges have been brought under the umbrella of the scheme in the interest of achieving larger goal of talent enrichment and reducing regional disparities. The program has facilitated procurement of multiple copies of routine basic laboratory equipment required for practical training and access to expensive lab chemicals. This has resulted in enhanced hands-on training for students and prescription of additional practicals within the curriculum which could not be performed earlier due to lack of equipment and consumables and were shown as demonstration experiments.

Cross-talks among the participating departments has promoted inter-disciplinary activities. Students get a flavor of scientific research in the form of minor research projects (disciplinary,inter-disciplinary) within the host college and a few students are trained in laboratories of national eminence. This has brought about a distinct change in the perception and outlook of the students towards learning science as undergraduates, has ensured science awareness beyond classroom teaching and has served as a good back up for pursuing higher studies and career in science.
A major outcome of the scheme has been the generation of e-resources, laboratory manuals and SOPs. Mentoring Committee meetings, Advisory Committee meetings, and Coordinators meetings from all participating colleges have provided

academic fodder by learning from each other's experience. This has led to constant improvement of the program which in turn is reflected in the improved NAAC rankings of these colleges.

Key Takeaways

This program has limited outreach as colleges are selected from applications received. Despite several call for proposals, there are very few applications from states such as UP, MP, Bihar, Jharkhand, Chhattisgarh, Nagaland, and Arunachal Pradesh. To be truly successful, the program needs to be expanded to cover all parts of the country.

The Next Step Forward

The scheme currently is limited to undergraduate science education. DBT will explore the expansion of the scheme in terms of scale, scope, and specialization to professional institutions such as Medical Schools, Dental Colleges, Pharmacy Colleges, Agricultural Institutions, Veterinary Institutions and other Applied Biological Sciences institutes in the fitness of the mandate of the program. At the national level, DBT is participating in MHRD's program for developing e-content in life sciences and setting-up of virtual classrooms to widen reach and access around DBT Star colleges as a part of pilot study. A major outcome of this program would be the development of LifeScience education at the grass root levels.