Theme paper

on

Enhancing effectiveness of teaching/learning process in Technical Education, under the National mission on Education through ICT, Sponsored by MHRD, New Delhi

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I. Objective:

The existing mechanism of enhancing faculty effectiveness through QIP/ISTE workshops, conducted for 20 to 40 teachers at a time, is clearly inadequate, given the large number of engineering colleges in the country. We can reach out only to a minuscule percentage of more than 1,50,000 teachers required to be engaged in the education process at this level.

The National mission on education through ICT, sponsored by MHRD proposes a technology-based intervention for faculty quality enhancement. The proposal is unique in scalability. Up to 1000 or more teachers can be involved simultaneously in the exercise. Further, the proposal envisages a collaborative development of digital teaching/learning contents incorporating specific needs of teachers and students as per the syllabi and examination pattern followed at different colleges and universities. This will ensure that the contents are meaningful for each locale, and are thus likely to be adopted for actual use. These contents will be released in open source under “Creative Commons India” license, which will encourage actual adoption of these contents and of the teaching methodology developed in each subject. Additionally, a teaching/learning portal will be developed and launched for each subject, which will further encourage millions of our students to remain engaged and benefit on a continued basis. The project would thus have a significant qualitative impact on the engineering education in the country on a very large scale. This methodology has evolved over years of similar activity at IIT Bombay and has been recently validated through a project sponsored by TIFAC.

This specific pilot proposal is to execute one complete life cycle for a subject covering all aspects of the designed methodology. The subject chosen for the pilot is ‘Effective teaching and learning of Computer Programming’. This course is taught in all engineering/MCA colleges in the country. An estimated 7,00,000 students study this subject every year, taught by about 7000 to 10000 teachers for lectures, tutorials and labs, typically in the first year of all branches of engineering.
2. **Methodology:**

2.1. **Preamble:**
Enabling faculty to handle technical education more effectively has different connotations to different people. It is interesting to ponder over views and expectations of different stakeholders of the system: the students, teachers themselves, college management, university administration, industry and business, educational thought leaders, senior government officials, political leadership, Indian society, and the global community at large. Some of the measures planned to meet these expectations may be less relevant, some others may be more difficult to implement. However, most of these would require a coordinated effort on part of all stakeholders to obtain what Dr Chidambaram famously describes as ‘coherent synergy’. Briefly stated, all our component effort-engines must fire in proper synchronization for the quality-rocket of our technical education to reach the moon. Negatively stated, if any component of these efforts is below a critical threshold, the resultant vector may not move in the desired direction at all, and the rocket may just land in the Indian Ocean!

This project attempts to address the critical subset of important issues, and adopts an approach to address these using a holistic intervention utilizing modern technology. It uses and ICT enabled process involving both synchronous and asynchronous modes to actually reach out and engage a large number of our teachers, and through them, a much larger number of students. Indeed, actual involvement of these important stakeholders in the entire process, scaled to very large numbers using ICT, can be said to be a major contribution of the project.

2.2 **Issues addressed:**

2.2.1 **Scale:**
Growth of Indian technical education sector has been unprecedented in last 25 years. Today we need to handle over 2.5 million students studying in about 3000 colleges, (presumably) being taught by over 1,50,000 teachers. Assuming one teacher teaches a modest 3.5 courses per year (the actual load is 4 courses per year plus laboratories), we need expertise development in 5,25,000 subject-teacher pairs.

2.2.2 **Educational background of teachers:**
A majority of teachers in our colleges are just graduates with 0 to 3 years of experience. In high-demand programs such as CS, IT and ELX, the percentage of such faculty is often more than 90%. There is a small percentage of teachers with postgraduate qualifications, and a minuscule percentage with a Ph D. This situation is unlikely to improve significantly in less than a decade.

2.2.3 **Mindset of students:**
Most students in all educational systems have always focussed on passing examinations with good grades. Increasingly, (at least) the engineering students believe that attending classes, tutorials, and labs are not very meaningful in achieving this main objective. Guide-books, coaching classes, and private tuitions, all of which explicitly emphasize examination oriented studies, are far more popular today. Unchanging syllabi of our university system, set patterns of examination questions papers, lack of emphasis on problem solving abilities, are some reasons behind this visible mind-shift.
2.2.4 Mindset of teachers:
There are wide discrepancies between the remuneration packages offered by industry and academia, which are far more glaring in the high-demand disciplines. As a result, the aspiration of joining the academia as a career is at its lowest ebb today in India. This is particularly proving to be a hindrance in attracting the academically more inclined and better performing students into the ranks of our teachers. A larger number of young teachers today are openly treating a teaching job as a temporary stepping-stone, rather than a career path. This considerably reduces their teaching effectiveness, even for whatever limited duration they are engaged in teaching.

2.2.5 Limitations of educational administrators:
Most college administrators are struggling with financial limitations imposed on them. Profit making motive behind some private managements is often sited as the main reason for inadequacy of academic infrastructure. This is only partially true. Most lack the adequate resources, for example, to attract the best qualified teachers at double or triple the salary, or to keep their laboratories modernized by making regular investments. Since this is the direct result of regulating the fee structure, things are unlikely to change in a hurry. Often there is a lack of proper planning and timely execution, which can be corrected to some extent. Most important and relevant to current topic, it is the lack of adequate number of faculty, which often forces them to either increase the teaching load per faculty or engage visiting faculty who have no long-term commitment to the institution. In the process, they face a perpetually downward moving spiral of woes, which continues to worsen the quality metric of the institution.

2.3. Background of efforts at IIT Bombay:
Since 2002, IIT Bombay has been offering courses through Distance Education program (DEP) using VSAT based live and interactive lectures to students/ teachers/ working professionals from multiple Remote Centres in the country. The Centre for Distance Engineering Education Program (CDEEP) now handles all the distance education related activity in IIT Bombay. The centre has set up studio plus classroom infrastructure for live recording and transmission of courses. Currently, there are 15 remote centres connected to IIT Bombay, who can receive live courses. So far, around 75 semester long subjects have been transmitted and more than 6000 students have received certificates from IIT Bombay through distance mode. The centre also offers Continuing Education Program (CEP) and Quality Improvement Program (QIP) through distance mode. From January 2008, IIT Bombay has started transmitting the courses live through the EDUSAT. These are accessible to about 50 Centres, which have been set up by ISRO, and more centres are planned. Each centre is in a town that typically has multiple engineering colleges located nearby. Additionally, from January 2008, CDEEP has also started live web casting of some of the courses. This web streaming is done live, as well as from a recorded version later using a web server on the internet specially set of for this purpose. There is a fee to be paid by participants if they wish to be evaluated and to get certificates from IIT Bombay. However, if anybody merely wishes to tune in to the lectures being delivered, and has a ISRO receiving station, even at home, this facility is completely free without any charge. The eOutreach project was started in May 2006 with funding from TIFAC to create and disseminate the recorded and edited audio-visual contents of these programs, These contents are created through organization of workshops, courses and nutshell lectures, and are released in Open Source for the benefit of students, teachers and professionals. The content
created is available for free download from the eoutreach website (http://ekalavya.it.iitb.ac.in/eOutreachHome.do) under the Creative Commons India license (by attribution 2.5).

We examined the participation of college students in the courses transmitted by IIT, or the utilization of these contents in actual teaching of subjects in various colleges and discovered very little adoption. There is nothing wrong with the quality of courses or in their technical depth since these are regular IIT courses. We analysed the situation further to discover that the teaching learning mechanism followed in most colleges, discussed in next section, precludes significant usage of contents in the present form.

2.4. Teaching/learning of a subject in a typical engineering college:

Any core or elective subject has a defined syllabus and a rigidly defined pattern of evaluation, comprising internal (quizzes, assignment, mid-semester examination, lab sessions), and external (written examination of 3 hours) examinations. It is common for most colleges to have about 40 hours of teaching within a semester, which includes tutorials, labs, and internal evaluation.

A major part of the syllabus is very similar in most universities, being often based on AICTE/IIT/NIT syllabi. But there are non-trivial variations. The prescribed textbooks differ in many cases. What is significantly different from the IIT system is the examination and evaluation paradigm. In most systems, students have to optionally solve, say, 6 out of 10 questions. At many places, questions are repeated from older examinations. Except in some autonomous colleges, the teacher who teaches the subject neither sets the question paper nor evaluates it. Both, the students as well as teachers, have to thus necessarily depend upon the prescribed syllabus, and the set examination pattern.

Since courses, lectures, workshops given by IIT faculty do not explicitly address these concerns, students, and by implication, the teachers are not interested in using these contents as primary or even secondary source for actual adoption. High quality digital contents so created will thus only add to the digital library of the colleges, their actual usage being limited to curious occasional perusal by a handful of students and teachers. An additional and important factor is that the majority of teachers has never participated in these workshops and thus has no sense of involvement which might otherwise prod them to use these somehow.

2.5. Our approach for engaging teachers and collaborative content creation.

Engaging teachers and students requires that they all get something, which they perceive as being immediately useful. It is only then that they will look at other parts of the contents, which will enhance the quality of their education. Their minds need to be challenged with technical problems with graded difficulty level. This requires creation of a collaborative portal where the participation of peers and experts may shake them out of slumber.

To enthuse the teachers, two mechanisms of encouragement are possible. ISTE conducts workshops for teachers, typically of one-week duration, for which the participating teachers get some point credits counted towards their promotion. There is sufficient enthusiasm amongst teachers to attend these. Additionally, if they are also
involved in a collaborative manner in contributing to contents, which can be meaningfully used in their own colleges, the adoption of such contents is far more likely. To achieve the scale, we propose the use of ISRO EDUSAT, and recommend a 2-week workshop to be jointly conducted by one instructor from IIT and each of up to 30 coordinators at ISRO centres. Up to 35 teachers can participate in each of these centres. This permits 1000 teachers to be simultaneously engaged. Each participating teacher works for four weeks. Each centre coordinator works for a calendar period of 4 months devoting four weeks to the workshop coordination. The Instructor at IIT Bombay works with experts and a large team of supporting technical and administrative staff for a period of about six months. Details for conducting these workshops are outlined below:

2.6. Methodology of conducting ISTE Workshops.

i. IIT Bombay is termed the 'Subject hub'. The hub chooses expert faculty for the subject. These must be minimum two in number, supported if necessary by a few additional experts to deal with specific topics. One amongst these would be named 'instructor-in-charge' for the subject.

ii. Choose subject coordinators at each of the ISRO remote centres (typically 30). These coordinators should have taught that subject at least a few times in the local college and should be generally familiar with the syllabus and examination pattern. These are invited to participate in a weeklong workshop at the hub. Before attending this workshop, they should collate and electronically submit the syllabus and question papers of past few years to the instructor at hub.

iii. The one-week workshop is conducted to finalize the following:
   (a) Definition of common syllabus to be covered.
   (b) Graded coverage from simple to difficult levels for each topic and subtopic.
   (c) Nature of tutorials and lab sessions, keeping the above gradation and the typical examination pattern in mind, but leading to the typical advanced levels reached in such subject teaching at the top institutions of the world.
   (d) Discussion of laboratory environment and the experiments to be conducted.
   (e) Use of the learning management system, audio-visual equipment, editing tools.
   (f) Other logistic details for conducting the main workshop.

iv. In the next two to three months, the instructor completes the content development jointly with other experts, interacting electronically with centre coordinators. The coordinators, in turn, complete the preparations at their centres, setting up the requisite lab environment, gearing up the Edusat hub, arranging classroom for lecture/tutorial sessions, etc. Enrolment of teachers for the main workshop is completed during this period.

v. The actual 2-week workshop is then conducted, with about 1000 participating teachers from these centres. The instructor and the experts at the hub deliver all lectures. Centre coordinators will facilitate the interaction during these lectures, and also conduct tutorials labs, and evaluation through quizzes/tests locally, under general supervision of the hub.
vi. The participating teachers complete this 2 week portion of the workshop, and are assigned work for the remaining two weeks to be carried out at their respective colleges. The assignment would include at least one activity from the following:

(a) Augmenting audio-visual contents.
1. Preparing a video-clip of interaction with some students on any one lecture using a simple webcam. The question answers may be in local language whose English transcript must be prepared and enclosed.
2. Preparing additional examples and slides for a chosen topic and preparing a lecture video clip.
3. Preparing a suitable animation to illustrate a chosen theme or concept discussed in a lecture or a lab experiment.

(b) Contribution to written contents.
1. Preparing a written transcript of an assigned module of a lecture.
2. Preparing explanatory solutions to selected tutorial problems.
3. Preparing supplementary write-up for a lab experiment, high-lighting local constraints and suggesting a mechanism to overcome these.

(c) Contribution to question bank.
1. Questions and answers for one quiz (4 short questions) on assigned topic.
2. Questions and answers for two questions in a mid-semester examination.
3. Question and answer for one question for the final semester-end examination.

2.7. Concluding activities at the remote centres.
The centre coordinators will interact with the participating teachers at their centre, collect and collate all submissions, and will upload these on the subject portal and send a CD recording to the hub.

2.8. Concluding activities at the hub.
The instructor will supervise the final editing of all contents and release these in open source. The instructor will also certify the ISTE workshop participation of all individual teachers, jointly with the corresponding centre coordinator. The subject portal will then be thrown open for access and participation by all interested students and teachers across the country. All can then use these contents, and further contribute collaboratively for subsequent revisions. Indeed the portal should become a thriving discussion forum across the nation for that subject.

As a pilot, we propose to implement this methodology for the subject “Effective Teaching and Learning of Computer Programming”. The action plan is:
(b) Content creation at IIT Bombay: May – November 2009
(c) 4 week engagement of 1000+ participating teachers:
   (i) For attending lectures/ tutorials/labs: 14th -30th December 2009
   (ii) For content contribution: 1st -14th January 2010
(d) Post production and open source release with launch of Subject portal: March 2010